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Jinjing Zhao, University of Arizona

GLS Showcase Award Ceremony

Chair: Dennis Ramirez

Judges Panel: Erin Hoffman, Colleen Macklin, James Paul Gee, Scott Price

1st Place: Czechoslovakia 38-89: Assassination
   Tereza Selmbacherová

2nd Place: Twelve a Dozen
   Justin Leites

3rd Place: Stagecraft
   Jen Helms
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Gabriella Anton, Craig G. Anderson, & Jazmyn Russell

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GLS 11 has come and gone. We did it again and again it was a blast. Put on by a small, but especially talented and motivated team of coordinators and volunteers, every year we wonder, is all of the fuss worth it? As it approaches we think, perhaps we over complicated things. There are too many special sessions and events, or we set our sights higher than we needed to. And then it comes around and we remember that going the extra mile is always worth it. There’s something special about the GLS Conference that we can’t quite describe, but it amazes us every year. We never regret the effort and we ultimately love every second.

Some highlights from GLS 11 include:

We hosted a pre-GLS NSF workshop on informal STEM learning and online affinity spaces. The two-day event focused on the intersection of STEM learning, informal environments, and participation in online spaces.

The Playful Learning Summit had not one, not two, but three fantastic keynote speakers, Sujata Bhatt, Kip Glazer, and Seann Dikkers.

The ARIS Global Summit was bigger and better than ever.

The Higher Education Game Alliance held an event celebrating games in higher education on the gorgeous Tripp Deck.


Filament Games hosted a fantastic after party at their new studio space in downtown Madison.

We heard some of the best keynote speakers GLS has ever had the opportunity to host—Nichole Pinkard, Brenda Romero, and John Romero.

We wrapped things up on Kurt Squire’s birthday and his band Crooked County gave a special performance on the Memorial Union Terrace.

Thanks again for joining us in Madison. We’ve got some new things planned for next year that we’re excited to tell you about soon. We hope you’ll join us.

Sincerely,

Constance Steinkuehler, GLS Conference Chair

Amanda Ochsner, GLS Conference Co-Chair
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LONG PAPERS
Panels
(Academic) Game [Design|Research] Programs Labs: What Are They and How Do You (Not) Start One?

Mark Chen, Pepperdine University
Roger Altizer, University of Utah
Mia Consalvo, Concordia University
Sean Duncan, Indiana University
Tracy Fullerton, University of Southern California
Liz Lawley, Rochester Institute of Technology
Casey O’Donnell, Michigan State University
Scot Osterweil, Massachusetts Institute of Technology
Kurt Squire, University of Wisconsin Madison

Abstract: Academic game labs take on a variety of forms at the universities that house them. Their funding structures, resources, and positions can come in varied nuanced configurations. This panel brings together a bevy of directors from academic game labs to share stories about starting, managing, shaping and even leaving labs. They have all attempted to define (and differentiate) the goals or missions of their labs, their relationship to the larger academy, and where they stand with regards to game studies/research as a field/discipline. Panelists will discuss their struggles and triumphs, how they and their labs have changed over the years, and anything else that can be packed into an hour-long discussion. The panelists will synthesize their experiences, field questions, and offer insights to those working with labs, hoping to start one, or seeking to better understand the various possible functions of a game lab.

Featured Panelists Include:

Roger Altizer – University of Utah – Director of Digital Medicine, Center for Medical Innovation - Associate Director, Entertainment Arts Engineering, http://eae.utah.edu
Entertainment Arts & Engineering is the overarching term used to describe the interdisciplinary work between the College of Engineering and the College of Fine Arts at the University of Utah. This work encompasses the wide array of fields in video game design and development, and students from both colleges work closely together throughout their academic careers. This partnership between disciplines reflects the current state of the interactive entertainment business world, and EAE students leave the program prepared to work effectively in a team environment.

Mark Chen – Pepperdine University – Director of the Gameful Design Lab (founded September 2014), http://gamefuldesignlab.com
The Pepperdine Gameful Design Lab (GDL) focuses on increasing gaming literacy among all populations with an emphasis in targeting those traditionally underserved. The GDL believes that participating in gaming culture and game design can lead to agency in everyday life and provide players/designers with a voice through powerful storytelling. This year, the GDL laid the groundwork for some awesome LA-area projects that might all crumble once funding lapses come summer. Mark will attempt to borrow some chutzpah from Liz.

Mia Consalvo (1) – Concordia University – Director of the mLab (founded 2013), http://www.mlabgamestudies.com
What does a game lab look like, and what is it good for, if game development is not your central focus? How can it help build a community for students and promote research at the same time? The mLab is currently engaged in such activities through a series of actions and strategies, which Mia will discuss in this panel.

The mLab’s mission statement: The mLab is a Canada Foundation for Innovation funded lab, which opened in 2013. Our goal at the mLab is to provide a space for anyone — researchers, designers, students — to come together to study, learn, play and create. We’re committed to deepening our understandings of the impact of digital games on everyday life. Through experimentation, deep exploration, and play, we strive to inspire better games, create more knowledge and have a lot of fun. All with snacks.
Sean Duncan (1) – Indiana University – Director of the Playful Culture Lab (founded September 2013), http://playfulculturelab.org

The Playful Culture Lab is the latest iteration of a game design and research laboratory, currently housed within Indiana University’s Center for Research on Learning and Technology. The mission of the lab is to push games beyond their conception as “technologies” and to investigate the educative potential of games and play as cultural practices. The work is aimed at transforming how education considers games — not as tools to implement within educational environments, but as participatory cultures in which learning is already embedded. Recent research projects have addressed learning within online affinity spaces, including gaming affinity spaces, and have been funded by the Digital Media and Learning Research Competition as well as the National Science Foundation.

Tracy Fullerton – University of Southern California – Director of the Game Innovation Lab (founded September 2004), http://gameinnovationlab.com

The premier center for experimental game design research at USC, the Game Innovation Lab was founded in 2004 and is directed by Professor Tracy Fullerton. The mission of the lab is to pursue experimental design of games in cultural realms including art, science, politics, and learning. The international success of games that have emerged from the lab, including Cloud, fLoW, Darfur is Dying, The Cat and the Coup, and The Night Journey, have made it a hub for indie and experimental games culture in Los Angeles. Our Playthink Salons attract speakers and participants from across the city and across disciplinary boundaries. Associated faculty include award winning game designers Richard Lemarchand (Uncharted series) and Peter Brinson (Waco, The Cat and the Coup) as well as pioneering games user researcher Dennis Wixon (Halo, Microsoft Surface). The lab has a strong history of collaboration with cross-disciplinary experts in many fields, including education and technology. Our commitment to an iterative, participatory process brings users, stakeholders and designers into constant dialogue. Current projects are supported by Microsoft Research, The Gates Foundation, The National Endowment for the Arts, The National Endowment for the Humanities, The Gilbert Foundation, and The Department of Education.


The RIT Lab for Social Computing was created out of smoke and mirrors and chutzpah, with a budget of zero, no physical space, and nothing but business cards to mark our presence. From those humble beginnings, the lab built funding relationships with sponsors, brought in grant money, provided support for many undergraduate and graduate students, and developed partnerships with businesses to build community games like Picture the Impossible and Just Press Play. When RIT recognized the importance and value of the games and media work happening at RIT, Liz’s lab became part of the larger MAGIC (Media, Arts, Games, Interaction, & Creativity) Center.

Casey O’Donnell (1) – Michigan State University – Associate Director of the Games for Entertainment and Learning (GEL) Lab, http://www.gel.msu.edu - [Former Director of the University of Georgia Game Lab]

Dr. Carrie Heeter founded the Communication Technology Laboratory (1980 to 2005), which was transformed in 2005 into the GEL Lab and directed by Brian Winn. The mission of the GEL Lab is to design innovative prototypes, techniques, and polished games for entertainment and learning and to advance state-of-the-art knowledge about social and individual effects of digital games. The GEL Lab is an association of game research and design faculty and students at Michigan State University, primarily in the College of Communication Arts and Sciences. The lab does externally funded research and development work and funds several graduate students and employs roughly 20 undergraduate students at any given time.

Scot Osterweil (2) – Massachusetts Institute of Technology – Creative Director, Education Arcade, http://education.mit.edu

Scot Osterweil is the Creative Director of The Education Arcade and a research director in the MIT Comparative Media Studies/Writing Program. He is a designer of award-winning educational games, working in both academic and commercial environments, and his work has focused on what is authentically playful in challenging academic subjects. He has designed games for computers, handheld devices, and multi-player online environments. He is the creator of the acclaimed Zoombinis series of math and logic games and leads a number of projects in the Education Arcade, including the MIT/Smithsonian curated game, Vanished (environmental science), Labyrinth (math), Kids Survey Network (data and statistics), Caduceus (medical science), iCue (history and civics) and the Hewlett Foundation’s Open Language Learning Initiative (ESL). He is a founding member of the Learning Games Network (www.learninggamesnetwork.org).
Kurt Squire - University of Wisconsin – Co-Director of the Games+Learning+Society Center in the Wisconsin Institute for Discovery, http://gameslearningsociety.org

GLS designs games for learning and studies game-centered learning systems.

GLS delves into how videogames capture our imaginations, how their power can be used to transform learning, and what this engaging medium means for society.

Endnotes

(1) Could not attend live panel. :(

(2) Joined us last minute; hurrah!
An Inside Look at Getting and Using Games in Classrooms

Steve Isaacs, William Annin Middle School, Basking Ridge, NJ
Matthew Farber, Valleyview Middle School, Denville, NJ
Jessica Millstone, Director of Engagement, BrainPOP
Seann Dikkers, Assistant Professor in Educational Studies at Ohio University

Abstract: The use of games in the classroom has gained attention and momentum in recent years. Despite the growing understanding of the value of games, its use has yet to become a mainstream approach of teaching and learning. There remain a number of barriers to get games into the classroom. Through this panel, we would like to share positive approaches to using games to enhance student learning, as well as to discuss strategies to overcome barriers. This panel will also address practical and logistical solutions to encourage games in education to become ubiquitous, as well as ideas to spread best practices through teacher communities.

Teachers Who Are Using Games

In 2012, the Joan Ganz Cooney Center at Sesame Workshop published results of a study about games in the classroom. In it, 500 participating K-8 teachers were asked questions about game-based learning knowledge, integration, and comfort. About 12% of the respondents reported that they had received training about digital games during pre-service training in college (Millstone, 2012). Most had learned about learning games informally from colleagues, on social media, or in teachers’ journals—not in a formal setting (Millstone, 2012).

Two years later, in the fall of 2014, the Cooney Center assessed the current impact of the game-based learning. The report, titled Level Up Learning: A National Survey on Teaching with Digital Games, surveyed about 700 K-8 teachers. The report found that 82% of surveyed teachers were self-described game players; and 78 percent of that group teaches with games (Takeuchi & Vaala, 2014). The report next compared game-using teachers to non-game-using teachers. 55% of teachers who reported that they did not play games in their free time did state that they used games in their teaching (Takeuchi & Vaala, 2014).

Lowering Barriers to Game-Based Learning Adoption

It can seem confusing to find an effective and engaging digital game to bring into a classroom. There is no ubiquitous model to follow. While Apple’s App Store and Android apps on Google Play offer digital distributions, the categories of content can seem overwhelming. For example, the App Store has many gaming categories ranging from role-playing to strategy to trivia. A search for “math games” listed flashcard apps right next to the innovative titles. To a non-gamer teacher, a content-driven experience seems more appropriate, when in fact better options exist. Lowering a few barriers, such as BrainPOP’s GameUp platform, which features single logins, easy-to-use teacher dashboards, as well as teacher training, may be the simple solutions required to further game-based learning initiatives.

Increasing Teacher Literacy of What “Good” Games Are

Textbooks, social media, and educational websites persist in referring to rote quizzes, Bingo, and trivia—activities that do not promote higher-order thinking—as games. Dan White, co-founder of Filament Games, and Erin Hoffman, Lead Designer for GlassLab explained the confusion, to Matthew Farber in the book Gamify Your Classroom. White pointed out a “literacy gap with teachers who cannot discriminate between the ‘drill and kill’ and quality gameplay delivery” (Farber, 2015, p. 21). Hoffman remarked on the number of obstacles, explaining several questions to Farber, “What competency should you be teaching? What standard? How are you going to get it to them? How is the school going to find out or buy the product? Who are the gatekeepers that will let you into it?” (Farber, 2015, p. 22). While there have been innovative games brought to the educational market in the past few years, sustainability is an emerging obstacle. In other words, how can a teacher use games when there are still relatively few “good” educational products available? The panel will analyze steps to take in teacher communities of practice to explain where games fit into classrooms. The panel will also discuss the role of communities of practice, which is where many classroom teachers—the ultimate gatekeeper of student learning—learn about best practices.
Best Practices in Assessing Play

Grading how a child plays a game is a slippery slope, potentially affecting creativity and divergent problem solving. Assessments differ for tabletop games. At Quest to Learn, the game-based public school in New York City, teachers give students a piece of paper with a picture of a frozen game state and ask, “What would you do in this scenario? What would each player do in this scenario? Explain your reasoning.” Here the teacher tasks the student to reflect on decision-making, as well as taught content skills (Farber, 2015). Solutions are also emerging for digital game. For example, BrainPOP’s GameUp and the GlassLab platform model, features original and third party games that are accessible with a single user login. Games are vetted for classroom use, provide real-time analytics on student performance, and include lesson plan ideas. However, there is no messaging about how teachers should act on the formative data aggregated on game play. This panel will review experiments in playful assessments and best practices, including the use of BrainPOP’s SnapThought Reflection Tool, as well as hand-written field journal notes that engage students in contemplating decisions made during play.

Moving from Gamification Mechanics to Core Mechanics

Gamification mechanics, such as points, badges, and leaderboards, are increasingly used in education. Gamification, however, has more to do with feedback than play. A game’s core mechanics are different, pertaining to the actions of play, like trading, voting, arguing, turn-taking, and guessing (Trombley, 2014). A game’s core mechanics can be defined as “the essential play activity performed again and again in a game” (Salen & Zimmerman, 2003, p. 316). Core mechanics draw players into the “magic circle”—the interconnected system where play happens (Farber, 2015, p. 32).

Implementing game mechanics, with aligned learning goals, can make learning more engaging. In practice, lessons should involve a game-like core mechanic. According to Institute of Play game designer Brendan Trombley, “focusing on the relationship between core mechanics and learning, we can estimate the effectiveness of a learning game by identifying the linkages between them” (2014). Using core mechanics with existing lesson and projects makes a project and activity less like “chocolate-covered broccoli” and more game-like (Trombley, 2014; Farber, 2015, p. 32). The core mechanic of persuading and voting clearly teaches concepts about democracy more effectively than lectures and PowerPoints.

Promoting Game-Based Learning in Schools

In 2014, MindShift published the Guide to Digital Games and Learning. The guide takes a practical look at how game-based learning is being (and can be) incorporated in a number of settings. The document explores the pedagogical foundations and assessment strategies found in game-based learning environments. Playing digital games with a large class in the constraints of a school period presents logistically challenges. What’s more, many tabletop games are limited to small numbers of players. Cost presents another obstacle; it is often not feasible to have several sets or licenses of the same game. One solution is to take a project-based learning (PBL) approach and create centers or stations around the classroom, one of which involves a tabletop or digital game. Cooperative and project-based learning is already more pervasive than game-based learning. Games can fit in this setting, supporting curriculum, not being the focal point of instruction. Games situated in a PBL setting with learning centers can connect content delivered in other modalities.

Participatory Learning

Games lend themselves well to meeting our students where they are. Providing opportunities to learn in their world empowers students and allows them to take charge of the learning. A prime example of this has been the use of Minecraft in classrooms. Educators have used Minecraft in numerous ways to enhance learning opportunities. Additionally, student choice in learning allows students to take demonstrate their learning in a manner that is relevant to them. Games often serve this purpose in a powerful way. Ideas are exchanged on social media and in online communities.

Leveling up in a game is similar to how students advance through the zone of proximal development (ZPD), as well as how informal learning starts as limited peripheral participation (LPP) and moves to mastery learning (Vygotsky, 1997; Lave & Wenger, 1991). This is just one of the commonalities that exist in teaching and game design. The iterative process of co-design is another. Teachers build lessons on higher order action verbs based on Bloom’s Taxonomy (Marzano & Kendall, 2007). Similarly, games are designed with action verbs. In Gamify Your Classroom, Farber interviewed Jim Gee about the “design grammar” of game mechanics. Gee stated, “It’s not a matter of picking the perfect mechanics. It’s [about getting] good marriages between the mechanic and the problem solving set.” (Farber, 2015, p. 33). The panelists see an opportunity for bridging best practices from game design to teaching and learning design.
One collaborative space of note is #EdTechBridge. One of BrainPOP’s researchers, Katya Hott, teamed up in the venture with panelist Steve Isaacs, a video game design teacher. The partnership began at SWSXedu (South by Southwest Education, the annual conference in Austin, Texas). The concept was to create a common language between developers and educators. The result is a weekly Twitter chat. Another emerging space is the Games4Ed pilot groups, to which both Farber and Isaacs belong. There were several meetings this year which brought together teachers, developers, as well as support from the US Department of Education’s Office of Educational Technology.

The Panelists

Steve Isaacs teaches Video Game Design and Development at William Annin Middle School in Basking Ridge, New Jersey. In addition, Isaacs has developed online versions of the course for The Virtual High School Collaborative and The Idaho Digital Learning Academy. Isaacs is a strong advocate for game-based learning and provides students with a quest-based learning environment that provides student choice in the selected learning pathway. He has been presenting on the national level on game-based learning, game design and development, empowering students through choice in learning, learning from failure, and other related topics. Isaacs is the co-founder of #EdTechBridge, a Twitter chat and online community focused on bringing EdTech developers, educators, students, and researchers together to collaborate in order to create better EdTech products for learning.

Matthew Farber teaches Social Studies at Valleyview Middle School, in Denville, New Jersey. He is a blogger for Edutopia and KQED/MindShift, a member of the GlassLab Teacher Network, and has playtested for the Institute of Play, E-Line Media, and BrainPOP. Farber is a past recipient of a Geraldine R. Dodge Teacher Fellowship, which sent him on an Earthwatch expedition, and the North Jersey Director for the New Jersey Council of the Social Studies. Farber is an adjunct instructor for the New Jersey City University (NJCU) Educational Technology Department, where he is currently a Doctoral Candidate in Educational Technology Leadership. His book, Gamify Your Classroom: A Field Guide to Game-Based Learning, was published in 2015 from Peter Lang Academic’s New Literacies and Digital Epistemologies series. It is a survey of best practices aggregated from interviews with game designers, developers, teachers, academics, and other experts-in-the-field.

Jessica Millstone is the Director of Engagement at BrainPOP, where she works on bridging games-based learning initiatives between BrainPOP’s GameUp and its many game and school partners. Prior to joining BrainPOP, Jessica was the inaugural Education Fellow on the Games and Learning Publishing Council at the Joan Ganz Cooney Center, a research and innovation lab at Sesame Workshop, where she investigated and produced a video case study series on the practice of using digital games in the elementary and middle school classroom. You can find her on Twitter at @j_millstone.

Seann Dikkers is an Assistant Professor in Educational Studies at Ohio University. Formerly, Seann served fourteen years as a middle school teacher, high school principal, and education consultant. Now he researches, writes, and shares the strategies for technology integration into schools and studies exemplary teaching with new media as the founder and director of Gaming Matter. His books include Real-Time Research, Mobile Media Learning, and the forthcoming TeacherCraft: Minecraft in the Classroom. Currently Seann is playing Clash of Clans, MC, Little Alchemy, and Hearthstone.

References


How I Learned to Stop Worrying and Love Youth AR Game Creation

Judy Perry, MIT Scheller Teacher Education Program
Bob Coulter, Missouri Botanical Garden
Juan Rubio, Seattle Public Library
Chris Holden, University of New Mexico

Abstract: In the constructionist tradition, the creation of augmented reality (AR) games can be an effective method of engaging youth in informal learning around both domain-specific content as well as general design thinking. However, given the complex, interdisciplinary nature of AR games, the facilitation of programming in which youth create these games can be challenging. How do students from different age groups and backgrounds best learn this novel genre and the related design process? What are the most challenging issues? How can facilitators attempt to empower youth agency and youth voice in the context of a larger organization’s educational goals and the desire for a “product” within a given timeframe? In this highly interactive session, panelists from diverse settings – including a botanical garden, an urban after-school program, and a university – shared insights from their efforts to empower youth via the creation of AR games.

Augmented Reality Games and Youth Design

Digital game design can be a catalyst for engaging youth with technology (Wang & Chen, 2010), creativity (Kafai, 2009), and design thinking (Kafai, 1996; Salen, 2007). A growing body of game creation toolkits enables non- or novice programmers to craft their own games, albeit frequently the tools themselves emphasize game mechanics rather than game design (Hayes, 2008). However, especially with appropriate facilitation, students tasked with constructing games can thoughtfully marry subject matter and game mechanics, and in doing so learn powerful habits of mind (Coulter, 2012; Coulter, Klopfer, et al., 2012; Matthews, 2010; Salen, 2007), including iterative design through prototyping, user-testing, and revision.

Among the many genres of games, mobile augmented reality (AR) games, which use location-aware mobile devices to anchor gameplay within real-world locations, provide additional opportunities to engage young game designers in deep thinking about the affordances of a particular locale, including its landscape and topography, physical structures, and cultural and historical context (Klopfer & Sheldon, 2010; Holden, Gagnon, Litts & Smith, 2013). Since AR games combine a digital layer on top of a real-world environment, the game designer can add creative elements such as fictionalized narratives, player roles, and other data or game mechanics. In this way, the game design experience fuses fact and fiction, the real and the imagined.

Game designers need not be experienced software programmers. Using one of several freely available toolkits, such as ARIS and TaleBlazer, participants with minimal programming skills can author and implement their own mobile AR games.

Pedagogical Considerations of AR Game Creation

While game design can be integrated into formal and informal learning settings, this panel will focus on groups taking a more informal approach to learning (e.g., after-school programs, workshops, and summer enrichment camps), venues which are often a good fit for the multidisciplinary, complex nature of the game design process.

In the constructionist tradition (Papert, 1980), facilitators emphasize learning that emerges from the thoughtful creation of artifacts. This creative process can vary widely from group to group given the many tasks that go into making a location-based AR game, leaving facilitators with many choices in terms of their pedagogical emphasis. Within each group, for example, efforts can vary widely and include such tasks as researching and organizing domain-specific content knowledge, articulating connections between the game and real-world locations and artifacts, designing game mechanics, engaging in prototyping and iterative design, gaining sophistication in programming, writing, and creating visual and multimedia game assets.

Diverse Audiences, Diverse Challenges and Opportunities?

Given the complexity of AR game creation, it is not surprising that facilitating youth creation of AR games comes with many inherent tensions and challenges: What happens when youth from diverse backgrounds and environments are tasked with designing AR games, a genre which is almost certainly new to them? How are youth able
to leverage the affordances of the AR tool, while working within its limits? How can organizations promote youth ownership and youth voice within a game whose topic was selected by the facilitators to align with the host organization’s mission? What are the advantages and challenges of different age groups (ranging from nine-year-olds to secondary and postsecondary) making AR games? How can creation of AR games change youth perception of place and their sense agency within their community?

Three panelists, working with distinctly different populations and physical environments, shared their experiences facilitating groups of students creating AR games. Bob Coulter (Missouri Botanical Garden) described experiences facilitating summer and weekend workshops in which elementary and middle school students created their own STEM-themed AR games situated in a botanical garden setting. Juan Rubio (Seattle Public Library) has facilitated multiple groups of middle and high school-aged urban youth in after school and summer programs, in which AR games served as a design focus for youth voice and youth investigation of local neighborhood settings. Chris Holden (Assistant Professor at the Honors College of the University of New Mexico) has worked with post-secondary students to create interactive AR games as a means to explore diverse areas ranging from language learning to community action, from classrooms to museums and community centers. The panel was moderated by Judy Perry (MIT Scheller Teacher Education Program), a project manager and researcher for the TaleBlazer AR game platform.

Session Format

The goal of this 60-minute session was to give the audience a feel for some of the opportunities and challenges faced when facilitating youth creation of AR games. Following brief snapshots of AR youth workshop implementations from each panelist, participants played a short, simplified AR experience. Participants downloaded the TaleBlazer app to their Android or iOS smartphones or tablets and then loaded the game. The game required participants to walk around the room to locate virtual characters who embodied issues typical of those encountered by youth creating games and the facilitators of such groups. Examples of characters encountered included:

- **Artsy Art**: “I’ve never done any coding before, and I’m not sure I’d be any good at it. But I’m a pretty good artist. Maybe I can just stick with art and leave the programming to someone else?”

- **Abyss Abby**: “Hi, my name is Abby. I’m an instructor here and I am feeling frustrated. No one ever seems to actually play these games. I don’t even have time to walk around outside to play them when I grade them.”

- **Ambitious Alice**: “I wanted to make a choose your own adventure, but I can’t get it to work. I’ve been trying for hours and we’re running out of time. What should I do?”

- **Madison Backstory**: “What if the game takes place in Hollywood which has just been invaded by aliens! But there are these bad guys with lasers. Yes, the game is about invasive species here in Madison - we just have to figure out how to work that in!”

Discussion

After the game, the moderator facilitated discussion among panelists based on generalized challenges embodied in specific characters’ narratives as well as questions from the audience.

**Artsy Art: Student Comfort Zones**

Given its interdisciplinary nature, AR game creation utilizes a wide range of skills, including brainstorming game concepts, integrating specific locations or objects, researching content, developing characters, writing narrative and dialogue, constructing game mechanics, creating art assets, programming and debugging the software, and play-testing and revising the game. Many students naturally gravitate toward (or away from) aspects of the AR game design. For example, Artsy Art was reluctant to program as coding intimidated him, and he would rather create visual assets. However, facilitators often view these “low stakes” opportunities as ideal for novices to try on new identities and develop new skills. In this way, facilitators are faced with the challenge: Students are usually interested in one aspect of the program: coding, art, storytelling. Do you let them focus on one aspect of game design or rotate so they are exposed to more disciplines?

Based on his experiences, Rubio, whose students have largely collaborated in large groups to make a single game, argued for having students specialize, yielding outcomes that are more productive and offer opportunities for students to iterate, fixing problems they have identified. Moving them around, he explains, removes the continuity. Coulter’s model of youth game creation favors students working in pairs. Even when one student is stronger
than another in one aspect of game design, the pair model allows for legitimate peripheral participation in which students see that it can be done. Holden finds that students do find ways for legitimate peripheral participation, and that the process can allow student leaders to emerge, who are comfortable for example with the tool usage, and give other teammates ways to learn in non-traditional ways.

**Abby Abyss: Purpose, Process, Product and Performance**

Augmented reality games are an emerging genre. This can be problematic for game makers of all ages who, desiring a more public showcase for their games, do not readily have opportunities to share the product of their efforts with a larger audience. How important is this for audiences and facilitators? Is there a larger goal for the creation of AR games, and if so, is it linked to the public consumption of these games?

Panelists offered their thoughts on ways and reasons to give games an audience, as well as the relative importance of that as an end goal. Rubio described using games made by earlier student groups as exemplars, arguing that it makes a difference to students to see something that their peers did, providing the projection of possibility. He also felt that sharing the game could be a very empowering experience, citing the example of former students at Global Kids, Inc. who invited First Lady Michelle Obama to share their game during a visit. Coulter maintained that games did not need to have a long shelf life to be meaningful, but rather that offering an opportunity for parents and others to see a showcase of student work (e.g., as the culmination of a week long summer camp) provided a workable and specific goal and gave it meaningful purpose. Holden proposed that AR game creation provides a vibrant learning opportunity, fundamentally different from traditional assignments (e.g., writing a term paper), which is simply done because it is assigned. Holden voiced concerns that AR games might be relegated as a new form of term paper, missing a valuable opportunity to use AR as an engaging tool to think with. He emphasized that AR game creation is only not about the product (in the way that students typically view term papers as merely a product), but about the design process as well.

**Ambitious Alice: The Fine Line Between Focus and Flailing**

Students making AR games hit brick walls. They struggle to turn a vague concept into a playable game or wrestle with scripting code to implement a particular game mechanic. Students flail and facilitators watch. Sometimes, the struggle compels students to creatively solve problems, take a step back, and redesign their work. Other times, these struggles become a wasteful and frustrating time sink. The challenge is deciding when to let students flail and when to provide guidance. How do facilitators decide when and how to intervene?

Coulter has seen students dive too quickly into game implementation, missing critical early design steps. The software, he notes, is not necessarily well suited for the initial brainstorming and envisioning game flow. He recommends instead utilizing a storyboarding technique to work out the flow of the game prior to jumping into the AR software implementation, helping students clarify and hone their ideas before worrying about the particularities of the software. Also, by having game creators work in pairs, Coulter’s students naturally draw out tacit design attributes by explaining and clarifying their ideas to one another. Rubio commonly sees students generate overly complex game ideas and finds it appropriate to step in at this key moment to attempt to help students simplify their ideas. It is important, he notes, to make this process transparent to students so that they note the need to step back and focus on the core aspects of their game design. By giving students a designated opportunity to provide feedback, so that ultimately the simplified game is still their creation. Holden, who typically works with older college-age students, utilizes enforced playtests as deadlines to compel students to “go into panic mode and get something done.” Traditional educational settings, he argues, do not prepare students well in terms of time and resource management. Creating AR games on a deadline compels students to practice these critical skills and find a way through these roadblocks.

**Madison Backstory: Games Beyond Narrative**

The narrative of AR games is often one of its most compelling aspects. While the genre of location-based AR games may be new to students, they are familiar with genres and narratives tropes. Students often channel their enthusiasm for a project into generating a rich backstory. However, teams often have a hard time moving forward from their first good idea into a more playable game design. How can facilitators help them proceed? When do facilitators intervene with criticism? And how strongly should they push it?

Holden sees his role as facilitator and helping students move from narrative to mechanics. The AR genre is still, he argues, an avant-garde genre. Using the narrative as a starting point gives the students a place to start and build from. Rubio recalls many times when students pitched complicated narratives. He relies on questioning students’ rationales and prompting them to justify their choices. Also, by introducing basic story arcs (e.g., the hero’s journey or hook-hold-payoff), students can begin to tune their narratives into games. Peer feedback also plays a key role.
Students are developing their identity as a game designer and the facilitator explains that designers need to revise iteratively based on feedback. In this way, the feedback and revision process is a way for students to move toward a more cohesive, playable game design.

Conclusions

Panelists shared a range of models in which youth successfully created location-based AR games. They all maintained that a rich learning opportunity emerges when youth are given the tools to creatively explore this new genre. However, panelists also noted that because the genre is still new and because generally students are not well versed in the design process, the role of the facilitator is critically important in helping students move through the challenges of creating a viable game.

References


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Log-data, interviews, and observation: What can they tell us about learning in a museum-based mobile game

Jennifer Sly, Minnesota Historical Society
Kate Haley-Goldman, Audience Viewpoints Consulting
Nicolaas VanMeerten, University of Minnesota; Minnesota Historical Society
David Gagnon, University of Wisconsin-Madison

Abstract: Museum exhibits are often considered passive experiences that have trouble engaging younger students. To increase their appeal, museums have begun re-inventing themselves by creating interactive multimedia exhibits that are supplemented with mobile technology. The Minnesota Historical Society (MNHS) has embraced this movement by developing a student-guided field trip experience called Play the Past (PtP), which was developed to enhance collaboration, critical thinking, and understanding of history. The current panel will discuss the development of PtP and evaluation of learning through several methods including, observations, interviews, and logged behavioral data. Lastly, the impact of the findings on the design of the exhibit will be discussed.

Panel Topic

This panel will look at three different approaches for measuring engagement, learning processes, and learning outcomes in an exhibit-based mobile game, Play the Past, for students in grades 4th - 6th at the Minnesota Historical Society (MNHS). The evaluation process involved staff and interns at the MNHS, experts from the University of Wisconsin, Madison, external evaluation from Audience Viewpoints (AVC), and a graduate student from the University of Minnesota to create this multi-faceted approach.

Why is it important?

This topic is important because it provides insight into how to evaluate a museum exhibit enhanced with mobile technology from several different perspectives. In addition, we are not aware of another study which has used logged behavioral data to analyze the learning behaviors of students who participated in a historical museum exhibit. This panel will also provide attendees with knowledge on how to implement this type of system within other informal learning environments by presenting information on the rapid prototyping and user testing methods used.

Panelists

Jennifer Sly is Museum Education and Technology Specialist at the MNHS. She leads the Play the Past and “Reinventing the Field Trip for the 21st Century” projects at the Minnesota Historical Society. For the past 15 years, Jennifer has worked at the intersection of technology and education in informal learning environments. Jennifer has a B.A. from St. Olaf College in Math and Music and an M.P.A. from the School of International Affairs at Columbia University.

David Gagnon is a Discovery Fellow and program director of the Mobile Learning Lab in the Wisconsin Institutes for Discovery at University of Wisconsin-Madison. He directs a team of educational researchers, software engineers, artists and storytellers that explore the intersections of learning science and media design, specializing in mobile media, video games and simulation. David is also the Director of the ARIS project, a free and open tool that allows anyone to produce mobile games, stories and tours. He is also active member of the Games+Learning+Society Research community.

Kate Haley-Goldman, is Principal at AVC. Kate’s fascination with data dates to her teen years with data collection trips and subsequent analysis with her mother, a field biologist. Kate’s academic background is in Anthropology, with her undergraduate years at Bryn Mawr College. In the 17 years she has been in the field, she has served as an Audience Researcher at the U.S. Holocaust Museum, spent over 10 years as Senior Researcher at the Institute for Learning Innovation, and most recently served as Director of Learning Research and Evaluation at the National Center for Interactive Learning. With experience in exhibition evaluation, citizen science, and amateur projects, and professional development programming, she has deep expertise in the field of informal learning. Kate is frequently called to advise on the use of technology in museums and other learning environments. She has directed projects both in the US and abroad, including mobile phones and smartphone apps, multimedia installations, websites, gaming, augmented and mixed reality, novel data visualization systems, and online learning. Currently, she
is Co-Principle Investigator of the National Science Foundation-funded open source project Open Exhibits.

Nicolaas VanMeerten is a Ph.D. student in the Educational Psychology program at the University of Minnesota. His research focuses on determining which behaviors are beneficial to learning in video game environments. In addition to this project with MNHS, he is currently developing a project to investigate how social play impacts learning in a multiplayer video game environment using logged behavioral data. He is also the co-founder of Glitch, a non-profit organization based at the University of Minnesota that provides extensive programming to promote gaming culture and game design as a creative practice.

Panel Structure

The session will be interactive, with the panel presenting evaluation results with attendees given time to reflect, critique, and interpret results.

I. Introduction by Jennifer Sly

II. Iterative Design and User Testing (David Gagnon)
   a. Attendee Interpretation

III. Observations, Interviews, Surveys (Kate Haley-Goldman)
   a. Attendee Interpretation

IV. Log Data (Nic VanMeerten)
   a. Attendee Interpretation

I. Introduction

Jennifer Sly will introduce the Play the Past project - a mobile game designed for students in grades 4th through 6th that visit the Minnesota History Center on field trips. The game uses the ARIS game platform and focuses on engaging students within an exhibit and encouraging their use of 21st Century skills. This section of the panel will describe the project, the process of development, and goals.

II. Iterative Design and User Testing

Play the Past used an iterative design method of development that used the ARIS game platform to rapidly prototype game designs and test with students visiting the museum. Over a two-year period, Play the Past tested with over 2,500 students and measured student engagement through observation, videotaped behavior, student interviews, and surveys of teachers and chaperones. This section of the panel will share findings from the iterative design period of the project and ask attendees to interpret these data points.

III. Observations, Interviews, and Surveys

AVC worked with interns and staff at the Minnesota History Center to conduct a series of exhibit observations, interviews, and surveys. AVC developed a protocol and trained staff to collect data for this evaluation. The observation and interview methods were paired in order to more purposefully focus on how Play the Past relates to student outcomes. A data collector followed individual students within a field trip group to first observe the student throughout their experience within the exhibition, particularly in the three exhibits connected to Play the Past, the Sod House, Iron Mine, and Fur Trade. MNHS data collectors noted such behaviors as Play the Past use, discussion and collaboration among students. Each student observed was then interviewed at the end of the field trip to more closely examine the connection between students’ use of Play the Past and what students take away from their experience at the museum. Both students and teachers were surveyed back in the classroom post-visit.

The findings from the observations and interviews will cover the following topics:

1. Student Engagement
2. Collaboration
3. Critical Thinking and Problem Solving

IV. Analysis of logged behavioral data for evidence of learning

The current analysis utilized behavioral data logged from a mobile device from every student who participated in the Play the Past exhibit for one year from September 1, 2014 – June 3, 2015 (7,291 4th to 6th grade students). This data was used to study how students interacted with the exhibit. Specifically, we assessed student engagement and behaviors that reflected learning within the exhibit through completion rates, collaboration between students, and the manipulation of artifacts to complete activities. A discussion of these findings will follow the presentation to determine how they could be used to improve the student’s experience with the exhibit and learning outcomes.
Presentations
The Iterative Design of an Eight-Week Course Aimed at Developing a Community of Gameful High School Teachers

Michelle Aubrecht, Ohio State University
Bob De Schutter, Miami University
Dave Clark, Butler County ESC
Andrew Wheatley

Abstract: This paper overviews the design and results of a course intended to provide the theoretical understanding and practical application of games and game-making in the classroom. The course design included a combination of gamification, badging, peer review, and building one’s own course by having assignment options. The paper shares the perspective of one of the students of the course, and explains the unique course design and approach to teaching teachers. Informal formative assessments are used to iteratively improve the quality of the course.

Background

The project that is outlined in this paper is part of a Straight A grant (funded by the state of Ohio), which provided its participants access to the Zulama program - a series of courses focused on games and 21st century skills and standards. Miami University contributed to this project by providing additional assistance in order to take the knowledge and skills taught through the Zulama curriculum into the practice of the participants. More specifically, Miami offered a Semester course on Game Theory beginning in the September 2014, called Game-Based Learning, which was designed and taught by visiting instructor Michelle Aubrecht. The course brought together seven teachers from the Madison Local, Monroe Local and Talawanda Schools as its participants.

The primary purpose of this course was for practicing teachers to have a theoretical framework for the new courses they would be teaching using the Zulama curriculum. None of the participating teachers had any prior experience teaching game making or using games in the classroom. Through the course, the project aimed for the teachers to:

1. gain a working knowledge of games and game making as an educational activity and art form,
2. understand their value and cultural significance,
3. discuss related topics such as game violence, twenty first century skills, and finally,
4. examine how classroom configurations influence student behavior.

In addition, we wanted those participating to feel confident about using the Zulama curriculum, project-based grading, and to embrace a teacher’s role as facilitator, guide, resource, and collaborator in their student’s educational journey. Assignments, face-to-face meetings, and grading were designed to model this sort of teaching approach using: contract grading, gamification, badging, no lectures, lots of discussion, game playing, and hands-on, small group activities and discussions (described more fully below).

Overall, we wanted the teachers to form a community, being comfortable in sharing their experiences, difficulties, and successes in ways that would extend into the time when they use the Zulama curriculum. These teachers are in a position to become leaders and experts in understanding 21st century skills as well as modeling their teaching in ways that will likely influence and inform fellow teachers. In addition, many of the teachers in the course were already resource people for technical and digital skills within their schools.

Course Design

To design the course, Michelle used a consulting, collaborative approach and formative assessment. She spoke with people involved with the grant, i.e., Miami University, the Butler County Educational Service Center, and Zulama representatives to understand what was promised in the grant as well as topics that teachers struggled with when new to games and game-making in the classroom. Once the class met, she also consulted with students, asking them what their goals were for the class and offering assignment options so that students could spend their time in meaningful ways. This resulted in the List of Learning Outcomes that is presented in Figure 1 below.
The initial syllabus was adapted to reflect student input after the first face-to-face meeting. In addition, Michelle drew upon her understanding of the field to address topics that she thought would give the teachers in the course a solid foundation for why teachers would want to use games with students or teach game-design, and what students would be learning. Given their lack of experience, it was important for the participants to see the big picture of educational gaming, grounded in both theory and practice.

Given that teachers are very busy - working full time and managing family life among other activities - we wanted to ensure that the amount of work would not be overwhelming or overly academic. This was perceived as a good decision, considering that a few students commented that the academic articles were somewhat confusing. This is possible due to them using discipline-specific language, such as those from the field of Art Education. However, while a few of the articles were academic in nature, most were from newspapers, or blogs, white papers and reports from places such as the Cooney Center/Sesame Workshop.

The required texts were written for general audiences (such as Theory of Fun (Koster, 2014) and a few chapters from Digital Natives (Prensky, 2010)). Likewise, the videos were selected for single ideas or concepts such as TED talks, online broadcasts, and several videos created for a MOOC on game based learning offered through the University of Wisconsin. In addition, several links to online resources were provided, which included games and game-making software. More specifically, we used Gamestar Mechanic, a simple drag and drop (no coding required) game-making software to give teachers a sense of the complexity of game making and necessity of collaboration and iterative development.

During the course, there were no lectures. Michelle made this choice because she wanted to model the sort of teaching she hoped they would use with their students. Meaning that they would provide meaningful work, explorative group activities, feedback and facilitate discussions. Students discussed the readings and assignments that were chosen to encourage student reflection. For example, students were asked to read through lists and articles about 21st century skills and new media literacies and then to make their own charts, citing instances where they observed themselves, colleagues, or their students using such skills. During the second face-to-face class, the instructor asked them to combine these into a shared document. Similarly, she asked them to get into small groups and discuss their writings about violence in games so that they would all came away with information to draw upon during future discussions about violence in games with colleagues, students and student’s parents.

<table>
<thead>
<tr>
<th>Learning Outcomes</th>
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<tbody>
<tr>
<td>Understanding and having resources to respond to the subject of Violence in the Classroom;</td>
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<tr>
<td>Understanding and be equipped to provide their students with assignments that support the development of 21st century skills;</td>
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<tr>
<td>Formative assessment - how to use it to improve and assess your teaching;</td>
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<tr>
<td>Understand project based learning and how to design and assess student work;</td>
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<tr>
<td>Understand the value of teacher as coach, facilitator, resource person, and guide;</td>
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<tr>
<td>Understand why and how classroom configurations can influence how students collaborate;</td>
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<tr>
<td>Understand the value and purpose of educational games and game making as a classroom activity;</td>
</tr>
<tr>
<td>Understand how game making is an art form;</td>
</tr>
<tr>
<td>Have access and knowledge about resources that will support classroom use of the Zumala Curriculum and game making.</td>
</tr>
</tbody>
</table>

Figure 1: List of learning outcomes for the course.
The course was offered both synchronously and asynchronously. Students met face-to-face three times— for eight hours on Saturdays once a month beginning in September and finishing right before Thanksgiving in November. In between face-to-face classes, the instructor posted assignments on a closed website and in the shared Google class folder. Students were to post comments in a shared Google folder and comment upon at least two other classmate’s posts. Each of the asynchronous weekly assignments (see Figure 2 below) was intended to take about two hours to complete, but optional readings and videos were provided if a student wished to go deeper.

**Week 4. Games & School (DUE November 1, Saturday)**

*Read*

- Assessment Drives Learning: How to Drive to a New Place, James Gee
- Jean Lave, Etienne Wenger & Communities of Practice
- Can Gaming Change Education?, eSchool News, Stansburyu

*Optional Readings*

- Moving Learning Games Forward: Obstacles, Opportunities, and Openness, Klopfer, Osterweil, Salen
- The Instructional Power of Digital Games, Social Networking, Simulations and How Teachers Can Leverage Them, by Klopfer, Osterweil, Groff, Haas
- Game Changer: Investing in digital play to advance children’s learning and health, Thai, Lowenstein, Ching, Rejeski

*Watch*

- The Gamer’s Edge, James Gee (3 min)
- Technology Inside vs. Outside of Classrooms, Halverson (5 min)
- Learning as Cheating the Game, Deb Fields & Jim Bower (4.5 min)
- Situated Learning & Place-Based Games, David Gagnon (5 min)
- Connected Learning: Playing, Creating, Making, Katie Salen (7 min)
- RSA Animate - Changing Education Paradigms, Sir Ken Robinson (11.5 min)

*Respond*

- In the class folder, write your thoughts about school, learning, and games. Then respond to two other class members writing. NYT feature: Learning by Playing (Quest to Learn in NYC) September 2010

Figure 2: Sample of weekly asynchronous class assignments.
Contract Grading, Gamification, and Badging

The instructor created the assignments and grading structure by borrowing from Davidson and Sheldon (https://gamingtheclassroom.wordpress.com/syllabus/). Davidson’s blog post Contract Grading (source: http://www.hastac.org/blogs/cathy-davidson/contract-grading-peer-review-heres-how-it-works) and her book, Now You See It, describe her use of contract grading. The instructor copied Davidson’s contract and adapted it for this class. Students were asked to choose the grade they wanted to earn and write it on the contract. They also signed it, as did the instructor and a witness from the class. To gamify the class, the instructor borrowed from Sheldon’s system for awarding points for various assignments From conversations with Seann Dikkers (personal communication, 2014), she borrowed his idea of providing an assignment bank with the option for students to suggest alternatives. Using the assignment bank the instructor created for the course, students selected the things they wanted to do in order to earn the desired grade. Accompanying the contract the student listed all of the assignments they agreed to complete. If they completed the assignments agreed to, they would earn the grade stated on the contract.

The instructor provided a base-line of non-negotiable assignments that would constitute a C. To earn 1000 points for a C, students were required to attend class, complete the required readings from Koster (2014) and Prensky (2010), all the asynchronous assignments, and write a response and respond to one another’s work using Google docs. (The points-chart and assignment bank will be shared during the presentation.) For these base-line assignments, students were asked to self-grade using a chart in the shared Google folder for the course.

To earn a B or an A, students could “build” their own course by choosing from among the options in the assignment bank, each with a specific number of points. For example, they could choose to write a game review for 25 points or explore a game-making software, earning anywhere from 100 to 500 points depending upon the depth they choose. Exploring a Zulama course offering, thinking through how they would implement it in their classroom and then presenting their findings to the class was worth 500 points. Most students did this which both allowed them to gain a letter grade and prepare to teach a Zulama course: something they would have to do anyway.

To incorporate some of Davidson’s ideas about peer review, the instructor added badges as a way to up-vote one another and to increase one’s grade to a plus or minus (see Figure 3). Students were asked to assign badges to fellow students each time they met face-to-face using a chart provided in the class Google folder. The purpose of the badges was to contribute to creating community and give feedback to students about how they were perceived by their peers. In addition, the badges indicate the sort of classroom behavior that the instructor considered valuable for creating an atmosphere conducive to peer-to-peer instruction and collaborative work. In a typical classroom where students gather regularly, it might be more useful. While everyone up-voted peers and the instructor a few times, it was not done after every face-to-face class.

Figure 3: Peer-awarded badges. From left to right: leadership/group facilitation, collaborator, congeniality, helpfulness, innovation, and going above and beyond.

Summary of the Pre/Post Formative Assessment

The project used formative assessment to fine-tune the course as it was being held. In addition, using the pre-post tests was another way for Michelle to model the approach to teaching that she thought would most help the students be successful in implementing the Zulama curriculum. They also had an assignment to write and use pre/post tests with the current students. It is not uncommon for a designer to make less than ideal or even entirely wrong decisions in the conceptual phase. However, while a designer often has the option to perform user tests and iteratively adjust her work (e.g., Vanden Abeele et al., 2012), a course designer cannot test or “rehearse” her work before implementing it. It is therefore not uncommon for experimental course designers to make adjustments to their work while the course is in progress (e.g., De Schutter & Papa, 2015). The formative assessments that are described below were held to accommodate this, and should not be interpreted as a formal evaluation of the learning outcomes of the course. The formative assessment used five questions that would help gauge the student’s preconceptions and how these would change after the session. Below we explain how the tests were adminis-
tered, and we provide an evaluation of questions one and four in order to assess how well the course objectives were communicated.

**Administration of the pre/post assessment**

The students answered these questions on the first all-day class on a Saturday morning. Students were given a pre-class reading assignment to read two chapters *Digital Natives* (Prensky, 2010), and bring a drawing of how their classroom was arranged. The post-test was given during the last 30 minutes of class on the final all-day Saturday class. The first time they were given paper and pens with the questions and the second time they were offered paper or digital “paper”; four responded digitally, typing, two choose to hand-write, and one didn’t do the post test. The ability to use the medium they were most comfortable with combined with their increased knowledge of the learning objectives contributed to more thoughtful and extended responses in the post-test.

The following five questions were used to assess the student’s understanding of the topics (1), and are as follows:

1. Why would games or game-making be used in schools?
2. What is the role of teachers in a classroom?
3. Given the technologies available, how can these transform, support, enhance, facilitate student learning? How does this apply to game design and game-making?
4. What is the difference between space that is designed well and designed poorly to facilitate students in collaborative work and research?
5. What elements are essential or must be including when making any kind of game?

**Evaluation of the student’s pre/post responses**

We include a discussion of Q1 (i.e., “Why would games or game-making be used in schools”) and Q4 (i.e., “What is the difference between space that is designed well and designed poorly to facilitate students in collaborative work and research”). However, the other questions followed a similar pattern.

**Q1: Why would games or game-making be used in schools?**

“Engagement” was the most frequent word used in describing the value of games in the pretest; it was given as a reason for why games would be used in schools. However, they were not able to explain what engagement would look like, how it would occur or how it would benefit the student. In the post assessment, students touched on some of the benefits of using games in classrooms and were more articulate and specific. The obvious conclusion is that they were synthesizing the readings and videos they had watched and had gained in understanding.

One student who teaches art responded as follows:

**Student A Pre:**

Make learning exciting. Take what kids know & like & use it in the classroom. Visual learners get to use visual skills to learn.

**Student A Post:**

An interactive way to create interest in learning with students in which they learn without always being conscious of that learning.

Her pre-assessment response is typical of many who hear about the idea of using games in the classroom. Many assume that all kids play and like video games, which actually is not the case. There are various degrees of ways kids play games and nuanced ways they understand themselves as gamers. Furthermore, while 97% of people under 18 play games, informally, outside the classroom (Lenhart et al., 2008), playing games for an educational purpose, as a required classroom activity is not the same. It is the way in which students identify themselves as game players that contributes to their willingness to play games selected for classroom use. In addition, how the game is presented and connected to learning activities makes a difference in student’s eagerness to play games in school.
While we would have liked to see the student's post assessment response more developed, it is noticeable how the emphasis has moved from the idea of games as potentially more exciting or novel ways of teaching, to the idea of games as a more interactive method that has other benefits for learning than simply their motivational value. At this early point in the course, a seed towards a better understanding of game-based learning is starting to develop for Student A. Student B, however, takes a much bigger leap in his perception towards games in class:

Student B Pre:
- Increases engagement
- Excellent opportunity for collaboration/PBL (project based learning)/21st century
- Teaches troubleshooting/improvement
- Can be easily integrated into a variety of subject areas

Student B Post:

My participation in the class has dramatically reshaped my opinion on the usage of games and game-making in school. Games and game-making have numerous applications to a wide variety of careers and professions that the skills developed in courses like those that are provided by Zulama would be beneficial. The whole concept of iteration, and the fact that gaming allows players to problem solve, suffer setbacks and then figure out ways to work through them, experience failure and ultimately that “epic win” experience all have applications that can benefit student growth. The collaborative aspect of gaming was one that I completely underestimated. The whole 21st Century skill sets of critical thinking, using technology, and collaboration, to name a few fit into the model that will help students.

Q4: What Is The Difference Between Space That Is Designed Well And Designed Poorly To Facilitate Students In Collaborative Work And Research?

In the pre-assessments there was a lack of depth in the responses and in the post assessment, students clearly grasped the need for movable furniture and providing a variety of spaces in which students may collaborate such as tables and access to a white board or projector to facilitate sharing computer screens with a group. One of the reasons this concept was clearly communicated was likely because of the assignment to make a graph of one’s existing classroom and then redesign it (see Figure 4, above). Most people worked in pairs. In addition, the classroom space where the class met at Miami University is designed to facilitate all of the activities associated with game design, thus they also experienced how the classroom space can support and facilitate various student activities.
Student A Pre:
One enhances learning
One distracts from learning process

Student A Post:
One enhances learning, aids learning and creates an environment in step with learning, while the other interferes or dictates how learning will take place.

Student B Pre:
Space guides application

Student B Post:
Learning spaces guide learning, plain and simple. Spaces that are created with comfortable and optimized areas for collaborative work will foster collaboration instead of impeding it. Learning spaces should also have other areas such as; play-testing, individual work, rapid prototyping, and even relaxing/informal areas.

Conclusion
The pre/post assessment responses confirmed for Michelle that her approach to teaching the course was successful. The pre-tests served to inform her selection of readings and viewings for the asynchronous portion of the class. From the pre-tests, one can see that most students had good ideas about the key concepts for the class, but lacked depth. Pre-assessment responses included very superficial, bulleted lists while the post-assessment responses had complete sentences in some cases and synthesized responses. It was clearly noticeable how their thinking progressed, and we noticed how some of our participants started to look at games as tools for critical and analytical thinking, systems thinking, problem-solving, and evidence based reasoning (as opposed to simply motivation). This was also evident to Michelle from classroom discussions; these were not formally documented. Finally, the most striking difference between pre and post assessments is the level of specific detail and thoughtful responses.

Thinking about games in education and game making as part of an academic curriculum can be something that evolves as one learns more about the subject. Games are multi-disciplinary and teaching with games or game-making has implications for teaching and learning that shifts the paradigm of school. Many consider playing games to be all about fun and school all about work. By bringing games into the classroom the shift that occurs can result in more freedom for student exploration and agency, even becoming intrinsically motivated to participate in learning. In essence, when one is drawn-in to a subject it is highly satisfying. One looses track of time, getting into a “flow” (Csikszentmihalyi, 1990). Such learning and skill building could be described as fun.

This course was important because it contextualized games within academia and classroom practices. It helped the teachers to embrace the idea that they would be learners along side their students and in this way the course helped them to overcome their anxiety regarding their limited knowledge in the filed of game design. Many teachers assume they have to have all the answers; however, the approach we advocated was for the teacher to encourage asking questions and finding answers together. In addition, with teacher guidance, students may see how to transfer the skills they exhibit in game play to other academic endeavors. As these concepts are implemented in classrooms, researchers may collaborate with teachers to better understand how learning environments can be restructured to address the needs of 21st century learners.

Endnotes
(1) For replications of the assessment, we recommend to change the order of the questions to Q2 (first), Q4, Q3, Q1, Q5 (last). We also advise to add the following sentence to Q5: “Explain how these elements combine to create the desired user experience.”
References


Meta-Analysis of Digital Games and Learning In Terms of the NRC’s Education for Life and Work Outcomes

Douglas B. Clark, Vanderbilt University
Emily E. Tanner-Smith, Vanderbilt University
Stephen S. Killingsworth, Vanderbilt University

Abstract: This meta-analysis synthesizes research in learning in digital games for students in the K-16 grade range. The studies were located in electronic bibliographic databases from Engineering, Computer Science, Medical, Natural Sciences, and Social Sciences fields. Learning is defined and categorized broadly in terms of the Cognitive, Intrapersonal, and Interpersonal clusters of 21st century competencies outlined in the NRC’s recent report on “Education for Life and Work” (Pellegrino & Hilton, 2012). In summary, findings from this meta-analysis indicate that compared to non-game instruction, digital games can enhance student learning as measured by cognitive competencies and some intrapersonal competencies. There was also evidence that certain types of game structures may be more/less effective for certain types of outcomes, underscoring the importance of design beyond simple choice of medium when discussing the affordances of digital games for learning.

Background

In 2006, the Federation of American Scientists issued a widely publicized report stating their belief that games offer a powerful new tool to support education (FAS, 2006). The report encouraged private and governmental support for expanded research into complex gaming environments for learning. A special issue of Science in 2009 echoed and expanded this call (Hines, Jasny, & Mervis, 2009), as have reports by the National Research Council (Honey & Hilton, 2010; NRC, 2009). However, these reports also underscore, that solid evidence for the contributions of games to learning is sparse.

Much of the early debate over digital games for education focused on whether games are “good” or “bad” for education. That question is, however, overly simplistic. The NRC report on laboratory activities and simulations (Singer, Holton, & Schweingruber, 2005) makes clear that the design, and not merely the medium, of a physical or virtual learning activity determines its efficacy. Digital games are a medium with certain affordances and constraints, just as physical labs and virtual simulations are media with certain affordances and constraints. Simulations and digital games actually share many similarities in this regard. Properly designed, these features of games can provide powerful affordances for motivation and learning. Individual studies have shown, for example, that well-designed games can promote conceptual understanding and process skills (e.g., Annetta, et al., 2009; Hickey et al., 2009; Ketelhut et al., 2006; Klopf et al., 2009; Moreno & Mayer, 2000, 2004), can foster a deeper epistemological understanding of the nature and processes through which science knowledge is developed (e.g., Barab et al., 2007; Neulight et al., 2007), and can produce gains in players’ willingness and ability to engage in scientific practices and discourse (e.g., Barab et al., 2009; Galas, 2006; McQuiggan, Rowe, & Lester, 2008). Leveraging these affordances, however, appears to depend on careful design (Clark et al., 2015).

The purpose and need for the current study is threefold. First, a study needs to be conducted that looks specifically at digital games and learning across disciplines and learning outcome types. Second, the study needs to analyze the impact of learning outcomes based on constituent design features as well as the level of game versus traditional instruction such that future development and research can build on that foundation. Third, the study needs to more thoroughly cover eligible studies across fields so that the results do indeed represent this diversity and such that a large enough sample of studies can be collected to reliably explore specific questions of design.

Objectives

This meta-analysis synthesizes research in learning in digital games for students of K-12 age as well as students enrolled at post-secondary educational institutions. The studies were located in electronic bibliographic databases from Engineering, Computer Science, Medical, Natural Sciences, and Social Sciences fields. Learning is defined and categorized broadly in terms of the Cognitive, Intrapersonal, and Interpersonal clusters of 21st century competencies outlined in the NRC’s recent report on Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century (Pellegrino & Hilton, 2012). The research questions this study addresses are:

1. What are the effects of digital games on learning for K-16 students?
2. How do these effects vary by learning outcome type in alignment with the categorizations of the recent NRC report on Education for Life and Work (Pellegrino & Hilton, 2012)?

3. How do these effects vary by learning content discipline?

4. How do these effects vary by game type?

**Search Strategy**

Our database search term criteria simply specified that the terms “game” or “games” needed to be included in the abstract or title. All of other potential terms were deemed likely to inadvertently cut out otherwise eligible studies. In terms of databases, research on games for learning spans many fields. Again we wanted to make sure that we were maximally sensitive in our meta-analysis. We therefore searched the following fields: Engineering, Computer Science, Medical, Natural Sciences, and Social Sciences. To do so, we searched the following databases and sub-databases for the terms “game” or “games” in the title or abstract: (a) ISI Web of Science (SSI and SSSI); (b) Proquest (ERIC, PsycINFO, Soc Abstracts, Social Services Abstracts); (c) PubMed; (d) Engineering Village (Inspec, Compendex), and (e) IEEE Xplore. We also checked the bibliographies in narrative reviews and meta-analyses, as well as those studies that were identified as eligible for inclusion in the meta-analysis.

**Selection Criteria**

This systematic review and meta-analysis explores the effects of digital games on cognitive, affective, and other learning related outcomes. Eligible studies must describe an eligible digital game program directed toward an eligible participant sample and report information on at least one eligible outcome variable that permits the calculation of an effect size. Each of these eligibility criteria are outlined in detail below:

1. **Digital Game.** To be eligible, the journal author(s) must explicitly designate the environment as a “game.” The study must focus on the effects of a digital game on an eligible outcome. Games do not need to have been designed explicitly as games for learning.

2. **Participants.** All study participants must be in the K-12 age range of 6 to 18 years of age (whether or not the study was conducted in the context of a K-12 institution), be students in a K-12 institution, or be students enrolled in a postsecondary educational institution.

3. **Research Designs.** To be eligible for the current meta-analysis, only randomized controlled trial and quasi-experimental designs were eligible for inclusion. (We are simultaneously conducting a parallel review of qualitative research that is not reported here).


5. **Date of Publication.** Eligible studies should be relatively modern to reflect the current state of digital game design. Therefore, the date of publication must be from 2000 to 2012.

6. **Study Site and Language.** The study must be published in English (but not necessarily conducted in English or an English speaking country).

7. **Effect Sizes.** To be eligible for the meta-analysis, the study must report sufficient information needed to calculate both post-test and pre-test effect sizes.

8. **Publication Status.** Only peer reviewed journals articles are eligible for inclusion.

**Literature Search**

All literature searches were conducted in September 2012. Overall, the literature search yielded 61,887 net hits (after accounting for \( n = 7,476 \) duplicates that were initially identified in EndNote). Most of the reports were identified in ISI Web of Science \( (n = 41,710) \) or PubMed \( (n = 14,685) \), although Proquest, Engineering Village, and IEEE Xplore also yielded several thousand results.

A majority of reports were initially screened out at the title level \( (n = 58,111) \). A total of 3,776 abstracts were next screened for eligibility, and 726 reports were screened and read in full text to determine final eligibility status. Most of the reports were ineligible for inclusion in the meta-analysis due to inadequate research designs (i.e., many
were concept pieces that did not empirically examine the effect of a digital game). After screening the full text articles, 80 reports based on analyses of 77 unique data samples ultimately met the eligibility criteria including sufficient information to calculate effect sizes and were included in the final meta-analysis. To clarify some reports include more than one data sample, usually referred to as multiple “studies” within the report, but some reports report on the same data sample as reported on in other reports. The number of reports and the number of distinct data samples is therefore not the same.

**Study Characteristics**

Games were classified based on the integration of the learning mechanic and the core game mechanic. Interestingly, there were very few games involving fully extrinsic integration of the learning mechanic and core mechanic (a controversial but simple design made famous by the Math Blasters series of educational games where the learning mechanic of solving equations was completely separated from the game mechanic of blasting “space trash” that was the core intended motivator). The learning mechanic of a game can be defined as the primary aspects and interactions within the game intended to support players in learning the target learning outcomes. The core game mechanic can be defined as the aspects and interactions within the game that were ostensibly designed to be the most interesting and engaging aspects of the game. Most of the games were coded as “intrinsic by default” (62%), which meant that the learning mechanic was integrated directly into the core game mechanic but that there were no other elaborate game mechanics due to the simplicity of the game design. “Tetris” would represent an example from this code, as would simple educational games where the player answered questions for points or rewards. Another 36% of the games represented intrinsic integration of learning mechanics and game mechanics in game designs involving more elaborate game mechanics.

Using the broad learning outcome domains from the NRC report on 21st century learning skills, 83% of outcomes measured cognitive competencies, 16% were for intrapersonal competencies, and less than 1% involved interpersonal competencies. In terms of the narrow outcome domains from the NRC report, the majority of effect sizes were for learning outcomes that were measures of knowledge (66%) or cognitive processes/strategies (14%) from the broad cognitive competencies domain followed by work ethic/conscientiousness (10%) and positive core self-evaluation from the broad intrapersonal domain.

**Meta-Analysis Comparisons**

Overall, the largest body of literature we identified compared digital game interventions with other (non-game) instructional conditions, which are comparisons that may have the greatest relevance to educators (Table 1). Note that a comparison is only significant if the confidence interval does not include “0” within its bounds (e.g., “(.23, 69)” is significant while “(-.36, .18)” is not. Effect sizes associated with non-significant confidence intervals are not significant. Findings from these studies indicated that digital games were associated with significantly better cognitive competency outcomes among students, relative to the other instruction comparison conditions. These beneficial effects on cognitive competencies were primarily based on knowledge outcome measures rather than cognitive processes/strategies outcome measures, of which there were fewer, or creativity outcome measures, of which there were none. Results indicated that game conditions integrating true simple games (i.e., game design involving more than simply draping school tasks with rudimentary game structures such as points and graphics) and those using interface enhancements (i.e., augmentations to the interface through which the player interacts with the game) showed the largest beneficial effects on literacy and general knowledge measures, whereas rudimentary game structures (i.e., game design involving simply draping school tasks with rudimentary game structures such as points and graphics) showed larger effects on science and math outcome measures. There was no consistent evidence that digital games outperformed the other instruction comparison conditions on social science, engineering, or psychology learning outcomes (although there were very few studies focusing on social science or engineering outcomes).

Although there were very few studies reporting findings on intrapersonal competencies outcomes, there was evidence that relative to other instructional conditions, digital games were associated with better intellectual openness and positive core self-evaluation outcomes within the intrapersonal competencies domain. However, no studies provided information about learning outcomes within the interpersonal competencies domain, so there is insufficient evidence to make any statements about the relative effectiveness of digital games for improving interpersonal competencies.
We then analyzed results from the 12 studies that compared digital game interventions to no treatment control conditions, which indicated no beneficial effects of digital games on learning outcomes. This result was consistent across different outcome domains, subdomains, and disciplines. It should be noted, however, that the failure to detect such effects could be due to low statistical power due to the small (n < 10) number of studies that were available for any given analysis. Several additional factors may also have contributed to these findings: (a) the fact that most of these studies focused on psychological assessments involving students with autism or other disabilities, (b) the fact that most of the game conditions implemented in these studies were minimally described, and (c) the fact that these studies often appeared to involve game conditions with low production values. Given these issues, there is insufficient evidence to make conclusions about the (in)effectiveness of digital games on learning outcomes for students, relative to no treatment control conditions.

Finally, we analyzed several studies that compared different designs of digital games to each other (Table 2). In many ways, we view these comparisons between designs as the most important in this study. Much of the debate in the field to date has focused on more simple questions about whether games are good or bad for learning. More productive questions focus on which designs and structures optimize which outcomes for whom and how. The NRC’s reports on labs (Singer, Hilton, & Schweingruber, 2005) and games and simulations (Honey et al., 2010) are much more useful when viewed through these lenses. Clearly there are productive designs and unproductive designs of books, labs, movies, simulations, and games for specific goals and people. Nobody needs to be convinced that “bad” games, simulations, books, or labs are unproductive. From our perspective, the most important

### Table 1. Mean Effect Sizes for Digital Games vs. Other Instruction Comparison Conditions

<table>
<thead>
<tr>
<th>Type of game</th>
<th>Cognitive</th>
<th>Intrapersonal</th>
<th>Interpersonal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>95% CI</td>
<td>n</td>
<td>95% CI</td>
</tr>
<tr>
<td>All games</td>
<td>.32 (.19, .44)</td>
<td>38</td>
<td>.22 (-.04, .49)</td>
</tr>
<tr>
<td>Rudimentary game structure</td>
<td>.22 (.03, .40)</td>
<td>18</td>
<td>.33 (.03, .63)</td>
</tr>
<tr>
<td>Beyond rudimentary game structure</td>
<td>.40 (.24, .56)</td>
<td>20</td>
<td>.16 (-.36, .67)</td>
</tr>
</tbody>
</table>

### Table 2. Mean Effect Sizes for Digital Games vs. Other Digital Game Conditions

<table>
<thead>
<tr>
<th>Type of focal game</th>
<th>Cognitive</th>
<th>Intrapersonal</th>
<th>Interpersonal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>95% CI</td>
<td>n</td>
<td>95% CI</td>
</tr>
<tr>
<td>All focal games</td>
<td>.29 (.10, .48)</td>
<td>13</td>
<td>-.06 (-.29, .18)</td>
</tr>
<tr>
<td>Interface enhancement</td>
<td>-.01 (-.36, .34)</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Scaffolding enhancement</td>
<td>.47 (.19, .75)</td>
<td>6</td>
<td>-.16 (-.46, .14)</td>
</tr>
<tr>
<td>Player arrangement</td>
<td>.12 (-.25, .50)</td>
<td>3</td>
<td>.10 (-.27, .47)</td>
</tr>
<tr>
<td>Rich context</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
questions for future research are which design approaches are productive and what affordances are offered within a medium (c.f., Underwood, Banyard, & Davies, 2007).

Our initial findings make clear that there were significantly cognitive learning gains for the various enhanced game designs compared in the constituent studies. Our ongoing work will explore these relationships in greater detail. In terms of our initial findings, there was some evidence that game conditions using scaffolding enhancement (i.e., enhancements to the supports for the player within the game or aspects of the game that adapt to the needs or actions of the player) showed larger beneficial effects on cognitive processesestrategies and knowledge outcomes, relative to those using interface enhancement (i.e., augmentations to the interface through which the player interacts with the game) or player arrangement conditions (i.e., changes in the social arrangements between players ranging from completely individual play to combinations of collaboration and competition). Again, however, there were relatively few (often n < 10) studies within any given analysis so it is unclear whether the lack of statistical significance for effects is due to low power or true null effects.

Findings from this report should be interpreted in light of its limitations. The primary limitation of these findings is that most of the analyses were based on a small number of studies (often n < 10), and thus it is unclear whether the lack of observed effects in some instances are due to null effects or simply low statistical power to detect such effects. Although meta-analysis often increases statistical power to detect effects by pooling findings across multiple studies, it is nonetheless sensitive to the number of studies and estimated parameters in any given model. Furthermore, the exploratory moderator analyses used to examine whether effects varied across different types of game conditions were likely severely underpowered given the small number of effect sizes within any given subgroup. For this reason, all subgroup analyses were considered exploratory and those results were presented descriptively rather than inferentially. Given these issues with statistical power and limited degrees of freedom, it was also not possible to conduct multivariable meta-regression models to examine whether other study, participant, methodological, or game characteristics were associated with effect size magnitude. In future analyses we plan to explore such multi-variable models for those meta-analyses that included a large number of studies, and at minimum, to explore for possible confounds among different study characteristics. However, the low statistical power to detect effects suggests that the effects measured in the statistically significant comparisons are substantial.

In summary, findings from this meta-analysis indicate that compared to non-game instruction, digital games can enhance student learning as measured by cognitive competencies and some intrapersonal competencies. There was a noticeable lack of interpersonal competency outcomes reported in the literature, so there is insufficient evidence at this time to make statements about digital game effects on those outcomes. There was also evidence that certain types of game structures may be more/less effective for certain types of outcomes, underscoring the importance of design beyond simple choice of medium when discussing the affordances of digital games for learning (just as researchers would assume for any other medium). Furthermore, there was no evidence in any of the analyses that digital games were associated with statistically significant adverse outcomes (i.e., worse learning outcomes).

Please also note that the results reported in this proposal represent preliminary analyses. Between now and the conference, we will be working to double-check all coding and analysis scripting as well as to extend and expand our analyses before we are ready to release the results broadly at the conference. Further analysis is required to investigate why the comparisons of games versus no treatment show a trend of no effect, whereas the comparisons of games versus non-game treatments show an effect. Several possible explanations, including the small number of studies included in the latter group, are discussed earlier in this section. Based on these discussions, we plan to (a) investigate specific questions arising from the analyses to date, (b) investigate issues of study quality and game quality systematically in greater detail, and (c) extensively cross-check all search outcomes, eligibility coding, study coding, and meta-analytic scripting to ensure that this study comprehensively includes all possible eligible studies, that the coding is completely cross checked, and that all analysis scripting is cross-checked.

Acknowledgements

This work was supported by the Games Learning and Assessment Lab – Research (GlassLab-Research) grant from The Gates Foundation through SRI International. The full version of the report is currently in-press at Review of Educational Research. Special acknowledgement to the team that assisted in coding and screening including Shara Bellamy, Jamie Eldredge, Lauren Kissenger, Kaitlin Reynolds, Kasia Steinka-Fry, Marriah Vinson, Eric Wilkey, and Stephanie Zuckerman.
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simulations, engineering and science using *StarLogo TNG*, *E-Learning*, 6(1), 71-96.


Disciplinarily-Integrated Games: A Generalizable Genre?
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Satyugjit Virk, Vanderbilt University
Pratim Sengupta, Vanderbilt University

Abstract: Disciplinary integration can be thought of in terms of Collins and colleagues’ analyses of model types (epistemic forms) and modeling strategies (epistemic games). More specifically, the puzzles and game-play mechanics of disciplinarily-integrated games distill modeling strategies for navigating and manipulating model types. Framing disciplinary integration in terms of model types and modeling strategies opens a vast trove of epistemic forms and epistemic games that span across disciplines (in fact well beyond STEM into the social sciences). To explore the generalizability of disciplinary integration to games, the following sections propose other hypothetical examples in physics, biology, chemistry, and the social sciences. We discuss this generalizability in terms of its economic, curricular, and developmental implications.

Introduction
Clark, Sengupta, Brady, Martinez-Garza, and Killingsworth (2015) outline an approach for leveraging digital games as a medium to support the development of scientific modeling in K-12 classrooms based on the Science as Practice perspective (Pickering, 1995; Lehrer & Schauble, 2006). Clark et al. name this approach disciplinary integration and outline its development though a program of iterative research on student learning. Sengupta and Clark (submitted) extend the theoretical framing of disciplinarily-integrated games in terms of materiality within the classroom and the iterative design of multiple complementary symbolic inscriptional systems.

Clark et al. (2015) and Sengupta and Clark (submitted) propose that disciplinarily-integrated games represent a highly generalizable genre. To explore this claim of generalizability, the current chapter proposes other hypothetical examples of disciplinarily-integrated games (which we will refer to as DIGs for brevity) in physics, biology, chemistry, and the social sciences. We explore DIGs in three categories, beginning with model types and modeling strategies involving the nearest and simplest transfer of the DIG template and extending to those involving the furthest and most complex transfer: (a) time-series analyses with Cartesian formal representations, (b) constraint-system analyses with Cartesian formal representations, and (c) other model types and non-Cartesian formal representations. We close with the discussion of the implications of this generalizability.

Background
As proposed in Clark, Sengupta, Brady, Martinez-Garza, and Killingsworth (2015), disciplinary integration can be thought of in terms of Allan Collins’s and colleagues’ analyses of “model types” and “modeling strategies” (Collins, White, & Fadel, in preparation), which Collins and colleagues have termed “epistemic forms” and “epistemic games” in earlier work (Collins, 2011; Collins & Ferguson, 1993; Morrison & Collins, 1995). Collins and colleagues argue that the professional work of scientists can be understood in terms of model types (epistemic forms) that are the target structures guiding scientific inquiry and modeling strategies (epistemic games) that are the sets of rules and strategies for creating, manipulating, and refining those model types. While Collins and colleagues did not write with the intention of informing the design of actual digital games (they used the term “game” as a metaphor), DIGs can leverage the ideas of Collins and colleagues by structuring digital game play around modeling strategies (epistemic games) of designing and manipulating formal disciplinary model types (epistemic forms). More specifically, the puzzles and game-play mechanics of DIGs distill model types and the modeling strategies for navigating and manipulating those models.

As discussed in Clark, Sengupta, Brady, Martinez-Garza, and Killingsworth (2015), this specific emphasis on modeling as game play around disciplinary model types stands in contrast to engaging in “inquiry” more broadly, as is common in 3D virtual worlds (e.g., Quest Atlantis, River City, or Crystal Island). A key distinction between these two forms of virtual environments involves the nature and breadth of focus of the inquiry undertaken by students. Virtual inquiry worlds generally engage students in the practices and discourses (Gee, 1990) of a discipline at the level of inquiry writ large. Much of the pedagogical power and engagement of 3D virtual inquiry worlds tends to focus heavily on their impressive affordances for roleplaying, narrative, and identity-building (cf. Gee, 2007; Squire, 2011). As Clark, Sengupta, Brady, Martinez-Garza, and Killingsworth explain, however, while 3D virtual inquiry worlds are compelling and powerful, their scope and structure involve tradeoffs in terms of the individual tasks or
puzzles. More specifically, individual tasks and puzzles are often relatively mundane (e.g., click on a character to be told a piece of evidence, click on a location to get a reading on oxygen levels, or click on a location to bring up another mini-game to collect evidence). Essentially, whereas 3D virtual inquiry worlds tend to cast students as scientists investigating a “mystery” at the level of overarching inquiry, DIGs do not attempt the depth of immersion, identity-building, and role-playing of virtual inquiry worlds (nor do we dispute their importance or value in virtual inquiry worlds). Instead, however, DIGs are designed to engage students more deeply in specific modeling and representational practices of developing, interpreting, manipulating, and translating across specific model types. This focus allows DIGs to progressively deepen the puzzle at the heart of the game and, more broadly, allows all elements of the game to emphasize that puzzle.

**SURGE Symbolic**

SURGE Symbolic is an example of a disciplinarily integrated game (http://www.surgeuniverse.com). Whereas earlier versions of SURGE focused on layering formal representations over informal representations, SURGE Symbolic inverts this order, layering informal representations over formal representations while organizing gameplay explicitly around navigating and coordinating across representations. Furthermore, while earlier versions supported reflection on the results of game play through formal representations as a means to support strategy-refinement, the formal representations were not the medium through which players planned, implemented, and manipulated their game strategies. The position graph, for example, can present information about the specific regions of the game-world that will be affected by dangerous electrical storms at given times, as well as about locations where rewards or allies will appear to rendezvous with Surge. As a result of this design approach, the Cartesian space emerges as a set of scientific instruments for the player, in the sense of providing access to data about the game world that are not available through other means. At the same time, the Cartesian graphs also play the role of an instrument panel or mission planner, offering fine-grained control over the movement of the Surge spacecraft.

![Figure 1: SURGE Symbolic](image)

To date, we have primarily discussed DIGs in terms of SURGE Symbolic. To have value, the proposed template and genre must be generalizable. As discussed, disciplinary integration can be thought of in terms of Collins and colleagues’ analyses of model types (epistemic forms) and modeling strategies (epistemic games). More specifically, the puzzles and game-play mechanics of disciplinarily-integrated games distill modeling strategies for navigating and manipulating model types. To explore this claim of generalizability, the following sections propose other hypothetical examples of DIGs in physics, biology, chemistry, and the social sciences. We will explore DIGs in three categories, beginning with the category involving the nearest and simplest transfer of the DIG template to the category involving the furthest and most complex transfer: (a) time-series analyses with Cartesian formal representations, (b) constraint-system analyses with Cartesian formal representations, and (c) other epistemic forms and non-Cartesian formal representations.

**Time Series Analyses with Cartesian Representations**

The nearest transfer of the template is to other topics focusing on time-series analyses where Cartesian graphs of
change over time remain the focal formal representation. In such cases, the template outlined in this paper transfers relatively directly and require minimal discussion because the template remains essentially identical with time series analyses as the modeling strategy and Cartesian representations of change over time as the model type.

One example would involve exploring predator-prey relationships in population ecology. The time-series analysis of the populations could focus on the formal representation of population versus time, which depict the classic Lotka-Volterra equation relationships. Perhaps the phenomenological representation depicts the predator and prey animals within a given area running around reproducing, eating, and being eaten. The phenomenological and formal representations could be bridged by an intermediate representation that aggregates or stacks the animals in the phenomenological representation to clarify population levels. In terms of narrative, perhaps the player is an alien zoo keeper who needs to manage populations within the zoo. Perhaps the keeper can adjust temperature and irrigation in the zoo. As per the DIG template, the challenges and opportunities in a game level are depicted within the formal representation itself, perhaps as target levels for various populations at various times to avoid or attain. Also in line with the DIG template, the player specifies her strategy for an attempt in another formal representation, perhaps temperature and irrigation levels over-time, which impact plant growth and activity levels of predator and prey.

![Figure 2: Cartesian graph of Lotka-Volterra equation.](image)

In terms of other possible topics, the phenomenological view in a DIG for teaching chemical reaction kinetics might be a cylinder with various reactant molecules mixing together to create products. In terms of narrative, the learner might need to get a certain number of products by a certain time because the cylinder is being used to create a series of pills to help cure a disease. A DIG about the action potential might include a phenomenological representation that is a dynamic visualizations showing how sodium and potassium ions flow into and out of the neuron at the axon hillock. In terms of narrative, the learner might need to generate the specific membrane potential over time graph in question because he is trying to remotely control an alien organism he has engineered and set loose on a foreign planet. In designing a DIG to teach about glacial retreat the phenomenological world view would consist of a dynamic glacial tongue protruding from an artic land mass towards the ocean. For narrative, perhaps in order to transport a family of penguins along the glacier so they can meet their friends, the glacier needs to hit these target points to unite the penguins with their friends along the land mass. All of these proposed DIGs focus on Time Series Analyses with Cartesian formal representations, and thus all would use a very similar design template to the SURGE Symbolic. Essentially, the challenges and opportunities are presented to the player in the formal representations and the learner manipulates and creates her strategy and actions through the formal representations.

**Constraint-Systems with Cartesian Representations**

What about generalizing beyond Cartesian time-series analyses? Collins and colleagues outline a wealth of model types and modeling strategies in terms of structural, functional/causal, and process/behavioral analyses. We propose that the next most proximal category of DIGs focuses on the constraint-systems that include Cartesian representations with axes other than time. Collins and colleagues define constraint-systems as process/behavioral analyses where: (a) the model type is the equation (or equations) describing the steady state of the system and (b) the most common modeling strategy is the controlling variables game where one variable is manipulated at a time while all others are held constant to determine its behavior on the system. Constraint-system analyses there lend themselves to displaying relationships using Cartesian graphs as the formal representation with one variable along each axis and the other variables as controls for manipulating the Cartesian graph.
In the domain of chemistry, the ideal gas is one possible example of a constraint-system analysis DIG. The ideal gas law is governed by the equation $PV = nRT$, where notably “P” stands for pressure, “V” stands for volume and “T” stands for temperature. Here, the phenomenological view would be a simulation game environment where molecules move around in a container and the learner can make the container larger or smaller (volume) by adding or removing blocks to compress or enlarge its lid and increase or decrease the temperature by altering the size of a flame on the system. Pressure is a byproduct of an increase in kinetic energy of molecules, temperature, and thus cannot be altered directly. Pressure in this system is visualized by a series of red marks on that occur every time a gas molecule collides with the container. There are numeric readouts for all three of these variables in the simulation. Here the learner can hold one of these three variables constant by clicking on a button designated for each, and can manipulate the other two variables, one variable at a time to see the effect they have on each other. For example, the learner may hold the pressure variable constant in this system, and then compress/enlarge the lid of the container to increase and decrease the volume and see the effect this has on the temperature in the system. In this game, the learner has to generate a certain amount of gas pressure in a container that will be transferred to specialized cells needed to power a hovercraft he uses to explore an alien world. If the cells have too much gas pressure they will burst, and if they have too little, they won’t have enough to power the craft. The learner sees a Pressure vs. Volume graph with a target box at the proper amount of pressure. The learner alters the flame level to change the temperature in the system and then adds or subtracts blocks on the lid to alter the volume of the container holding the gas. As he does this, he sees the Pressure vs. Volume graph being created and can see if the target box is hit or not, thereby winning the level or losing it. The target box could be placed instead on the Volume vs. Temperature graph in a different level, where the learner has to generate a particular volume in the gas in order to transfer it to cells used for a different purpose in the hovercraft.

In the domain of physics, our DIG framework could be applied to the constraint-system of Coulomb’s force or repulsion and attraction. This system is particularly interesting for Cartesian graphs because it involves both multiplicative and exponential relationships ($F = k \cdot q1 \cdot q2/r^2$). Here, the phenomenological view would be a series of charge spheres, where the learner could control the distance between the spheres (r) and the charges on each sphere (q1, q2). The narrative might cast the learner as a space explorer on a space ship who needs to achieve the right amount of repulsion or attraction between charge spheres in an alien device in order to get it to work and see what it does (parallel to game-play in SuperCharged; Squire et al, 2004, but played out in the formal representations rather than in a simulated world). All of these constraint-stem analyses parallel the time-series analyses examples in using a Cartesian graph as the formal representation that presents the challenges and opportunities in a game level as well as a Cartesian graph or graphs through which the player plans, authors, and executes her strategy for the game level.

**Other Epistemic Forms and Non-Cartesian Formal Representations**

The previous sections suggest that the DIG template and genre proposed in this paper are generalizable to topics focusing on time-series analyses and constraint-system analyses where the formal representations are Cartesian graphs. This opens up a wide range topics across which the genre might apply. But what about other model types and modeling strategies beyond these?

Collins and colleagues (Collins & Ferguson, 1993; Collins, 2011; Collins et al., in preparation) discuss three different major groups of model types: “(a) structural models for analyzing the structure of phenomena, (b) causal and functional models for analyzing causal or functional aspects of phenomena, and (c) behavioral models for describing the dynamic behavior of phenomena” (Collins, personal communication). The time-series and constraint-system epistemic games we have focused on thus far in terms of possible DIGs are behavioral models (which Collins and Ferguson, 1993, originally termed “process analyses”). Process/behavioral models focus on the dynamic behavior of phenomena. The major behavioral/process model types discussed by Collins and colleagues include: system-dynamics models, aggregate-behavior models, constraint-system analyses, situation-action models, and trend and cyclical analysis (with time-series analyses being a subset of trend analyses). With that in mind, the next place to look for possible DIGs would be in this behavioral/process set of model types, which makes sense given that a focus on dynamic behavior lends itself well to the medium of digital games.

System-dynamics models, for example, seem promising for DIGs because they involve specifying relationships and action sequences that determine/predict outcomes given a scenario or set of parameters. In a system-dynamics model, variables are linked together by positive or negative links. Variables can be increased or decreased, which in turn changes other variables in the system though the links. These models can be qualitative or quantitative. Various lag, homeostatic, or feedback functions can be built into the models. Climate, economic, ecological models, and models in many other disciplines can be structured as system-dynamics models. The figures below present a simple system-dynamics models for economics and for population ecology.
Could interesting game-play be built around interpreting and manipulating a system-dynamics model? Actually, such a game has already been developed as a recreational “indie” franchise of games that has been highly successful commercially. *Democracy I, II, and III* are essentially system-dynamics models (http://www.positech.co.uk), where the changes you make to one variable influences all of the connected variables (either positively or negatively depending on the valence and magnitude of the link). *Democracy* is a great example because all of the game-play is centered and focused in the formal representations, which in the case of *Democracy* is incredibly complex with a huge number of nodes, but which would not need to be so complex for other games. Nonetheless, the *Democracy* example focuses entirely on reading and manipulating a single formal system-dynamics representation while monitoring other formal representations for information and changes across variables. Thus system-dynamics models, in conjunction with other formal representations, clearly are viable for DIGs. System dynamics models might also be implemented in DIGs as the control representation. In the earlier example about population dynamics, for example, rather than using Cartesian change-over-time graphs for the player to plan and author her strategy, she might manipulate the population system-dynamics model, above, to plan and author her strategy while a Cartesian graph of populations over time might still be employed as the representation that presents the challenges and opportunities for the level.

In terms of other process/behavioral model types, situation-action models are also promising for sciences as well as social sciences and robotics. Situation-action models specify a set of if/then rules that specify what actions an agent will take in what situations. As situations change, either because of previous actions or because of changes in agent’s environment, the rules then specify the next actions (or inaction). Such situation-action model rule sets could be used either for player control or for game communication of challenges and opportunities in a level. In the population ecology game, for example, a situation-action model might be used for the player to author her strategy by specifying the actions and properties of the animals being modeled, which might then play out in a system-dynamic model or an agent-based model (another type of behavioral/process model).

While behavioral/process model types thus seem fertile ground for generalizing DIGs, Collins and colleagues’ structural-analysis model types or causal/functional model types seem like more challenging terrain for DIGs. Structural-analysis model types “include compare and contrast, cost-benefit analysis, primitive elements analysis, tables or cross-product analysis, tree structures or hierarchical analysis, and axiom systems. Structural-analysis [model types] answer the question ‘What is the nature of x?’ by breaking x down into subsets or constituents and describing the relationships among the constituents” (Collins & Ferguson, 1993, p 29). Causal/functional analysis model types specify “the causal or functional structures that relate elements in a system… These include critical-event analysis, cause-and-effect analysis, problem-centered analysis, multicausal analysis, and form-and-function analysis” (Collins & Ferguson, 1993, p. 33). Structural-analysis and causal/functional analysis model types are less dynamic than process/behavioral analysis model types.

In DIGs, structural-analysis model types and causal/functional model types might support more static or less dynamic puzzle-like or mystery type of games where the player is working to construct or discover the relationships in the model. Structural-analysis model types and causal/functional model types might well however be incorporated into DIGs in tandem with other more dynamic models for more dynamic game-play. The model that articulates the challenge and goals for a DIG, for example, might be a dynamic agent-based model from which the player needs to deduce the relationships of the elements/agents within some structural-analysis or causal/functional model type. In this case, intermediate representations would likely be very helpful for payers in translating between the different formal representations. While these examples for suggest that the overarching genre of DIGs might indeed be generalizable for structural-analysis model types and causal/functional model types, however, the DIG genre outlined in this paper seem most generalizable across behavioral/process analysis model types.
Final Thoughts: Generalizability of Genre

We therefore propose that disciplinary integration of digital games provide a generalizable genre that holds promise as a vehicle for engaging students with key model types and modeling strategies that cross multiple disciplines and respond to calls for greater emphasis on problem-solving, 21st century skills, and engaging students in the practices of disciplines to develop deeper understanding. We now close the paper by considering the implications of this proposed generalizability in terms of the propagation of digital learning games across the curriculum and the conceptual development of students within this integrated curriculum.

Up to now, developing digital games for learning in multiple disciplines at an economically feasible budget has often devolved into simple forms of gamification (i.e., simply layering points and badges over mechanics that are not themselves game-like). Developing a game where core disciplinary ideas drive game-mechanics, on the other hand, has proven time-intensive and cost-intensive. This, in turn, has created a barrier to the systematic integration of digital games as a medium across the curriculum. A potential advantage of the generalizability of the DIG template proposed in this chapter is that once a DIG template is honed and refined through iterative cycles of design and research, then other games can be developed building on the conceptual, design, functional, and software foundations of that DIG template to create other DIGs in other disciplines that focus on the same epistemic forms and games. This could therefore create important economies of scale in terms of development time and cost.

Even more importantly, this generalizability has critical implications in terms of the development of students across the curriculum and integration across the curriculum. Much research on digital environments in the classroom focus at the level of the activity rather than the level of the longer-term curriculum because of the limitations of development of technology. However, the conceptualization of DIGs as multiple representational systems lends itself well to thinking about the connections between the curricula beyond DIGs in terms of the epistemic and representational forms therein, which we describe next.

The “science as practice” perspective is rooted in the long-term production of scientific knowledge through the long-term development of epistemic and representational practices. However, in a K12 science classroom, students typically have to learn several different domains during the same academic year, thereby minimizing opportunities of meaningful, long-term engagement within a single curricular unit. However, by considering the epistemic and representational forms within each unit, a few DIGs could be interspersed throughout the academic year with the goal to meaningfully connect across the preceding and succeeding curricular units. Within a DIG, the multiple representational systems can be designed in a manner that learners being with a familiar representational form, develop intermediate abstractions, and then generate new representational forms that are not only canonically more sophisticated, but can also provide become representational forms that are used in the succeeding curricular unit.

In its strongest form, therefore, DIGs can help us conceptualize the year-long science curriculum as a careful assembly of curricular units, arranged in terms of meaningful connections between epistemic and representational forms, help us design DIGs that can create a meaningful coherence across these units. From the perspective of student learning, it shifts the focus from thinking about learning within a game – i.e., a short-term focus on learning – to the development of epistemic and representational practices that are central to the long-term development of scientific expertise in an authentic manner, i.e., in a manner that is representative of the professional practice of scientists.

Acknowledgements

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References


Play-making: Games and the Quest for Agency

Bob Coulter, Missouri Botanical Garden

Abstract: This paper argues that game play and the design of games offers a window into youth agency, defined here as the use of competence, strategy, and awareness. Analysis of game experiences in light of classical (Aristotelian) and progressive (Deweyan) learning goals illuminates design principles that can support the development of agency in contexts beyond games. A key factor is the role of making that occurs within games but is often absent in other learning environments. A three part model articulates aspects of making that occur within game spaces: (1) creation of original games or modifications of existing games, (2) construction of tacit mini-theories used within game play, and (3) development, application, and modification of transcendent artifacts used within game play. Each of these ‘making’ processes allows kids to exercise agency, and thus be active participants in the game space — an identity well worth nurturing for other parts of kids’ lives.

Play has long been a characteristic of childhood, as illustrated in artwork such as Bruegel’s painting *Children’s Play* and as documented in sociological research (Sutton-Smith, 2001). In fact, many educators consider play to be the work of childhood (Paley, 2005), as young people develop a range of social and intellectual capacities through play, which together contribute to the development of agency. While there are academic debates about just what constitutes agency, Valentine’s definition (2011, p. 347) is sufficient for our purposes. She argues that “children demonstrate their agency through competence, strategy, and awareness, and [this] agency entitles them to greater participation and more rights.” This framing of agency aligns particularly well with games, since competence, strategy, and awareness are foundational elements of game play. To support this, there is a range of research implicitly linking games and agency. Work in this regard includes research by Barab and colleagues (2010) articulating the value of consequential choices in game settings, Gee’s (2007) learning principles that focus on the developmental value of active and critical engagement within games, and Squire’s (2011) delineation of games as participatory, identity-building experiences. The model offered here attempts to make the game-agency link more explicit and comprehensive.

Consistent across these research agendas is the premise of games being situated learning environments that scaffold complex thinking (Putnam and Borko, 2000). More specifically, good game designs embody Dewey’s (1938/1997) philosophy of experience as they promote continuity from previous experience into new ventures, interaction with the game space and with each other, a deeply felt sense of purpose, and a progressive unfolding of more complex experience over time. Dewey developed these markers nearly 80 years ago as a critique of mainstream schools. Sadly, they remain ideals more sought after than achieved in today’s highly prescriptive schools. Under increasing pressures for test-driven accountability (Ravitch, 2010), many schools focus on accumulating factual knowledge and skills out of context, in pursuit of tasks which neither the student nor the teacher values. The result is an environment that operates on a “wastebasket economy” (Rheingold and Seaman, 2013), with many assignments completed simply to be graded and thrown away. Without a catalyst toward something better, these schools devolve to a robotic framework in which neither teachers nor students find value in their work (Coulter, 2014). If instead we are to develop agency in young people, we need to create Dewey-inspired environments built to foster meaningful experience. Within that bed of experience, we also need to heed Aristotle (1997) and work toward a more productive balance of knowledge (episteme), skill (techne), and practical wisdom (phronesis). When this happens, we can achieve eudaimonia, or a flourishing that is reflected in our personal growth and vitality, and in our ability to serve the public good.

These ideas of flourishing within rich experiences come together to inform the design of comprehensive game-focused experiences such as the Quest to Learn charter school in New York City (Salen, Tekenbas, et al., 2010), as well as in a host of smaller game camps and after-school programs (Coulter, et al., 2012; Martin, 2011). In any of these game-infused spaces, youth demonstrate the competence, awareness, and strategy that Valentine argues are the cornerstones of agency. Unfortunately, these opportunities can be hard to come by. Even when they are not in class, most kids find themselves in spaces that are highly structured by adults, whether it be during recess or in an after-school program, or even in a sports league where all of the choices are made by the adult coaches and referees. Compounding the challenge, fear of danger leads to restrictions being imposed on where kids can go and what they can do. Freely chosen and structured play — the work of childhood — is increasingly a rarity as kids are shuttled from one planned and sheltered space to the next. As a result, kids fit play in where they can. Wyness (2015), building on Oswell’s (2013) conception of ‘tactical agency’ captures the situation rather astutely. As Wyness (p. 23) notes, tactical agency involves “children using interstitial spaces, often hidden, and often in creative ways that temporarily subvert structures dominated by adults.”
To draw a clearer contrast in how schools and games typically support agency, consider the affordances of each relative to the four key parameters that make up Dewey’s (1938/1997) philosophy of experience (Table 1).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>School</th>
<th>Games</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Continuity</strong>: Ideas and concepts flow naturally across multiple strands of work.</td>
<td>Discrete units with sharp breaks in focus (e.g. an ecology unit followed by electricity).</td>
<td>Play within and across game genres allows transfer of skills and strategies.</td>
</tr>
<tr>
<td><strong>Interaction</strong>: Opportunities to work collaboratively with others and with rich materials.</td>
<td>Materials tend to be minimal; interpersonal interaction largely prohibited.</td>
<td>Immersion in a game environment; interpersonal rivalry and sharing of strategies.</td>
</tr>
<tr>
<td><strong>Sense of Purpose</strong>: Goals authentically felt by the learner.</td>
<td>Assigned work. Goal is a good grade.</td>
<td>Pursuing a quest or defined win state.</td>
</tr>
<tr>
<td><strong>Progressive Unfolding of Experience</strong>: Increasing complexity over time.</td>
<td>For content, occurs cyclically in a spiral curriculum; skills are practiced periodically over time.</td>
<td>Leveling up within a game leads to more complex levels.</td>
</tr>
</tbody>
</table>

Table 1.

While each situation has its nuances, there is a clear distinction to be drawn in terms of the agency of a student and that of a player. Self Determination Theory, a psychological construct supported by an extensive research base (Deci and Ryan, 2002), articulates the importance of people of all ages being able to exercise control over their lives. If we can assume therefore that kids intrinsically want to achieve some degree of agency, and the dominant structures in their lives don’t allow it, we shouldn’t be surprised to see them seek out the interstitial spaces for agency described by Oswell and Wyness that were noted previously. Play is healthy; apparent ‘game obsessions’ may well be an effort to feed a need for agency that players aren’t getting in more experientially sterile parts of their lives.

Even within a rich environment, however, we need to pay attention to how a person acts to leverage what is available. Space limits preclude in-depth analysis, but there is a clear distinction between how a student approaches tasks in a typical school assignment and in a well-designed game context. In school, the goal is to fulfill an assignment set by others (most often using pre-determined formulas and procedures), whereas a game space rewards the critical and creative thinking Gee (2007) articulates, and it builds on the consequential choices described by Barab and colleagues (2010). Framed within an Aristotelian context, knowledge, skills, and wisdom serve very different functions in the two environments (Table 2).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>School</th>
<th>Games</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Knowledge (episteme)</strong></td>
<td>Paramount, in response to concerns for ‘coverage’ of a wide range of curriculum concepts.</td>
<td>Accumulated as needed: applied toward achieving game-related goals.</td>
</tr>
<tr>
<td><strong>Skill (techne)</strong></td>
<td>Often practiced as discrete processes out of context.</td>
<td>Practiced iteratively to achieve goals embedded within the game.</td>
</tr>
<tr>
<td><strong>Practical Wisdom (phronesis)</strong></td>
<td>Largely not recognized in highly structured curricula, learning tasks, and assessments.</td>
<td>Developed over time through practice and collaboration with peers.</td>
</tr>
</tbody>
</table>

Table 2.

Stitching these pieces together, we can see that agency requires both a conducive environment and the ability to act productively within that environment. Dewey and Aristotle sketch some of the essentials for us, but we need more definition if we are to act on this premise. Games and game-like experiences show that it is possible for kids to exercise agency (even if it needs to be done furtively at times), but it doesn’t just happen spontaneously. Rather, I will argue, agency emerges through the ‘making’ tasks that are embedded within the games.
Play-making: An Agenda for Action

Building and creating allows people to move past the ennui of the wastebasket economy by employing competence, strategy, and awareness toward valued ends. In this sense, games align well with the maker movement, an emerging field focusing on the value of crafting artifacts (Hatch, 2013). While there are well-placed critiques of certain aspects of the maker movement, such as its perceived gender and racial biases (Chachra, 2015), the underlying ideal of creating rather than consuming as a path toward learning is well supported by constructionist learning theory (Harel and Papert, 1991; Kafai and Resnick, 1996). Scholarship within the maker movement has identified specific benefits of making that also apply as good game practices, and by extension, as fruitful opportunities to foster agency in other pursuits — including school. Opportunities to ‘make’ as it will be described here would counteract many of the limitations of traditional schooling described earlier.

One useful framework for making has been offered by Thomas (2014), who argues that makers employ a range of character attributes including curiosity, playfulness, risk-taking, responsibility, persistence, resourcefulness, generosity, and optimism. Each of these, of course, has substantial overlap with committed gaming, while at the same time frequently being undervalued in a school context. For example, risk-taking is essential in a game, but hard to do in a high-stakes testing environment. Being collaborative or resourceful in school is often known as cheating. In a complimentary body of research, Halverson and Sheridan (2014) show how a productive maker space supports makers in the process of making. The balance of this paper offers a model illustrating the ways in which ‘makers making in a maker space’ overlaps with ‘gamers gaming in a game space.’ In both, there is a process of creation taking place, with a strong potential to nurture the development of agency. While the design of games offers the closest link to making, there is also great potential for making to occur within the play of existing games.

To illustrate this synergy between making and gaming, a three part ‘play-making’ model is offered, based on the author’s phronetic (Kinsella and Pitman, 2012) and autoethnographic (Denzin, 2014) research agenda. This body of work reflects more than a decade of experience with game design camps and nearly 20 years of leading a regional gaming competition. In brief, the model defines three domains of play-making in the context of gaming:

1. Creation of lasting artifacts such as games or modifications of existing games
2. Creation of transitory resources such as drawings needed within game play
3. Creation of tacit formulations or mini-theories as part of the game play.

In each of these domains, strategies are developed, enacted, and revised. Throughout, there is an ongoing process of creation, evaluation, and rethinking that guides a player’s choices and that nurtures increasing levels of agency. To illustrate how this happens, consider these vignettes from the life of a nine-year-old:

Max is working diligently at a summer game design camp to refine his creation, drawing on peer feedback to add features which fine tune the level of challenge. Through iterative adjustments like this, he gets closer to his ideal game. Even though this is just his first game camp, he has developed facility with Star Logo Nova (Scheller Teacher Education Program, 2014) and is increasingly seeing himself as a builder. This identity grows each day as he integrates ideas gleaned from other games he has played and from suggestions made by peers who test his game. He also absorbs ideas by talking with peers about games they are developing and by making effective use of the camp director, who provides Max with ‘more able assistance’ (Luckin, 2010).

Max’s gaming life also extends to formal and informal play opportunities. This is most visible in his participation in a dice-based math game, which is the focal point of a regional competition involving a thousand youth ages 8-13 each year. The game – a variant of Equations (Wff n’ Proof, 1963) – involves 20 cubes with numbers and operations on the cube faces. After rolling the cubes, the goal-setter creates a goal using up to five of the cubes. For example, placing 7 x 4 on the board would make the goal of 28. At this point there are 17 of the 20 cubes remaining. The other players take turns requiring, forbidding, or permitting a cube. Each player’s intent is to work toward the goal but not to allow the goal to be reached on the very next play. Also, the one placing a cube needs to avoid making it impossible to ever reach the goal. Most often, this happens by forbidding an essential cube. If a player commits either of these “flubs,” another player is likely to issue a challenge, which needs to be considered by the other players. Scoring rewards the one who correctly challenges another player. While playing, Max engages in a making process as he constructs and reconstructures possible equations that reach the goal. He needs to accommodate any cubes that another player has required, and quickly re-build his solution if a cube he was
counting on has been forbidden. From a maker point of view, he is constructing a series of
transient artifacts in the form of written equations. While these equations have no useful life once
a challenge has been resolved, they are very much a valued creation in the moment.

Finally, Max enjoys testing new games. One he was asked to provide feedback on was created
by the author as a participant in a course on game design. Players take turns rolling a 12-sided
die and progressing that number of spaces along a 1-100 grid. On each turn, the player can stop,
or continue rolling. If the subsequent roll is higher than the last, the scores combine. If not, there
is no score for that round and play moves to the next player. Throughout the game, Max needs
to create, consider, and act on mini-theories that draw on his understanding of probability and his
position within the game (“We’re getting to the end…Do I take a bigger risk to catch up with the
others?”) From the beginning he needs to balance his own tolerance for risk with the potential
reward. These mini-theories are almost always entirely tacit, but they are no less constructions –
one that grow and change as he gains experience, confidence, and insight.

These experiences and others like them enable game players to realize the benefits Thomas (2014) ascribes to the
making process. Drawing from the vignettes, we see how play-making supports the development of competence,
strategy, and awareness – the hallmarks of agency:

Curiosity: Each of the game spaces just described fosters curiosity as designers and players construct and modify
artifacts and ideas that give them the greatest advantage. In each iteration of the game, players try to discern
subtle nuances, which can be exploited to improve outcomes the next time around.

Playfulness: In each of the games there is an element of playfulness that goes with seeing how different
combinations come together. Players and designers need to consider multiple options, imagine potential outcomes,
make choices (sometimes with great trepidation!), and evaluate the outcome with an eye toward more successful
play in the next round.

Risk: Each of the games just described offers an element of risk. Designers have to think of ways to embed risks
that make the game challenging. In Equations, for example, the scoring reflects a risk/reward structure, as the
one who is the first to issue a challenge scores better. But, there is a risk involved, since there is no opportunity to
retract a challenge made too hastily. Hence the need to have equations crafted and ready to support a challenge.
In the 1-100 game, there is risk embedded in each choice to re-roll the die or settle for the points already earned.

Responsibility: Games enforce responsibility through consequential choices (Barab et al., 2010). In the vignettes
just cited, Max needed to accept responsibility for choices in his design features, the equations he constructed,
and (while playing the 1-100 game) in his choice on each turn to keep the points or re-roll the cube.

Persistence: None of these game processes is easy or automatic. If they were, the game would lose players’
interest. Rather, design challenges need to be overcome, and players need to work to develop new skills and
strategies, and to bounce back from disappointment when a construction proves to be inadequate.

Resourcefulness: Learning from peers, investigating related games, and drawing on “more able assistance”
(Luckin, 2010) all help in developing a repertoire of resources to improve participants’ ability to design and play
games.

Generosity: A sense of generosity is part of the community ethic instilled in each of the game spaces illustrated in
the vignette, whether it be through sharing design tips and math strategies, or simply by commiserating when a
score is lost to a bad roll of the die.

Optimism: A good game space nurtures the expectation that continuing efforts will pay off in improved play. This
expectation nurtures a ‘growth’ (as opposed to a ‘fixed’) mindset that Dweck and colleagues (2000) have shown
to be educationally valuable.

Play-making Beyond Games

We need to build on Gee’s (2007) call not simply to employ games for learning but rather to utilize what we
know about games to create better learning environments. The model presented here has value in doing just
this. It’s clear that making – in all of its manifestations – is a foundational element within a good game space.
It’s equally clear that this making contributes to the agency that is necessary to secure greater participation in
the world. Taking on this agent role as a creator and problem solver promotes what Aristotle (1976) describes as *eudaemonia*, or a flourishing in life that enables people to contribute to a healthier community and develop the self. This won’t happen if the work of childhood continues to focus on accumulating factual knowledge and skills out of context, and robotically following scripts set for them. Rather, we need to follow Aristotle and work toward a more productive balance of knowledge (*episteme*), skill (*techne*), and practical wisdom (*phronesis*). Real-world problems (and effective game play) require all three. Can school tasks and other childhood experiences be designed to do the same? Looking at the learning space from a Deweyan perspective, environments marked by continuity, interaction, purpose, and a progressive unfolding of experience are perfect for nurturing the competence, strategy, and awareness Valentine (2011) describes as hallmarks of agency.

Charting a path toward agency, Princen (2011, p. 175) offers criteria we can use as benchmarks for successful play-making, within games and beyond. He argues that people are at their best when:

1. They are faced with a genuine challenge;
2. They are creative and productive;
3. They find meaning in their own problem solving and in acts larger than themselves;
4. They help themselves and help others;
5. They self-organize and self-govern; and
6. They feel that they are getting a fair shot at the benefits of their work.

Framed more poetically, Wendell Berry (2011, p. 97) captures this dynamic of an active, puzzling-out problem solver: "It may be that when we no longer know what to do we have come to our real work, and that when we no longer know which way to go we have come to our real journey. The mind that is not baffled is not employed." We know that kids can do more than simply be passive recipients of what others give them. In school or out, it’s the making and remaking that promotes the agency needed to flourish in life. Games are a great medium for pointing the way forward.

**References**


Metafiction in Videogames

James Earl Cox III, University of Southern California

Abstract: There have been doubts about the existence of metafiction within videogames. It may be related to the paucity of research that grounds metafiction as a game relevant term. This discourse will briefly define what metafiction is and explore the existence of metafiction within fiction. In doing so, it will separate metafiction in videogames from credits and in-game instructions. A description of four types of metafiction in videogames (emergent metafiction: fiction that reveals itself to the player, immersive: fiction that brings the player into the fiction, internal: character-to-character, and external: designer-to-player) is discussed. Ultimately, the implication of metafiction in videogames is illuminated, and its potential impact on the future of game design summarized.

What Metafiction Means

Metafiction within literature, while many people may be unaware of the term itself or its use within writing, is an accepted convention. It appears that there has yet to be a single definition for what metafiction is and its role within writing, yet it can be generally said that authors and writers acknowledge its presence such as explored in Waugh, 1984 and Currie, 1995. For the sake of metafiction within videogames, our operating definition: “Metafiction is fiction that points out its own fictionality.” In other words, fiction that is self-aware. This definition deviates from other interpretations, which can be excessively inclusive. A good example is the inclusion of internal metafiction: the belief that fiction within fiction is metafiction. Such as a book written about a character writing a book, or a reader reading a book. While these works may exhibit a few of the traits found in metafictional pieces, this cannot be not included within the category of metafiction because the fiction in question never admits its own fictionality. On the other hand, an important term that is associated with metafiction is ‘the fourth wall’ or more specifically, ‘breaking of the fourth wall.’ This term comes from Greek plays where various characters might speak to the audience directly, to provide them with opinions or to refresh plot points. As a stage has three walls, the audience provides the fourth wall, and admitting the fictionality of the play by actors talking to the audience breaks the unstated barrier between them. This action is essentially metafiction.

Defining Metafiction for Videogames

Within our working definition of metafiction, 25 game encounters are included in this examination of metafiction. Much like metafiction in writing or in film, metafiction in videogames is self-admitting fiction: a metafictional videogame will bend the fourth-wall, testing the boundaries of Huizinga’s magic circle, without breaking the fiction. There needs to be some clarity though about what qualifies as metafiction in videogames, to separate it from metagaming and to define it within the boundaries of videogames.

First, metafiction in videogames must be fiction. Much like how we don’t count the opening credits to a movie as metafiction or the publisher’s information to a book as metafiction, we should not classify the menu screen and pause menu as metafictional encounters in videogames. Likewise, we should not claim that tutorials and in-game instructions are metafictional. While these instances do closely resemble metafiction, and some may actually breach the boundaries of metafiction, simply being provided in-game instructions does not make an in-game encounter metafictional in nature. To support this, we must examine the purpose of these encounters. When reading a book, or watching a movie, there are a number of conventions one must first grasp to fully understand the narrative and structure of the artifact: to read a book, you first must understand the language in which it is written, and you must understand the organizational structure of the writing. The majority of written fiction does not include instruction manuals on grammar and vocabulary within their pages because readers have already learned the accepted conventions for story reading. This same analogy applies to movies. All movies take advantage of conventions that the audience has learned to expect and understand how to interpret. As an example, many movies make use of time skips, saving the viewer from dull car rides, meals, and bathroom breaks. The passage of time is implied. Yet when we come to videogames, an interesting anomaly occurs concerning the unique changing conventions of games. While many games make use of similar control schemes for movement, most videogames use the keyboard and controller buttons for different purposes, and therefore include in-game instructions to define the purpose of the buttons. Such instructions are not metafiction but rather a product of a medium with constantly changing conventions.

While videogames do have an active player role in the fictionality of the game, movies and written stories have a level of interactivity as well. Movies, being the most passive of the three mediums, requires an audience member’s attention to exist: the story will continue to play out on screen regardless of if the audience is watching or not, but
for the medium to be internalized by the audience, it must be watched. Therefore, there is a required level of participation for the story to exist. For written fiction, the participation takes on a different role. A story in written form will cease playing as soon as the reader, or audience, stops reading the story. This is much like how a videogame stops when paused. Yet, in a written story, all the imagery, while some may be suggested by way of cover art, is formed with in the audience’s mind. Videogames may have more freedom of control and maneuverability, but written stories are in fact extremely freer in terms of images and appearances. Written stories are extremely interactive. While videogames do have a level of player control over the narrative, so do movies and written stories.

As a final note on defining metafiction in videogames, there is a difference between metafictional videogames and metagaming. While metafiction retains the definition stated above, metagaming is utilizing outside knowledge to influence in-game decisions. For example, if before playing a game, Player A knows that Player B is aggressively offensive, yet is poor at managing defense, Player A may use this prior knowledge to his advantage to win the game.

The Four Types of Metafictional Encounters in Videogames

Defining metafiction within videogames narrows us down to actual metafictional encounters. While collecting the 25 examples, four types of metafictional video game became clear: that of emergent, immersive, internal, and external (see Figure 1). These categories also act like a sliding scale, as encounters that exhibit metafictional tendencies overlap to varying degrees.

<table>
<thead>
<tr>
<th>Type of Metafiction</th>
<th>Key Attribute</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergent: Em</td>
<td>Fiction Revealed</td>
<td>Character breaches 4th wall</td>
</tr>
<tr>
<td>Immersive: Im</td>
<td>Player Immersed</td>
<td>Incorporates player into fictional world</td>
</tr>
<tr>
<td>Internal: Int</td>
<td>Character-to-Character</td>
<td>Situational irony</td>
</tr>
<tr>
<td>External: Ext</td>
<td>Designer-to-Player</td>
<td>Cameo Appearance of Developer</td>
</tr>
</tbody>
</table>

Figure 1: Metafiction types.

Emergent Metafiction

Emergent metafictional is seen in encounters where the game admits its own fictionality to the player. An example would be if a character were to address the player with “welcome to our game, player! I hope you enjoy your stay.” It is an in-game breach of the fictional world to reach out to the player. Menu screens and in-game tutorials do not count as this type of metafiction, nor metafiction of any type; the differences will be explained after this section on the four types.

Immersive Metafiction

Immersive metafiction incorporates the player, more or less in their role as player, into the fictional world. An example would be a game where the player is viewed as a god presiding over a population of NPCs who are aware of the player’s ability to turn off and on their world with the flip of a power switch. This type of metafictional encounter makes use of the player’s position and relationship to the game to bring them into the narrative and incorporate their unique position as part of the fiction.

Internal Metafiction

The third type of metafictional encounter is internal, or character-to-character, metafiction. An example would be an in-game scenario where one character says to another “Ever feel like we’re just bad guy NPCs in a game, waiting for a hero to show up and just slay us?” In of itself, this type of metafictional encounter is self-contained. While it does address the fictionality of the game world, it is different from the other three, as it never fully breaches the fourth wall, but more simply alludes to it. This type of metafictional encounter is the most used for situational irony.

External Metafiction

The fourth type of metafiction is external. The word ‘external’ may be a tad deceiving, as the metafiction does exist within the game. Rather, it is the message being conveyed that is external. It is usually a message from the developer, or any member of the production end, directed to the player. An example would be if the player stumbles into a room in game and comes across some graffiti spelling out “Thanks for playing! –Dev. Team.” The information, while it exists within the game’s world, is often not acknowledged by in-game characters and acts as a secret message. Most Easter Eggs in games are of this type. External metafiction is also most likely to be confused with
Data Collection

The cataloging system used to collect data on these metafictional encounters was surveymonkey.com. Surveymonkey was chosen because of the easy access to collect and examine data regardless of computer or location. To be clear, the author identified and recorded all games included in this study. The games were not collected through the online survey rather the site was simply used for its accessibility and download capabilities. Initially, basic game information was collected, such as the games titles, dates released, and ESRB rating. Then using Grace’s Game Type and Game Genre, both game type and genre were collected for all 25 examples (see Figure 2). After gathering these general data, more specific data related to metafictional encounters of each game were collected, including a general time each encounter lasted, the specific encounter time, the nature of the encounter (out of the four types stated in the previous section) and a transcript of the encounter or a description if there were no in-game words exchanged.

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<thead>
<tr>
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<th>Release Date</th>
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<td>Max Payne</td>
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<td>X X</td>
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<tr>
<td>Jak 3</td>
<td>Nov 9, 2004</td>
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</table>

Figure 2: Examples.

Implications for Videogames and Conclusions

On collection and examination of 25 examples of metafiction in games amenable to categorization through a classification system of metafictional encounters, it is safe to say that metafiction does exist within games. The implications of its existence in videogames are significant in that it underpins the realization that videogames can, and often do, tell stories. Metafiction can only exist within mediums that tell stories as metafiction is fiction that is self-conscious of its own fictionality. Not all games tell stories, but many do. Although the player is needed in the right time and location in game for a metafictional encounter to occur, only games that have metafiction within them beforehand can harbor metafiction to be discovered. This means that, although the player does have a hand in shaping the story of the game by participating, the player has no control over the precept whether a game’s story is metafictional or not; it reveals an instance of players limited control and that players cannot create it themselves.

The implications of metafiction existing in videogames portend a significant impact on the future of videogames. Additional research may elucidate the potential for deepening stories, and increasing player immersion within the game. The acceptance of metafiction within a game, the ability of a game to acknowledge its own fictionality (its own ersatz) while still remaining within the bounds of acceptable play, and not violating the player’s trust, could be used to draw players in and facilitate smoother game functionally. There is the possibility to phase out menu screens and tutorials and, in their place, use immersive metafiction to transform these previously breaching paus-
es and disillusions into streamlined immersive gameplay.

References


A Playful Class:  
Case-study Analysis of Gamified Course Design  
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Amira Alkhawajah, Ohio University  
Chris Hawks, Ohio University

Abstract: Recently researchers of ‘gamified’ or ‘badgified’ classrooms are documenting promising increases in motivation and engagement using vocabulary swapping (Leach et. al, 2014), leaderboards (DeShutter & Abeele, 2014), and formative recognition strategies (Augilar, Homan & Fishman, 2013), yet these efforts retain core pedagogical designs of the traditional classroom. Gaming media leverages elements still foreign to classroom settings; like ‘questing’, ‘adapting play-style’, ‘voluntary competition’, ‘repeatable content’, ‘strategy guides’, and ‘cheats’. How much more can engagement be amplified by embedding these features as pedagogical changes to traditional course designs? We present qualitative design-based research and supporting evidence from one course iteration. Participants reported increased motivation and engagement supported by time on task data, ‘help desk’ data, and an increase in average task completion to 66.2 per student. We conclude game-like elements further increase student motivation, engagement, and investment of time on course tasks.

Introduction

Much work has already been done that shows the potential of digital media for learning. We review some of the seminal work along with efforts to bring playful design considerations to formal classroom learning spaces. Though an often contentious term, ‘gamification’ represents educators’ efforts to take advantage of vocabulary, techniques, and tropes from popular gaming and digital media formats. If popular digital media effectively and consistently engages and motivates rigorous time on task and learning, it stands to reason that gamification of a course, when designed well, will likewise increase student interest and performance.

Classroom integration efforts are still in their infancy and documented efforts are starting with shifts to game-like vocabulary; where designers claim they communicate better with students and create language that resonates (Sheldon, 2012). Researchers also claim these changes, though simple, produce remarkable results including significant increase in attendance, participation, motivation, and engagement (Leach, et. al., 2014) - just by using game-like language. Building on past research, we designed and delivered three graduate level courses at a midwestern university testing popular game mechanics used as the central pedagogical approach and course design. We want to determine if the results are further amplified if a course is designed to ‘play’ like a game, not just sound like one.

This study describes the second of three courses in which we include six aspects of game design that we value from our own gaming experiences. We designed to include: ‘quest selection’, ‘adjusting play-style’, ‘voluntary competition’, ‘repeatable content’, ‘help desk’, and ‘expansion packs’ as core delivery instruments for the course. We use qualitative interviews, journaling, and supporting outcome data from the course to document the design process, goals, delivery of the course, and future considerations for designing a game-like classroom. Our findings document moderate fidelity between design intention and user experience, positive student perception of the course, increased time on task and task completion, student achievement exceeding past iterations of the course. We conclude that investing time to use design strategies from gaming media, even in preliminary efforts, can create incomparable learning experiences that warrant educator attention, research, and further case study and design iterations.

Literature Review

Widespread delivery of digital media, and increasing proficiency communicating in virtual worlds, can be treated as a form of literacy (Lankshear & Knobel, 2008). Among youth, converging technology and mobile devices serve to amplify interests, communications, and information access (Squire & Dikkers, 2012). Further, research indicates the potential of digital media and virtual worlds for leveraging engagement and motivation into measurable literacies (Steinkuehler & Duncan, 2008). Broadly speaking, increasing access and dedication to digital learning experiences is growing, but the classroom is not necessarily central to this conversation. Further we were informed by past research we have done exploring how exemplary teachers learn and adopt new technologies for the classroom (Dikkers, 2015) to inform our own practices. These teachers notably listened to their students, experimented, and measured their practice by student engagement and motivation.
What if a playful experience could be intentionally designed for classroom pedagogical implementation? Obviously, simply adding badges or awards to a task, does not turn that task into a playful experience, nor meet the criteria of ‘playful’ we are interested in pursuing. Instead, we are concerned with an intentionally designed experience that uses core motivational elements from mainstream game design. The most prominent examples of playful design have been the Quest to Learn (Q2L) school in New York (Salen, Torres, Wolozin, Rufo-Tepper, & Shapiro, 2011) and the Khan Academy (Light & Pierson, 2014). Using playful design for university courses, therefore, is an ongoing effort to explore the edges of information and computing technology (ICT) in learning.

Further, we follow a course charted by Lee Sheldon’s (2012) reporting of his Multiplayer Classroom designs to alter grading systems, assignment of work, and the role of identity (or avatar) for his face to face undergraduate course. Aguilar, Holman, and Fishman (2013), for instance, recently recorded positive student perceptions (N=473) of the grading system after only renaming exams and essays (‘boss battles’), and grades (experience points), and offered moderate assignment choices (students picked 2 of 4 assignments). Leaderboards have also been shown to be a net positive feature of gameful course design (DeShutter & Abeele, 2014). Further, in a randomized control trial, Leach, et al (2014), interestingly left course lessons and assignments untouched, to isolate the effect of ‘vocabulary shifting’ alone. This is a ‘worst case’ for gamification critics (not essentially redesigning the experience); yet they found earlier turned in work (averaging 1.3 days earlier), increased visits to the site, and voluntary ‘vocabulary shifting’ alone. This is a ‘worst case’ for gamification critics (not essentially redesigning the experience); yet they found earlier turned in work (averaging 1.3 days earlier), increased visits to the site, and voluntary online discussion including 47 threads (220 replies). These examples are easily applicable to course design and establish moderate foundational data supporting cosmetic changes to otherwise traditional classes.

Building on this work, this study seeks to move forward with classroom design using a growing understanding of emergent digitally mediated learning practices (Ito, 2010; Lankshear & Knobel, 2008; Dikkers, 2015), while testing more playful differentiation, pacing, and student interaction around relevant problem-based challenges. Particularly, game design seeks to create spaces where every element supports a central design goal (Shell, 2008), not just use of new terms. Finally, we intended to deploy an example of playful online course design that could be reasonably replicated by any instructor across many content areas. We then identify if learner perception and activity were positively associated with the course design:

- Do adult learners perceive increased motivation and engagement with course content because of game-like design elements?
- Does a gamefully designed course increase learner time on task, number of tasks taken on, pacing of work, and the difficulty of work performed?

**Context and Course Design**

Previous to this study, we had completed one course that replicated vocabulary and design elements used in earlier studies (above). This pilot served as an undocumented learning pilot for us and guided the selection of our target design features. We also considered our own experience with games and selected six gameful elements: ‘quest selection’, ‘adjusting play-style’, ‘voluntary competition’, ‘repeatable content’, ‘help desk’, and ‘expansion packs’; each of which could be cultivated with changes to the delivery of content, reconsidering student-teacher relationships, and timely responsiveness. We purposefully designed a framework for course design that includes:

- **Quest selection and adjusting play style.** The traditional syllabus for the course included 12 weekly readings with reflection papers, a midterm test, and a final test (14 tasks). The new design included 73 different tasks (quests) and a final ‘quest log’ to be shaped by the learner around course objectives. Quests ranged from 30 minutes to 4 hours per quest (based on student self reporting). This allowed for authentic learner ‘quest selection’, self-adjustment to their ‘play-style’ to accept quests that fit their interests or schedule. Choice was intended to increase agency. Also, learner options allowed us to include more time consuming high-level activities that we would never require from all students; like full text readings, travel to conferences, and/or full software designs.

- **Voluntary competition and repeatable content.** Building on game design principles (Schell, 2008), we intentionally detached weekly, playful, activity from summative grading practices, and we included repeatable activities and a voluntary leaderboard (opt in). We expected complex activities to be infinitely replayable with minor changes, including visual design projects, reports, action research, travel, interviews, programming, and reading content area research materials. This essentially meant that only the final quest log was required work and we clarified an expectation that every student had ‘production’ toward the course objectives each week, without directing what exactly that work would look like. They could direct their own ‘play style’.

- **The help desk.** Based on earlier research supporting online design (Barab, MaKinster, & Scheckler, 2003), we planned for having a fast, easy, and private way for individual students to get help using digital tools by
setting up a ‘help desk’. Access was open to e-mail, phone, chat, and/or video conferencing as soon as we could get back to students. We documented each ‘call’ in and the nature of the call and replied to all inquiries within 24 hours. This could be considered renaming for “office hours”, yet with a wider range of communication tools and no time limits.

■ The expansion pack. Often mainstream games will release a ‘full’ game and later release supporting content for the game in the form of an ‘expansion packs’. In course design, we considered the possibility that if learners engaged with the content like a game, they could increase work time and actually complete all 14 tasks from the course. We increased course activities from 12 to 73 for expanded choices, but still only required one project per week. In addition, we did ask “What if we had students that completely geeked out and finished all 73 tasks? We might need an expansion pack!” Yet we did not consider this more than a hypothetical situation.

Overall, course delivery included presentation of the ‘game’ of class largely being a chance to explore the field by selecting at least one quest per week and being ready to share their ‘adventures’ in class each week. Class time was then consumed by learner presentations of their adventures each week. All lecture content was woven into reactions to student ‘quests’, also it could be requested, shared via email, or found in the course folders. The final two weeks of the course were set aside for preparation of the ‘Quest Log’, or portfolio that would include their documentation and narrative. Their individual quests were designed to help with the final quest, however learners had to organize, analyze, evaluate, and relate their activity accordingly to show they had met the course objectives. As they turned in each quest, they would be graded as ‘done’ or ‘needs work’ toward inclusion in the end of semester portfolio. Also, work was given experience, or “XP points”, that students could accumulate. These had no connection to their grade or final portfolio, and we explained them to be purely for entertainment.

The masters level course itself included adult learners (n=24) at a mid-sized midwestern university. The course covered technology applications for education and had five objectives including the use of technology for communication and collaboration, organization and management, increasing learner performance, evaluation, and lifetime learning. Students were made aware of the experimental nature of the course on the first day of class.

Methods

We treated the implementation as part of a longer sequence of design-based research iterations (Barab & Squire, 2004; Laurel, 2003) not to draw generalizable conclusions, but to clearly identify design elements, share design features, and report local reaction to those changes. Each week the research team met and discussed ongoing student (n=24) activity, recorded observations, reviewed learner activity as recorded by the learning management system (3D GameLab) and notes, and finally, we made adjustments throughout the course based on student reaction and suggestions. During the course, we documented informal user feedback, ‘player’ reactions, and anecdotal support that the design elements were or were not supporting intended experiences. As researchers and designers, this method ties us into the work at a level that we do not claim our findings are generalizable, but that they add findings that can be compared to other design efforts within this conversation.

Supporting data collection included class outcome data, reported time on task, number of completed quests, leaderboard results, and overall course grading. Actual course meetings were private, and no student is identified in the data. During the course, we collected weekly notes and looked for indicators that revealed learner motivation, engagement, time on task, and ways we could modify the course in progress or ideas for the next iteration. After course completion, all students were invited to take an online survey and 14 volunteered to self-report on their perceived response to the course design. The research team then purposefully invited 6 students, based on our journals, unique comments in class, or high/low performance on course content. In the interviews we asked what influenced their motivation, engagement, and investment in the content and probed based on those prompts to identify what design elements were influential in their learning. We consider this data to be preliminary and informative for this individual course, but not necessarily generalizable beyond the context of this case.

Findings

Our learners positively responded to playful course design. First, we looked for and saw evidence of increased motivation, sustained engagement, and increased task completion. Students credited their increased motivation to expanded choices, self-pacing, experience points, and voluntary competition. Self-direction in the learning was often noted, commonly students shared statements like, “I like that I was able to choose and drop one if I did not feel like doing it and move on to another.”

They also identified ‘flex time’ as supporting larger amounts of time on task, “I could crank out a maximum number
of points early in the semester before I got busy.” This showed up in the overall quest completion rates (Figure 1). Students began to name this, “‘binge questing’… I felt totally just engaged and I want to finish more and more quests so sometimes I maybe finish 20 quests in the weekend.” This kind of work load would require an all day ‘binge’ doing course tasks. However, not all students chose to binge quest, where all students did flex between busy and slow weekly production, some consistently completed 1-3 quests a week, as required, and others had greater range in weekly production.

Overall course data shows our students were likely to binge quest early in the first five weeks, completing an average of 6-7 quests per week (see Figure 1). Overall, students self-report an average of roughly 4 hours/week of time on task; turn in an average of 5 activities/week; and average a total of 66.2 course activities per student. This production rate was clearly higher than the required 1 quest per week to stay productive (also the assigned requirement in the traditional course). Student weekly work increased.

![Figure 1: Average quests completed each week per student. n=24](image)

Students suggest that their choices and speed of accessing new content allow them to customize experiences so they could more easily immerse, or ‘addict’ themselves in the learning. For instance, “I think I am getting addicted... I only wanted to complete one quest this morning and am now on my third-fourth.” Despite detachment from formal grading, students ascribe motivational worth to informal XP points. Learners reported a clear connection to the XP points because of individual interest, “[I would] spend two or three days doing nothing but completing quests and watching my XP points grow”; to provide feedback, “I received immediate feedback on where I [comparatively] stood in the class”; and to motivate themselves, “I really liked getting up to that next level.” XP also provided timely data with which they could self-regulate learning, “If I didn’t like a big challenge I would pick out two or three tasks that were only worth a few points and that would be it for the day.”

The leaderboard likewise provided a window for students to gauge performances against their peers using avatar names. “I did like to look at the leaderboard just to make sure I was kind of on pace.” Others opted out of the leaderboard because they claimed they, “do not want to compare… I just want to learn for its own sake, for me.” Also, five weeks into the course, four students finished all 73 existing quests. We guessed that if prior elements were effective, we would have some students ‘geek out’ on the course (Ito, 2010). Yet when this actually happened we needed two weeks to prepare and release another 70 quests which were aligned with course goals. These quests far exceeded expectations for the course and required learners to begin to code, read entire books, and do tasks far beyond the traditional course scope. Each required large investments of time. 7 students chose to invest in these “end game” quests and even aspired to finish all 70 after the course was over. 1 student in the course chose to stop accepting quests and wanted to invest in a single larger project on their own (still showing progress each week in class). All students in the course at least doubled the 14 original assignments (weekly readings and discussion posts) required in the previous iteration of the class; top performers completed over 90 quests and the lowest performer in the course completed 32 quests (this student dropped out).
Two design elements are not named as relevant for student motivation or engagement. Notably, repeatable content was not consistently done by students. Nor did any participants perceive repeatable content as influencing their motivation or engagement in the follow up interviews. Nor did we observe replaying quests as common. The help desk, (16/20 contacts via email) was used weekly by some students (n=9) with more regularity as the course content became more difficult and as we approached the final, graded, project. However, the help desk is not perceived by other participants as affecting their motivation or engagement; generally it is considered helpful and a "nice touch", but not necessarily needed beyond existing weekly meetings and contacting other students in the course. As a team we considered the help desk essential for those that used it and it addressed their learning preferences.

Interestingly, class discussions circulated around broader topics, but were ignited by the game-like elements in the course. For instance, quests that lead learners to introductory coding are not necessarily needed for course outcomes. When one student brought this up, others defended the quest as a ‘real-world’ skill that easily applied to the subject area. Overall, we ended up discussing the core goals of the course, school-to-work, and future employability.

Another discussion revolved around whether the leaderboard should be voluntary or required - and whether or not it was "legal to stockpile quests," (not turning them in to give others a false sense of ‘winning’ on the leaderboard). Indeed our most active students were “saving” quests so that the others couldn’t see their performance level. Because the XP points were playful, they became part of the social game and tool of strategy among competitive learners. This conversation led to the influence of different cultures on an idea, the nature of education, and individual rights in a connected world. Other relevant discussions included the value of "points", independent lifetime learning, the value of competition and comparison to classmates, and working with others to troubleshoot and solve problems.

We observed that the competitive ‘meta-game’ that developed (above) was rooted in elements that were not connected to the grade. Not all of those that ‘gamed’ the course were competitive however, some were explorers. Once, one of our team incidentally bumped into a student drawing out a ‘map’ in their journal and asked what it was. He showed that he was trying to figure out how all the course quests were connected and if he’d explored the whole class. Having some hidden content, he was "looking for Easter eggs" in much the same way that he did in his computer games. His goal: to "share the map with everyone so they had a 'cheat' for min/maxing the course." Both ‘cheating’ (using tips and help guides to bypass game rules), ‘clearing’ (exploring every part of a map), and ‘min/maxing’ (investing minimal work for maximum output) are common gamer activities to get more out of a game. This student offered that these were fun for him in his gaming time and that he was enjoying the same entertainment from the course. To his credit, he had successfully decoded our quest trees, regular patterns for hidden content, and noticed that each tree had repeatable options.

From an instructor perspective, this course was time intensive prior to starting the course, and self-sustaining once the course started - with the exception of scrambling to add the expansion pack in week 7. Our role was primarily to maintain expectations (one task per week), provide a sounding board for students to tell their experiences to, and to guide with consistent and timely feedback on many of the quests. We noted the primary hindrance to student activity was our ability to ‘confirm’ quest completion to unlock new options. This is a design challenge for the next iteration.

In addition, we saw the quality of our writing in quests needed more work. Often entertainment media gives cause
for task completion into rich, compelling, narrative arcs. Where this takes creativity, time, and intention up front, we did see that as class went on, some students fell into a work pattern that was less enthusiastic than when they started. This was associated with a sense that they had “completed the game” and had what they needed for the final portfolio.

Discussion

Most course design considerations in this study are noted by students as being motivating, engaging, and we show a clear increase in task completion and time on task clearly exceeding our expectations for the course. It is worth repeating that our students doubled the workload of the previous course and appreciated the changes made to the class in evaluations. Overall, our results replicate previous research findings showing increased motivation and engagement. We agree that basic vocabulary shifts, (Leach et al, 2014) to create an environment of motivation and engagement in the class, as do the use of leaderboards, badges, and cosmetic visual design (DeShutter & Abeele, 2014). Moreover, we suggest in this case that activity choice and self-pacing offers a far greater opportunity to motivate and engage worthy of much more conversation and design work on how to manage a differentiated course. Aguilar et al’s (2013) design allowed learners to pick 2 of 4 projects, where we allowed them to pick 14 of 74(+70) quests. In both cases students reported and displayed significantly more engagement and time on task. In our case we saw the emergence of ‘binge questing’, course ‘mapping’, and small groups of competitive ‘gamers’ trying out maneuver each other. In this particular case, we see evidence that more choice in work, more challenging work, and more playfully competitive elements to compare work actually make the work more enjoyable and create positive class environments for learning - just like a complex game.

Interestingly, binge questing is an example of unexpected student behavior that breaks from our experience of traditional course activity. When we limit work to only one assignment per week, we wonder if we are actually holding our students back from far more invested and rigorous learning experiences. If a course is essentially redesigned, we should expect this and other essentially different student behaviors. Likewise, students invest more ‘play time’ toward the beginning of the course, rather than gradually increasing work loads toward a ‘final’ at the end of the course (see Figure 1) - this alone deserves greater attention by researchers. However, it is probably not surprising to game designers who expect high investment initially and a smaller percentage of players that stick with a game and replay it.

Further, we began to see a variety of play preferences and styles. Some did enough each week to stay productive, but over half of the class were well beyond an ‘A’ grade by the fifth week of the class. Some worked ahead and slowed down later in the course, others had a bump in effort at the end of the course when they needed more products to prove they had met the objectives. Some preferred quests increasing their reading load (to build their reference list), some preferred production quests, and some embraced the chance to learn coding basics. We also see variety in the level and kind of support that different students preferred between the help line, class questions, and emailing. Finally, we saw variety between learners that worked socially (either with or against their friends) and some that preferred independent learning.

Where we considered this effort a success in terms of motivation and engagement, we are limited by, nor did this study seek, quantitative outcome measures of learning that we know are valuable to many educators. We concede that it is possible that our students were very busy, but not learning in a measurable way. We also are limited in our claims due to the method used for study; a single design-based iteration is not capable of making any generalizable claims beyond the case in question. We also saw less impact from our efforts to design repeatable content, yet as a single iteration, this does not diminish our interest in this kind of design, instead we consider this a growth area for our design team. We suggest that ‘repeatable’ game content is generally in pursuit of a goal (“grinding”) or to show expertise (challenging), so we do not feel we properly executed this part of the design and continue to look for positive exemplars from other course designers and the digital games that we play. Further, we seek out counsel from professional game designers that can inform what elements of this design could be improved on for better results.

We do claim the changes in learner activity in this design iteration are reasonably attributed to the design elements included in the course. Further pedagogical transformation of courses, can continue to be more game-like, we maintain that this design direction continues to have potential to produce greater motivation, engagement, and increased investment of time on task. That said, we are encouraged that the discussions on leaderboards and creating a ‘map’ of the class are unique experiences that support the success of unique game-like design elements to create player-like experiences, discussions, and the beginnings of communities of practice or affinity spaces around a game. In addition, we are convinced that these events were highly unlikely without the elements added to the course.
The community of gameful course designers can and should continue to build on these elements and increase outcomes, further document design-based research and ideas, and move toward quantifiable studies to test these local outcomes. Moving forward, we discussed that managing such a course was aided by the use of the 3D GameLab learning management system, however not required. In our third to fifth iterations (in process), we are now reducing the management tools down to a simple shared spreadsheet, and Google suite products. We are seeing positive, but less striking results however because we are not able to automate some of the quest completion elements as we did with 3DGameLab. We are still looking for an affordable (open source) learning management system that allows full control over layout, and differentiation using basic Boolean logic sequencing of content, and does not assume a traditional course design model. That said, the idea of authentic and diverse options for activity, self-pacing, leaderboards, and other possible game-like activities are workable with minimal tools.

References


(Endnotes)

A PDF version can be found at the following web address: https://drive.google.com/file/d/0B5Z_O23HjUMPakU4dnBtWH-VPcGc/edit?pli=1
The Evolution of Scenario-Based Learning

Estelle Domingos, Capella University
Justin Lee, Capella University

Abstract: Scenario-based learning is a technique intended to engage and motivate the learner by immersing them into authentic situational contexts to allow them to practice skills prior to mastery. Follow along as we explore the iterative process of Capella University’s Course Media team through their six years of designing, writing, and developing a handful of gameful, scenario-based products. Through this, at times, messy process, how their approach becomes subsequently honed and redefined is captured, along with a summary of key takeaways to consider for the success of others embarking along similar paths.

Capella University is a competency-based online university delivering bachelors, masters, and doctoral degrees, as well as non-degree certifications. As an online university, we have a unique opportunity to integrate interactivity into our courses for adult learners. We, the Course Media team, create games and other interactive media that simulate authentic real-world professional experiences. Since 2010, we have been honing our approach towards game-like, scenario-based learning and with each iteration, we have been gaining valuable insight.

Seed

Our vision is to develop engaging, effective learning experiences for our online learners in an increasingly efficient way. At Capella, we have spent the better part of a decade making interactive media (over 13,000 pieces), and up until 2010, most were standalone pieces supporting a single unit or course. Often the pieces were narrowly focused on terminology and knowledge retention. Only a small minority of pieces tackled complex concepts or presented fictional case studies. We knew the capabilities of media were growing in tandem with learner expectations, and we knew the value of interactivity in engaging learners and making learning stick. We were in need for an opportunity (think “funded project”) to stretch our interactive capabilities into the forefront of interactive learning.

Figure 1: An example screen from Riverbend City.

An opportunity arose with the formation of the School of Public Service Leadership. This new school had undergraduate and master programs, including public safety, public administration, public health, and nursing. Its leadership was looking to differentiate the school’s programs with an emphasis on using an interdisciplinary approach. And, this request came with budget. Suddenly, our lens became creating media from the perspective of whole
programs across the school. This new challenge was the moment the idea of creating a game-like scenario using a reusable overarching storyline was born.

What did we create? The storyline revolved around a train derailment and chemical spill in fictitious Riverbend City (see Figure 1). In each course, learners approached the storyline in relevant ways; for example, scenarios (dubbed “missions”) in public health courses focused on citywide chemical health problems related to the spill and its fallout. Within each mission, the learner ventured to different places in the city and observed conversations revealing multiple perspectives and approaches to solving a variety of problems. Our illustrators drew almost 400 characters, dozens of scene locations, and a city map. A custom Flash framework was built to empower designers to create pieces with little to no development needed, and they eventually churned out over 110 unique missions across dozens of courses.

Sprout

In 2013, a similar opportunity presented itself. A master’s program in Human Resource Management was being developed, and stakeholders were looking for a similar approach to Riverbend City. Three years had past and many of the facets of this original approach needed to be changed dramatically. Through needs analysis discussions, it was determined that for these new scenarios to be truly valuable, the learner needed to play a more active role. They also needed to be directly tied to course assessments. It was time to rebuild from the ground up, this time using web standards (HTML/CSS/Javascript) for the technical framework, and a first person approach to the content and interactivity, allowing the learner to play a dynamic role through the discovery of information.

This project had a rough start. The project stakeholders found it quite difficult to visualize what the final product would look and act like, as well as initially see the value of such a integrated series of pieces in their courses. It took nearly three months of discussions, wireframing, storyboarding, and prototyping before we received their tentative trust to begin development of the pieces and ultimately deliver a valuable product that satisfied their needs.

CapraTek, a fictional technology company, was created including nearly 100 characters, giving learners an intimate view of the inner workings of a human resource department (see Figure 2). We created 19 activities for 9 courses. Learners progressed through different tenuous situations in which learners needed to make decisions about who to talk to and prioritize which questions to ask. Some limited branching interactions were introduced, as well as, simple decision points with feedback. After completing an activity, the learners then brought this information into the course room and were asked to discuss their insights and write recommendations for the various
problems that were presented within the CapraTek activity.

Bloom

Because CapraTek was successfully launched and accepted as a viable approach for differentiation, two new products after a similar product built further momentum in 2014. The master’s program for Leadership in Education Administration and the master’s programs for Nursing and Healthcare Administration Informatics emerged at the same time, and now having a stronger codebase from CapraTek, what we’ve called the “Capra Engine”, we initiated the process once again.

Having reflected on lessons learned after the CapraTek project completed, this time around we required upfront commitment from business stakeholders to limit indecision and keep the project within scope. Their response came in the form of firm backing and trust, which allowed more time for streamlining our processes and development. We documented our approach and best practices, using scope and design documents to be more systematic and transparent about our plans and set expectations with the stakeholders. With this new demand our code needed to evolve, building upon it to be more modular and reusable. This CapraTek codebase was forked for each of the projects and developed upon simultaneously for each project due to tight time constraints… the impending course launch.

Figure 3: An example screen from Blooming Park.

Blooming Park School District is a fictitious district located in a large suburb of a major city and is brimming with diversity (see Figure 3). This setting provides our learners experience critically thinking through a variety of diversity related issues that they may not have been exposed to in their previous work experiences. This is extremely valuable, as these learners are aspiring principals and assistant principals. The Blooming Park simulations are designed to give learners the opportunity to investigate the current state of a school and take the information gathered to create recommendations for improvements. We increased the game-like experience by incorporating more complex branching, detective-style exploration scenes and also included a minigame titled “Closing the Achievement Gap” in these simulations. Currently, we have created 8 pieces in 3 courses, with plans for more activity development in the future.

VilaHealth is a system of health in a major metropolitan area, including hospitals, clinics, specialty services, etc (see Figure 4). Even in a time of modern technology, VilaHealth itself is not a perfect system. With plans for growth and expansion, it has just acquired two smaller systems of health in more rural locations. Consistent changes in government regulation (Meaningful Use), hospital and health system interoperability and interfacing, the desire to make data driven decisions and improve efficiency and patient health, make for a complex, often unclear industry.
This is what becomes the learner’s playground. VilaHealth pieces, or “challenges,” give context to the assignment within the course and set up a specific real life situation. In the challenges, learners gather information in an authentic way: learners interact with and interview key hospital personnel, and request or receive hospital data, demographic data, technology needs, etc. Learners take this information analyze it using critical thinking (what’s valuable/what’s not), document their findings, make decisions and recommendations based on the situation in their course assignment. In total, 24 VilaHealth challenges are used in 8 courses.

We were more forward thinking during development by planning for the creation of new features like greater branching, quantifying choices into categories with more robust point and feedback structures. However, we did not have enough time or find an appropriate scenario opportunity to implement these new ideas.

**Gameful Considerations**

Because we work with adult learners, our approach to games cannot be superficial. There are some different considerations for adult play vs. K-12 play and learning. What does that look like? For us it involves putting learners in the role they desire to have and using stories and characters to create this environment for them to play and practice in (pg. 28, Enders, 2013).

There are intentionally limited superficial rewards given during our gameplay, because adult learners are not as motivated by these. Their motivation is in the eventual reward—the “A” they receive, or the corrective feedback given by faculty or peers. Learning and striving for that a-ha moment is their goal, culminating in their achieving preparedness for their desired profession or career advancement. Our scenarios also allow adults to apply their previous knowledge while filling in any gaps they may have (pp. 64–68, Holton, Knowles & Swanson, 2005; Kapp, 2012).

**Cultivating the Garden**

We plan to continue building upon our existing framework by adding further complexity and depth to our interactions. We want our learning experiences to be more meaningful and also become authentic assessments themselves (having scores be their grade).

It is our goal that the content and learning be so engaging that our learners try to succeed, try to fail, and experi-
ment (pg. 58, Renaud & Wagoner, 2011; pg. 29, Enders, 2013). By enhancing the game-like qualities of our scenarios we hope to elicit the idea or feelings of play: pretending, make believe, low risk, failing safely, practice and simulation. We want to learn about the patterns of play and exploration that our learners are using through the use of data tracking and learner feedback and then revise our experiences based on our findings.

Another major goal for our team is creating efficiencies in our process. We want to combine our current 2 code-bases into one streamlined engine (taking the best of each) that will allow for faster development and allow more runway to accomplish more in-depth script writing and visually rich designs.

Another area of efficiency we are working on is our overall process. We would like to document more about our process and our capabilities, move ideation and decision making even earlier in our media design process to allow for longer development time and create additional prototypes for more sophisticated features. Finally, we would also like to make our assets more scalable, such as the creation of a character generation tool to put power in the hands of the content producers and reduce our role as the middleman.

Some ideas we would like to further explore and analyze more in-depth within our learning experiences:

- Throwing players into an intense situation or crisis,
- How reactions and choices impact multiple viewpoints,
- Gathering and prioritizing the most valuable information,
- Increasing critical thinking,
- “Gray” areas in decision making, not always a right or wrong,
- Represent the complexities of the professions we are training learners to perform in.

**Key Takeaways**

1. **Choose a technology that is flexible and supportive**

   It is paramount when creating any large and complex gameful learning experience, or any technology-based solution, to build it using a technology that supports growth and iteration. It is also important that your team is already familiar with this technology—choosing a new or trendy technology can be very risky. Also, leverage existing technology where appropriate. For example, for our revised scenario framework, we have integrated MediaElement.js for audio and video delivery, Font Awesome for customized vector icons, and jQuery UI for interactive form elements.

2. **Test, reflect, explore**

   Whenever you start something new, try to start small. Create a prototype that you can test to gather feedback. Improve your prototype based on the feedback, and test again. Continue iterating as you progress with your project further honing it into the best it can be. And gathering feedback doesn’t end after you launch your product, but you should instead develop a plan to continue gathering feedback. Then, reflect on how well your product meets your objectives. Gathering outside perspectives on similar projects can be insightful, so be sure to explore what others in your industry are doing to solve similar problems.

3. **Understand your audience**

   This takeaway seems pretty straightforward—and part of it is. An intimate knowledge of the user of your product early in the process can allow you to make better and more informed decisions that benefit of your end product. But an audience that can sometimes slip by unnoticed are those you are working with or for. These are the stakeholders who have invested money, time, or reputation into your product, and are partially responsible for guiding the direction of the product. Understanding their perspective, their expectations, and their communication style with can sometimes be the key to a successful product and process.

4. **Get involved in the process early and often**

   As a maker, try to get involved in foundational conversations early and every chance you can get. A knowledge of instructional design approaches, how to tell engaging stories, ability to synthesize gameful designs, and understanding content delivery options can help drive towards a successful product direction. Establishing this direction from the very beginning instead of after a poorly derived direction has already been set in motion by “the powers that be” allows for the development of a more holistic perspective and approach for the product and the creation team. Benefits include better group dynamics, creation of a shared language, and time and resource savings.
References


"I Have To Tell You Something": How Narrative and Pretend Play Intersect In Story Games

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Abstract: In this paper, we explore learning and play within the context of rules-light, narrative-ly-focused tabletop role-playing games, colloquially called “story games.” Focusing on data drawn from the Story Games Project, we highlight exchanges within a game session of the game Fiasco, which illustrate a negotiation of roles and collaborative narrative construction among players. With an emphasis on revoicing and pretend play, we discuss implicit mechanics which guide the enactment of roles within the play of these games, as well as the means by which players learn to embody different identities through play.

Introduction

In recent years, the field of games and learning has shifted away from studies of gameplay toward discussions of applications and outcomes. Games are, more than ever, seen as tools and teaching machines by which educators and educational researchers apply technological solutions to educational problems. But, for many games scholars outside of education-oriented fields, this can be perplexing, as the long study of play has rarely focused on overtly instrumental intent. It is within this context that we wish to dig back into analyses of game play, and form better understandings of how players engage with new forms of games. In particular, we focus on affordances and constraints of analog role-playing games, to investigate how games can provide potentially transformative learning opportunities with prosaic technological substrates (paper, pencils, and face-to-face interpersonal discussion). In this paper, we empirically explore the potential of the “story game” (see Duncan, 2014) — or rules-light tabletop role-playing game — for their potential impact on instruction, their ability to foster identity play, and how they may provide opportunities to create collaborative narratives. While digital games are seen as technologies for researchers and educators to “bake in” educational content and messages, we wish to broaden the field’s conception of games while developing an understanding of the unique affordances of these specific kinds of games.

By refocusing on what is learned and can be learned through engagement with genres of entertainment games, our goals are threefold. First, we wish to better elucidate how play in “the wild” (Hutchins, 1995) may give rise to learning practices difficult to engineer in a classroom. Next, we wish to see how non-digital games in particular may afford forms of interaction, play, and learning that are difficult to achieve in digital contexts. Third, we aim to gather considerations of these games’ applicability to instructional contexts. In this paper, we ask: How do we understand learning within generative, productive gaming spaces that involve role-playing and narrative construction? How does player identity play intersect with the needs of narrative play in non-digital games? And how do players see the instructional potential of these experiences?

Narrative and Play

For the purposes of this study, we focus on narrative-based analog games in which players collaboratively (and potentially competitively) develop shared stories with one another. It could be argued that a troubling legacy of game studies’ so-called “narratology vs. ludology debates” (e.g. Frasca, 1999) was an over-consideration of game mechanics at the expense of player (and designer) narratives in the understanding of games’ impact. Recently, the pendulum has begun to swing back to considerations of narrative, with overt criticisms of recent emphases on “procedurality” in games (Sicart, 2011), including criticisms of an over-emphasis on mechanical, procedural factors in understanding how players (and scholars) make meaning from games. Within this context, the tabletop and live-action role-playing game becomes quite a provocative site to focus on — including both overt mechanics that shape the player’s activities as well as an ethos of narrative contribution by players, these games challenge us to new considerations of game collaborative narrative.

The study of role-playing games is often traced back to the groundbreaking work of Gary Alan Fine (2002), who applied Erving Goffman’s frame analytic approach toward the understanding of identity and the embodiment of roles within early tabletop role-playing games (e.g. Dungeons & Dragons, Traveller). Fine’s work has been extended and elaborated over the past decades, with a burgeoning field beginning to develop around the study of role-playing games in its many forms (e.g., Simkins, 2015; Simkins & Steinkuehler, 2008; Bowman, 2010; Torner & White,
2012, to name but a few). Within each of these works, scholars have understandably emphasized role-playing as one of the game’s central activities, as well as on the improvisational nature of the narrative construction that occurs within these gaming spaces. The term “story game” connotes a specific subgenre of tabletop role-playing game, characterizing multiple role-playing and gaming experiences (intersecting with categories such as indie RPGs, freeform games, Nordic larp, and others). Tied often to independently produced, small press tabletop role-playing games and their designers (e.g., the work of Avery Mcdaldno, such as Monsterhearts, The Quiet Year, and Dream Askew), these games are often short in duration and involve much less in terms of mechanical calculation. Character statistics, where they exist, are often used primarily in service of forwarding the game’s evolving story, and are thus much more limited than in digital role-playing games. Many games do not involve gamemasters, and most use prosaic gaming tools (six-sided dice, index cards) rather than specialized gaming tools typically associated with the hobby (e.g., polyhedral dice, miniatures).

At the same time that these games have risen in prominence, Anthony Perone and Artin Göncü (2005; 2014) have recently explored and advocated for considerations of pretend play across the lifespan. Göncü & Perone (2005) argue for considerations of adult pretend play and later lifespan pretend play, toward understanding how childhood developmental play activities extend into adult contexts. In recent work, Perone & Göncü (2014) have focused on better understanding improvisation as adult play, furthering argue that adult improvisers “desire to construct intersubjective, imaginative worlds in their activities” (pg. 204). These emphases sync well with other recent approaches promoting adult play as a political act (e.g., DeKoven, 2014; Sicart, 2015), as well as hint at their potential to promote considerations of alternative social futures (e.g., New London Group, 1996). Göncü & Perone (2005) provocatively stated that “when adults, like children, move into the illusory world of pretending, they are trying to understand something that they have not yet mastered in real life. In play, they construct a representation of this experience and test its applicability in real life” (pg. 144). We thus posit that story games provide interesting and potentially fruitful avenues for understanding lifespan pretend play, their relationship to the designed experiences of games (Squire, 2006), and their potential application in educational contexts.

A Case Study: Fiasco

In this paper, we present rules from an empirical study of play in one of these games: Jason Morningstar’s Fiasco (Morningstar, 2009; Morningstar & Segedy, 2011; Duncan, 2014). Fiasco provides an exciting site from which to study the creation of collaborative narratives in a role-playing environment. Fiasco can be set in multiple time periods and locations, but all games share the common theme of creating a salacious (and often hilarious) crime-oriented story in roughly the vein of a Joel and Ethan Coen film (e.g., Fargo, Burn After Reading, Blood Simple). During a single session, players create new characters, put them into untenable situations, and then watch as the characters’ goals all fall apart in entertaining fashion. The game is playable in fewer than two hours, and is designed to be welcoming to new players unfamiliar with role-playing games.

Commonly considered one of the best “gateway” games in this genre, Fiasco is currently ranked the third highest of all role-playing games on RPGGeek.com, and was the winner of the prestigious 2011 Diana Jones award for significant contribution to the tabletop gaming hobby. Fiasco provides a simply structured but generative gaming environment in which to explore the adoption of roles, the generation of a collaborative-constructed narrative, and the potential of psychosocial moratoria (Gee, 2003) that can give players the opportunity to explore sensitive and/or taboo topics. Duncan (2014) elaborated in detail the ways that Fiasco’s mechanics structured and constrained role-playing and narrative play within the game, providing us with a unique environment within which to study the interaction of rule systems and pretend play.

With our Story Games Project as a whole, we have striven to balance several goals: The goal of assessing play-in-the-moment during the course of a game, understanding how players reflect on their play, and providing players the opportunity to share their own perceived connections between gaming activities and educational contexts. The present study thus reflects an attempt to move beyond game analysis (e.g., Well-Played; Davidson, 2008) toward exploratory empirical work that can document and systematically characterizes player experience, focusing specifically on opportunities for player learning present within generative, role-playing game experiences. With Fiasco as the initial locus of the project, we sought out and tracked the performance of multiple play groups.

Method

The Story Games Project is an ongoing series of studies, investigating lifespan pretend play as structured through role-playing games such as Fiasco, The Quiet Year, Monsterhearts, and others. Focusing at the present on story games that promote role-playing and collaborative narrative construction, we chose to investigate play within single, one-shot games of Fiasco. Adult participants were recruited via advertisement posters, solicitations to undergraduate teacher education courses, and through personal contacts by researchers within local gaming
groups. Students with career interests in education and related fields were privileged for participation in the gaming sessions, within which players were simply presented with four playsets (settings and narrative seeds to begin the game), then asked to play the game. Subsequent to each gameplay session, players were prompted to debrief on the gaming experience, their experience embodying roles, creating a collaborative narrative, and their considerations of the educational applications of these games. While we have collected data from five gameplay sessions to date, for the present paper, we present a case study (Stake, 1995) of one play group, focusing on a critical moment drawn from a single gameplay session between a group of four adult players.

The play group included one man and three women (pseudonymized here as Adam, Betty, Catherine, and Diana), who were all college-age or older adults, none of whom had played Fiasco before and who only had limited experience with tabletop role-playing games. For their Fiasco session, the group collectively chose the playset “Regina’s Wedding,” which provided a game setting through character relationships, character needs, objects that would need to be incorporated into the story, and “moments” drawn from traditional wedding structures (the “Dude Party,” “The Gathering of the Clans,” “The Ceremony”). The rules of Fiasco, as the name implies, fosters stories based around disastrous and often comedic set of events, and “Regina’s Wedding” further focused this upon a wedding featuring a character named “Regina.” For the game session, all play was video and audio recorded, as were the post-game debriefing focus groups. Additional interviews were conducted with participants one week after the game session, in order to elicit further reflections on the game’s events. All gameplay dialogue and interviews were transcribed for analysis.

**Results**

“Regina’s Wedding” provided the playset background for the group presented here. Within their play, we suspected that they would be faced with the tasks of learning how to negotiate and generate collaborative narrative, as well as balance this activity with the performance of new roles within the game. We present excerpts from the game’s transcript to illustrate an early moment in the session in which a novice player (Adam) was faced with his first significant choices in both narrative construction and character embodiment.

Early in the game, central plot points had yet to be established, including the nature of an unspecified, key secret that “Regina” (played by Betty) would be hiding. Additionally, Adam’s character was initially established as marginal to the central events of the wedding — Regina (played by Betty) was to be married to Abdul (played by Catherine), which was to be officiated by Joe, the brother of Abdul (played by Diana). Adam’s marginal position and relative inexperience with these games led to a difficult initial path to participation; in the following excerpt, Adam was encouraged and coached by the game session Facilitator (a member of the research team) as well as the other players:

**Adam:** I can establish [the next scene] or resolve [a scene others dictate to me]?

**Facilitator:** Yes.

**Diana:** [Gives away her dice, ending previous scene activity]

**Facilitator:** And what resolving a scene means is, like, you, you get to choose how the scene will end, but you don’t get to start the scene. So you would say something like ‘I want to see a scene between Hank and Regina...’ And then you’d give the die.

**Adam:** Okay...

**Adam:** I don’t know. [Long pause]

**Betty:** You do realize this is going to determine the rest of your life. [Laughter from whole group]

**Adam:** That’s what I’m saying this, is a lot of pressure...

**Betty:** Maybe we can just go around in a circle [Betty makes circular gesture with finger], and just do it...

**Diana:** Think of your relationship.

**Adam:** I want it... I want, I want... I want to do this one. [Quickly points at table near Diana; laughter from all]

**Diana:** Okay.
Adam: [Finger pointed at table, taking on a deeper voice] I have to tell you something.

Diana: Okay, okay.

Initially, Adam’s reticence appears to be a factor of both learning the rules of the game system, but also a genuine struggle with contributing something of consequence to the story. Once he declares “I have to tell you something,” gesturing firmly at the table near Diana, he abruptly switches into character, and begins to both dive into a character as well as impact the central plot points of “Regina’s Wedding.” Next, with both Adam and Diana fully in character:

Adam: All right. You’re officiating this wedding, but you need to understand something. [Looks at Betty briefly] Regina used to be a man. [Betty bursts out laughing, doubles-over with laughter]

Diana: Dude, we all know that.

Adam: You guys all know that?

Diana: Yeah, man.

We see here that Adam first strives to connect with a presumably shocking plot twist — the secret that Regina has been hiding is that she was transsexual. This surprises Betty, who laughs at the surprise of the revelation, which is nearly immediately shut down by Diana, and reframed as insignificant. Diana’s “Dude, we all know that” occurs immediately and quickly, decisively defusing the revelation from leading to further “shock” scenes with other characters. Adam builds on this with another attempt, reframing the original shock of the transsexual character reveal into a side reveal about his character’s religious convictions and potential transphobia:

Adam: You guys don’t think it’s weird? You guys don’t think it’s ... wrong? God made... Reginald... a man.

Diana: [laughing] Well, you know, man, like, honestly, like, I... I just think that--

Adam: [deadpanning] This marriage is a farce.

Diana: [overlapping, unclear dialogue] I ...

At this point, there is narrative chaos as Adam searches for where to take this revelation, given Diana’s pushback. Diana appears to not know how to react to this new religious revelation, and the discussion turns from being about Regina to a discussion of legitimacy of each character’s potential actions:

Adam: You can’t officiate it.

Diana: I... I can. I got a degree online and I have a piece of paper that says I can, all right? This is my first one. You’re not going to ruin this for me.

Adam: I’ll let you officiate my wedding.

Diana: You, you don’t even have-- [unintelligible]

Adam [interrupting]: I could get married!

At this point, the back and forth between Adam and Diana appears to be a negotiation of the plausibility of Adam’s character’s claims, guiding both his character points, as well as evaluating their utility in the overall plot of the evolving game. After a first attempt to simply introduce Regina’s past as a plot point fell flat, and then the introduction of a religious framework for explaining Adam’s character’s outrage seemed to face impediments, Adam and Diana eventually settled on a final solution that made sense for all:

Adam: Because Reginald took her! And left her. Broke her heart. I don’t know, she’s missing.

Diana: Did you just say Reginald took your woman?

Adam: Yes.

Diana: I think I need to tell Abdul about this.
Finally, Diana references and later continues to discuss the implications for Abdul (Catherine’s character, who is engaged to be married to Regina, Betty’s character) and is also the brother of Joe, Diana’s character. Diana, guiding Adam into the other established relationships, validates Adam’s final character choices and begins to build the further narrative with Adam at this point. Adam appeared to be searching for a narrative “hook” of some sort; “I don’t know, she’s missing” seems to indicate the tentative creation of a new potential non-player character to add to the narrative as well as a potential motivation for his character. But, with a question (“Did you just say Reginald took your woman?”), Diana prompted Adam for the first time, quickly moving to the consequences of that statement for Abdul in subsequent interactions in that scene. This short exchange between Adam and Diana reflects an interesting confluence between narrative and pretend play in these forms of games, in the sense that Adam simultaneously searches for both character points and narrative points to connect with the other players. Diana served as an arbiter of his contributions, evaluating their potential impact (presumably according to her personal tastes and goals) and eventually guiding Adam with a question at the end of the exchange. In the next section, we evaluate the significance of this brief exchange, and identify some of the factors that influenced the form that this interaction took.

Discussion

First, we note this exchange as a means of isolating a microcosm of kinds of negotiation that take place during collaborative, face-to-face tabletop role-playing games. In this case, Adam (encountering his first opportunity to role-play this character and to shape the course of the game) found himself in a potentially uncomfortable position. He was unable to decide what to do in order to set the stage for his scene, as well as what he might subsequently do. The encouragement of the group notwithstanding, there appeared to be no apparent other game mechanics at play nor other scaffolds in the game that would easily guide him through this process; Adam was left to choose what to create, and how to create it with the group.

It is notable that Adam eschewed one mechanical element of the game that could have helped with this. He did not choose to “resolve” in scene above (indicated in the first excerpted line). “Resolving” is a mechanic within the game that gives all other players the opportunity to negotiate a scene and goal for the scene, with the player who is on the hot seat (in this case, Adam), left to “resolve” the outcome of the scene. Rather, Adam seems to have wanted to “establish” (create his scene), but struggled in how exactly to do this, perhaps implying an authorial pressure that comes with first performance in the game. With his stammering “I want it” statements, followed by “I have to tell you something,” once he decided on the Regina revelation, Adam quickly moved into character, and communicated an important revelation to the group through a change in tone and action (pointing at the table). Adam created the solution to a narrative problem by adopting his character and jumping into the story, without much meta-discussion ahead of time.

Additionally, we see it as significant that, even with this uncertainty on Adam’s part, Diana clearly resisted Adam’s initial forays into exploring Regina’s sexual identity. It is unclear why this was the case (Diana’s distaste may have been with either the concept of imposing a transsexual character on another player in the game, or distaste with Adam’s move to introduce character development that othered another character for shocking entertainment value). Regardless, it was immediately tamped down (“Dude, we all know that”) and rejected as insignificant backstory. Within character, Diana acknowledged Adam’s contribution to the story, but downplayed it unimportant for the existing story. Adam seems to have moved toward a character explanation next (his religious beliefs, as a means of justifying his narrative choice regarding Regina’s secret. This was also tamped down by Diana, followed finally with the introduction of an ex (who was wooed away by Reginald), as well as a new motivation for Adam’s character that could be tied to Abdul’s character. In each of these cases, all activities took place within character, without discussion of the narrative by the other two players, and entirely within the framework of the established story. The frame of the game provided a pretend play space within which narrative became negotiated through the play activity.

Additionally, in these brief exchanges, we see Diana serve a role to mediate and judge the quality of Adam’s contributions. While not explicitly put in that role by the game — Adam chose Diana to participate in a scene with him, the game has no “gamemaster” or equivalent role — she did serve to deflate several avenues of exploration (the shock of Regina’s history, then the religious rationale for Adam’s character’s revelations). In particular, it is notable how, much like in overtly instructional contexts, Diana essentially revoiced (O’Connor & Michaels, 1993) Adam’s contributions — “Did you just say Reginald took your woman?” — providing him with a new framing of his narrative explorations. Diana did this in a fashion that dictated the potential of future non-player characters entering the game, and its impact upon other characters at the table. These, again, were revoiced in character, and revealed the strength with which the frame of the role-playing activity itself may have been held with even novice players.
This final Adam/Diana exchange provides a window into the process by which Diana led Adam’s narrative contributions back into the context of the earlier game. It was presented as a question — in essence, it was Diana asking, “Is this how you wish to contribute back to the story? How you want to connect this insight back not just to Regina, but to Abdul?” The work of revoicing served at once to validate Adam’s contribution, as well as give Diana a means by which she could act to bring Adam’s story back into the established narrative. The collaborative structure of this exchange is one in which Diana (ostensibly originally a secondary player) actually served a key role in gatekeeping appropriate contributions, then providing Adam with productive reframings of his contributions. In-character revoicing potentially provides players with a means to guide the play of others, to shape the narrative of the game, and to do so without breaking the role-playing, fictional frame of the game. Role-playing and narrative clearly intersect in collaborative ways within games such as Fiasco, with activities such as revoicing serving to communicate this collaborative intent with other players.

Conclusions and Future Work

As we can see from this brief case, story games such as Fiasco may include the adoption of roles and identities that provide opportunities for players to take on positions within systems to create collaborative narrative. This brief exchange illustrates that while collaboration and identity play occur within these games, their evolution is not always as one might suspect from first look. While the rules of Fiasco place the player whose scene it is on the spot (in this case, Adam), these data shows the key roles that others play in assisting, guiding, and constraining the contributions of the featured player. By challenging and revoicing his statements, Diana served to guide Adam’s novice contributions back to the themes of the evolving story, and to do so within the constraints (and frame) of the existing play activity. As Perone and Göncü theorized pretend play throughout the lifespan, we suspect there are contributions from game studies that can help us to better understand the ways that, for some adults, these gamed forms of pretend play are scaffolded by and constrained by game rules. While improvisation and collaborative writing may seem a difficult affair for many (as it initially did for Adam), games such as Fiasco illustrate the potential of role-playing, fictional spaces for providing players spaces within which learners can explore multiple identities, work with others to shape stories, and to do so through the collaborative, performative experience.

But, do players know that this is what they are doing? Are there ways to better instruct, guide, or provide spaces for reflection on the learning that may be occurring through these activities? As with many (or some might argue, most) games and learning interventions, our first inclination is to consider the ways that these games might benefit from guided reflection or some other kind of explicit instructional experience to alleviate problematic approaches to identity play that arise within the game. We hasten to note that Regina’s transsexual revelation appears to have been meant by Adam to drive a story in a humorous way, while Diana may have seen this as belittling or offensive and stopped this direction from being pursued without better connection to existing themes in the story. We find these moments both exciting for their potential to provide means embodying marginalized experiences (such as gender identity), though we are also troubled about the educational implications of this blurry line between identity play and the replication of problematic stereotype.

Much of the joy of Fiasco is about transgression — being able to play characters that have great ambition and fail spectacularly (Duncan, 2014). The game’s ethos of “failure play” is one that is intended by Morningstar to be playful, humorous, though one that can lead to simplistic stereotypes, just for the sake of keeping a story moving. It may take effort to reconcile these play spaces with existing instructional approaches with games, which typically seek to empower learners and provide opportunities to defuse the use of stereotypes. This circles back to our original framing of games in the introduction of the present paper: If games serve for many as “technologies” to deliver content, practices, and opportunities for assessment, then we need to think seriously about the means by which this content, these practices, and these opportunities are designed. If we wish to better understand the educational application of story games, then we need to understand the ways in which roles are chosen, and how narrative constraints give those roles meaning in the context of the collaborative story. Pretend play and narrative are enticingly intertwined within Fiasco, and in future work, we will further investigate how the content of the play activities are connected to representations of the real world.

Göncü & Perone (2005) stated that “pretend play does not give way to labor or games with rules,” and our results do seem to support this claim. These game rules serve to delimit a space within which pretend play can thrive, with the important caveat that “games with rules” (or lack thereof) influence and facilitate lifespan pretend play in ways that demarcate potentially uncomfortable identity exploration in the “safe space” of a game. Our data also raises concerns about these forms of play as means by which games can potentially serve as vehicles for “identity tourism,” allowing participants to replicate stereotypes of others without significant pushback from the game environment or other players. While games such as these serve to provide fascinating avenues for the expression of pretend play across the lifespan and its relationship to collaborative narrative construction, there is much still to be studied regarding these play environments and their educational application.

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DeVane, B. (2014). Beyond the screen: Game-based learning as nexus of identification. Mind, Culture, and Activity 21(3), 221-237.


Abstract: The purpose of this paper is to provide an overview of current literature on video game making and modding (modification) in fan communities and other informal settings. The paper also identifies new game making tools and communities that have the potential to broaden participation and expand the nature of game making practices. A final section addresses key issues and directions for future research.

Introduction

Academic interest in video gaming has exploded over the last few decades, and scholars have approached the study of gaming from fields as diverse as cognitive psychology, medicine, economics, sociology, law, computer science, and education. Much scholarship has focused on video game play; that is, who plays what kinds of games, how playing games affects cognitive, emotional, social or physiological capacities or dispositions, the social interactions associated with game play, and so forth. More limited scholarly attention has been devoted to making games as a practice in its own right. Making video games encompasses all aspects of creating a game, from the more technical aspects of writing software code or graphic design to the more conceptual tasks of identifying engaging game goals, actions, and themes. Game making has been popularized through the availability of simplified game design tools that can be readily used by aspiring game makers of all ages and backgrounds.

There is a growing literature on game-making in educational settings, including both in school and afterschool programs. Another line of investigation has focused on understanding game making, or in particular game modification (modding), as a fan practice. Game modding, and to some extent, game making, is a popular leisure pursuit among game players, and there are many fan communities devoted to sharing player-created games, mods, advice, tutorials, and tools.

Game making and modding among fans takes many forms, and can include: (a) the use of existing commercial games (or game "engines") to create new, stand alone games, (b) the use of software tools to modify existing games by creating an "add-on" or new content that changes a part of an existing game, and (c) the use of other software to make new games. This includes software created specifically for game design as well as software designed for a wider range of applications but adopted for game design. In this paper we primarily discuss key literature on video game modding, or (b) above. We found few empirical studies of total game conversions or the use of game-making software outside of school or after-school educational settings. We have included those few studies in our discussion below. We also limited our review to literature published within the last decade (2004-2014).

Buckingham and Burn (2007) point out that games problematize any clear distinction between production and consumption of digital media. “sandbox” games like Minecraft provide players with the freedom and tools to design objects or environments, while other games give players a more limited ability to customize avatars or edit game maps or levels. What “counts” as game making or modding is a question that we struggled with as we conducted our review and that we will return to in the concluding sections.

Gaming Making and Modding Among Fans

Game making as a fan practice often takes the form of modding existing games designed for entertainment, typically as an extension of game play. Players have modded games practically since the first computer games were created (Unger, 2012), and game modding has grown in diversity and sophistication along with games themselves. Some commercial game designers encourage game modding by releasing software tools that allow players to modify game content; in addition, players have created their own modding tools. Fans share such tools, tutorials and completed mods, as well as discuss modding, through online fan communities, some devoted exclusively to sharing knowledge and strategies for game modding. As one example, Mod DataBase (www.moddb.com) was launched in 2002 with the goal of serving as a clearinghouse of sorts for all types of game mods, add-ons, and user-generated content. As of February 2015, the site had almost 39,000 files available and more than 137 million downloads. ModDB is organized by game platform, and in addition to game content, has videos, news, tutorials, groups, and forums, among other features. The site has a page with some basic information about mods for newcomers (“Anyone who complains ‘nothing good in life is free’ needs to be shown a few mods”), including discussion of the “mod-friendliness” of various games.
A variety of tools available for game making, often with supportive online communities, are used independently by fans. *Scratch* and *Gamestar Mechanic*, for example, while designed with educational goals, also are used by players outside of any educational setting. Other tools are designed for players with more professional aspirations, such as *GameMaker* (https://www.yoyogames.com/studio). Blurring the lines still further, *Little Big Planet* is a game primarily designed for entertainment in which players can not only play the game, but also create their own games with its level editor (Rafalow & Tekinbas, 2014).

While there have been numerous studies of game-related fan practices and communities in general, scholarly discussions or empirical studies of game modding and making outside of educational settings are relatively few. Most research focuses on modding practices and modders in relation to online communities, rather than, for example, studying individual game modders. In the following section, we discuss key ideas from the limited scholarly literature on game modding. Next, we discuss game *making* as a fan practice, and identify some new game making tools that have yet to be studied.

**Scholarship on Game Modding**

Scholarly work on fan game modding has focused on several key topics. One focus has been identifying the various practices that might be associated with game modding “in the wild.” Another focus has been understanding the game modders themselves, creating demographic profiles and identifying motivations for engaging in modding practices. One issue is how definitions of what counts as modding contributes to different perceptions of who is and isn’t engaged in modding, in particular, the underrepresentation of women. A third major focus has been on the social contexts of modding, including the nature and ethos of modding communities or affinity spaces, as well as the collaborative processes and forms of teaching and learning involved in modding. We briefly discuss each topic below.

**Modding Practices**

One challenge confronting researchers is the great diversity in the kinds of practices associated with game modding. There have been a few attempts to categorize mods, typically based on their scope and complexity. Sotamaa (2010), in a study of the game *Operation Flashpoint (OFP)*, identified three major types of modding practices: the creation of missions, add-ons, and mods. Unger (2012) proposes a general typology of game modding practices that included mutators/tweaks, add-ons, mods, and total conversions. Unger also suggests a means of analyzing mods by differentiating among “layers” of games that might be modded, including the narrative, audible, visual, interface, and rule system layers. These and other analytic frameworks tend to emphasize the technical features of mods. As Unger suggests, mods also may be understood in more qualitative terms, by identifying how mods change game play or narrative. Game mods might be characterized as an adjustment to the game, as an extension of game play or story, or as invention of a new story or form of game play.

**Game Modders**

The sheer number of game mods and the size of game modding communities suggest that game modding is a widespread practice, but the proportion of game players who also mod is small (Hayes, 2008). Given the distribution of game modding across different games and game communities, obtaining representative data about demographics, motivations, or other attributes of modders is understandably difficult, if not impossible. Several studies investigated attributes of game modders in modding communities using non-representative samples. For example, Sotamaa (2010) collected information from 23 participants in the *OFP* modding forum along with 6 members of a local *OFP* modding team; Poor (2014) distributed a questionnaire across a variety of game sites and modding forums, yielding 111 respondents; Owens (2011) collected survey data from 83 participants in the RPG Maker online community. These small scale studies make it clear, as Sotamaa (2010, p 239) wrote, “there is no such thing as an average computer game modder.” Respondents in these studies ranged from high school age to senior citizens, and their levels of educational attainment were equally as diverse, though some college completion seemed predominant. Women comprised a small percentage of modders, however.

Participants in these studies report varied motivations for modding. Sotamaa, for example, identified five major motivations that are similar to the findings of other studies: (a) playing, or improving game play, (b) hacking, or understanding and manipulating the game code, (c) researching, or gathering information about content relevant to the game mod, (d) artistic expression, and (e) cooperation with other modders. He also found some modders who hoped to use modding as a stepping stone to employment in the game design industry (also see Postigo, 2007).

Wirman (2014) argues that the association of modding with a “discourse of hackerism” (p. 79) has led to the marginalization or exclusion of certain practices from what counts as modding. This discourse emphasizes modding
as a technical activity that gives modders higher status based on their technological sophistication. This type of modding also carries an aura of illicitness, as modders operate outside the normal boundaries of what game developers intend. She contrasts this with the ethos of *The Sims* modding communities, in which practices like graphics-focused “skinning” (changing the appearance of objects or people) are popular and valued, yet do not alter the underlying game code, and are encouraged by the game company. Wirman claims that the exclusion of skinning and similar practices from most discussions of modding, as well as the association of modding with first-person shooter games, devalues the participation of women modders in games like *The Sims*, and contributes to a larger discourse that values a limited range of “intellectual” skills and knowledge in gaming. Gee & Hayes (2009) propose that “soft modding” skills, such as translating a book into a game or understanding how to engage players, should be given just as much value as technical modding skills, though they are typically overlooked in discussions of modding.

Very little attention has been given to how this discourse of hackerism might marginalize or be unappealing to particular groups of male gamers. Betsy DiSalvo and her colleagues’ research into the orientations of African-American adolescent boys towards games and game modding is one exception. These boys tended to engage in social and competitive game play, and equated digital games with “real life” sports, where rules were not to be violated. Game modding and the hacker ideology conflicted with their views of sportsmanship and how the boys used competitive game play to increase their social status among their peers (DiSalvo, Crowley, & Norwood, 2008; DiSalvo & Bruckman, 2010).

### Modding Community and Culture

The culture and community aspects of modding have been examined from different perspectives. Complex modding projects can require collaboration among a team of contributors, who have expertise in different areas, such as animation, scripting, interface design, and modeling, and some studies have examined this collaborative process (e.g., Steinkuehler & Johnson, 2009). Sotamaa (2010) found that although modding team members are formally assigned to different roles, their actual engagement with modding tasks is fluid, with members assisting each other on different aspects of a mod as needed. Collaboration also takes place through modding forums, where mod makers may ask for technical advice or share beta versions for debugging. Popular mods and modders can develop a fan base of their own, with fans even making requests for new design features (ibid).

Given the often communal nature of mod development, ownership and intellectual property rights have become topics of interest to researchers. Many mod communities promote an open source model, in which mods are made available freely for use by the community at large (Sotamaa, 2010; Unger, 2012). While requiring payment for mods is often frowned upon in mod communities, modders may request donations for mods that require considerable time and effort to produce. However, ownership of mods, or more specifically attribution rights, can be strictly enforced in these communities (Kow & Nardi, 2010).

Tensions can arise between modders and game design companies. Modding is both encouraged and viewed as subversive by game companies, and choices made by the game developer can greatly affect the “moddability” of a game. From one point of view, modding is a form of unpaid labor that benefits game companies by extending a game’s playability and keeping fans engaged. From another perspective, modding might be viewed as an effort to hack the game rules, cheat or otherwise disrupt the game experience, or as an infringement of IP rights if copyrighted art or graphics are modified or “stolen.” Game companies deal with this issue in two primary ways (Kow and Nardi, 2010): (a) through restrictions on the software platform or alternatively, by providing modding tools or development kits that allow players to make modifications while implicitly controlling what can be produced (Unger, 2012), and (b) through legal enforcement, spelling out the terms and conditions of game content use in legal documents such as end-user license agreements. Typically these documents give companies ownership rights to any user-created content uploaded to a game site or online game, and the right to restrict distribution they consider inappropriate or in violation of copyright agreements.

There has been little study of how modders and companies mutually negotiate their potentially competing interests: corporate profits on the one hand and a perceived common good on the other. In one analysis, Kow and Nardi (2010) discuss a conflict between the *World of Warcraft* modding community and Blizzard Entertainment that highlighted the negative repercussions of a company’s use of legal mandates — in this case, banning modders from seeking donations or charging players for use of a mod — on modders’ commitment to modding and their sense of ownership over their creations. They suggest that companies can manage, for example, the use of mods with undesirable effects, by changes in the game software: “... mods and the software changes are a concrete form of negotiation, in programming terms, between the company and the modders, as each develops code that suggests a new path forward to the other. Mutually exclusive values in different concrete situations can thus, in a way, be reconciled, (n.p.).
How the culture of game modding communities supports mutual teaching and learning has also received some attention from scholars. A volume edited by Hayes and Duncan (2012) includes several studies of the teaching and learning dynamics of game modding communities. Researchers have applied various forms of discourse analysis to understand how modders collectively build knowledge about modding practices and tools, as well as about broader issues related to games and their content. Hayes and Lee (2012), for example, analyzed a Sims modding forum to understand how participants learn the “language” of modding, a crucial step in newcomers’ ability to request appropriate help and to experienced members’ ability to provide assistance. Owens (2010), in a close analysis of a forum thread devoted to modding Civilization III, illustrates how participants’ desire to increase the historical accuracy of the game led them to complex discussions of the role of science and technology in society.

**New Game Making Tools & Communities**

Stand-alone game making tools have been available to aspiring game designers for decades. A variety of game-making software tools were created in the 1990s for novice programmers, such as Game Maker, RPG Maker, and Adventure Game Studio (Hayes & Games, 2008). Updated versions of these and other game-making tools are available today and typically have active user communities. Many new game-making tools recently have been released (see Table 1). The marketing for these tools tends to emphasize their ease of use and how quickly games can be created. Several are intended for the design of mobile games. Some tools are aimed at children as well as older users, and offer information for parents and teachers about the educational value of game making. Some allow users to export their games to stores such as the iOS App Store or the Android Market. Others host the games on their sites. In addition to these new tools, each of the major game consoles has or will have game making software. There is Project Spark for the Xbox One; in 2014 GameMaker: Studio was released for the Playstation 4, and Nintendo plans to release Mario Maker for the Wii U in September 2015.

Other new software tools also have been adopted for game-making by users. Twine, an open source tool for creating interactive stories, is perhaps the most widely known of such tools, due to the Gamergate controversy over Depression Quest, a game created with Twine (Lee, 2014). Twine, its games and community provide a contrast to more mainstream tools and communities. As Harvey (2014) points out, Twine games are “often both quick to make and to play” (p. 99), addressing topics that are personal and unusual for mainstream games.

These tools and their respective communities represent intriguing new directions for game making, in both formal and informal settings. They hold exciting but somewhat different potential for creativity, for introducing a broader audience to game making, and for cultivating a more varied ethos around game making. Some of these tools let users create and tinker with game design principles within a constrained, structured space. Sploder, for example, offers game creation tools for different genres, such as arcade and platform games. Some, like Stencyl, aim to attract users who want to make money by selling their games through online stores like Steam. Twine has been celebrated for serving as a hub for a women-focused game making community (Ellison, 2013). We found little published research on the use or impact of these tools, perhaps because they are still relatively new.
<table>
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<tr>
<th><strong>Site</strong></th>
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<td>iOS, Android, Flash</td>
<td>Free curriculum, no license fee</td>
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<td>Hosted on site, iOS</td>
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<td>Free and open source curriculum, student blogging platform in development, no license fees</td>
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<td>Web, Stand-alone Mac or PC Applications, iOS or Android (need additional support)</td>
<td>Education license fees, no curriculum</td>
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Table 1: New game making tools.

**Discussion & Directions for Future Research**

One of the more prominent issues evident in our review is that of inclusiveness, in terms of who participates in game making or modding, and in what sort of skills and designs are valued. Up to recently, the most prominent modders and modding communities have been heavily dominated by white men, and have over-valued technical prowess. The growing number of game making or modding tools available for popular use is already giving a wider audience the tools to participate in game making. However, even communities tied to widely appealing games with level editors like *Little Big Planet* seem to have, for example, small proportions of female modders (Rafalow & Tekinbas, 2014). Educational game making programs in afterschool contexts also tend to attract a far larger proportion of boys than girls (Webb, Repenning, & Koh, 2012). The reasons for these ongoing disparities are complex, involving both perceptions of games and game modding, and features of particular communities that are overtly or implicitly exclusive, and they merit further attention.

In general, we were surprised by the relatively small number of empirical studies of game making or modding in fan communities or other non-educational settings. There is a larger body of research on the dynamics of game fan communities, in which game modding is sometimes mentioned, and game modding also appears in some discussions of young people’s out-of-school digital media practices more broadly (e.g., Ito et al., 2009). Building on this literature, we think there are several approaches to the study of informal game modding that are necessary and useful. First are descriptive studies devoted specifically to game modding practices and communities. We need
studies of a much wider range of games and communities, to identify common elements as well as differences. A second approach is to focus on the modders themselves and build a better understanding of the role of modding in the context of their lives and broader trajectories of engagement with digital media (see, for example, Gee & Hayes, 2010; Durga, 2012; Rafalow & Tekinbas, 2014). A third approach is to locate game modding in the larger context of game play, devoting more attention, for example, to understanding how modding might be prompted by particular kinds of play, or even how the boundaries of play and modding are becoming intentionally blurred, in games like Little Big Planet or Gamestar Mechanic. How do play and modding mutually inform each other, and each make a contribution to what users gain from the experience? How do deliberate attempts on the part of game publishers to encourage game making, by providing level editors or modding tools, both encourage wider participation and potentially limit what users can do and create? The hacker ethos that pervaded earlier modding communities is hard to sustain when game making or modding is simplified and officially sanctioned. How such tools encourage new forms of culture and community is an empirical question worthy of investigation.

In addition to descriptive studies, ethnographic interventions might be implemented in fan communities to identify ways to promote learning, enhance participation, or promote new ways of collaboration and communication. While the thought of researchers “intervening” in fan communities might seem inappropriate or unethical, we draw on ideas of intervention that inform community art installations, where artists identify issues and ideas from intensive studies of local communities, and then create artwork that is intended to communicate these ideas and issues back to the community, with the goal of prompting new perspectives, dialogue, and community-driven change (Mounajjed, Peng, & Walker, 2007).

There are many challenges facing researchers in this area, and indeed in any research on digital media. The biggest challenge is how rapidly game making tools are evolving, reflecting both the evolution of computer technology as well as the evolution of games and game platforms. Tools and programs come and go rapidly; many of the game making tools and programs currently available were not in existence a decade ago, and if they were, their features have been modified considerably. The rise in popularity of gaming on mobile devices like cell phones and tablets makes it likely that game design for apps will become much more common. A challenge for researchers is identifying core questions and topics that transcend the features of individual tools and platforms. There is a similar flux in game modding communities; communities can expand, shrink or disappear along with the popularity of particular games. There are long-lasting game communities, but they are organic and evolving. While this poses a challenge, we also see an opportunity, for little research has investigated how these communities change (for exceptions, see Lammers, 2011; Lee, 2012). Overall, game making and modding “in the wild” represent a vibrant and contested arena that deserve much more attention.

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13 Fallacies: A Card Game to Promote Critical Thinking in At-risk College Students

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Joel B. Langston, Indiana University South Bend

Abstract: Fostering undergraduates’ critical thinking is a ubiquitous goal across disciplines (e.g. Gellin, 2003). How best to support the development of these skills has been a topic of debate. In this study, we investigated the design and effectiveness of a card-based game focused on student understanding of common fallacies. 13 Fallacies is designed with the intention to improve the quality of student reasoning by engaging them in exploration of common fallacies in thinking and associated social negotiation. There is strong theoretical support for 13 Fallacies to yield positive learning outcomes. Using a design-based research approach, we have completed an iterative design phase, play testing phase and have collected data on student learning outcomes as a result of classroom implementation of 13 Fallacies. Results indicate that 13 Fallacies improved student understanding of common fallacies in thinking.

Introduction

Fostering undergraduates’ critical thinking and argumentative reasoning is a ubiquitous goal across disciplines (e.g. Gellin, 2003). It is important for students to understand errors in thinking and distinguish among opinion, reasoned judgments and fact (Halpern, 2003). How best to support the development of these skills, however, has been a topic of debate (e.g. Cavagnetto, 2010). Despite our natural tendencies to argue from a young age (Hay & Ross, 1982), there are many errors we commit in our daily thinking. Often, premises might be unacceptable, unrelated to conclusions or inconsistent (Kuhn, 1991). Moreover, experts that are cited may not be credible and important information might be missing from arguments. Recognizing the errors in our thinking can be a challenge since they often seem persuasive and resemble sound reasoning despite their unsound nature (Toulmin, Rieke & Janik, 1984). Whether committing these fallacies is intentional with the goal of persuasion or simply an oversight, it is important for undergraduate students to develop an understanding of them in order to defend against them while improving the quality of their critical thinking and the strength of the arguments they advance. In our information-rich world, distinguishing sound, credible reasoning is an imperative skill across both academic and civic domains.

Gaming as a way of learning and reviewing content has become an increasingly popular way to engage students. Many games go beyond domain knowledge (e.g. Squire & Jan, 2007) to focus on more general skill sets like argumentation that can be abstracted beyond specific domains. While digital games have become increasingly popular, card-based games have been found to bridge the digital divide (Bochennek, Wittekindt, Zimmermann & Klingebiel, 2007). Card-based games as pedagogy foster collaborative learning and essential 21st Century habits of mind (Reese & Wells, 2007). Considering broad critical thinking goals of higher education and game-based pedagogical approaches, we have designed and implemented a card-based game called 13 Fallacies. This game is aimed at scaffolding students’ recognition of fallacies in others’ thinking and avoiding them in their own reasoning through social negotiation.

There are two hypotheses that have guided the design of 13 Fallacies. The first hypothesis is that, through playing the game, students will develop a deeper, enduring understanding of common fallacies in thinking. This will include not only their ability to identify these fallacies in others’ thinking, but also avoid them in their own reasoning in both formal learning environments and in their everyday lives. Second, playing 13 Fallacies will improve students’ argumentation skills and foster their development of well-reasoned, evidence-based arguments. We further hypothesize that these experiences will provide conditionally-admitted undergraduate students with general problem solving skills (Perkins & Salomon, 1989) that will, in turn, prepare them for future learning (Bransford & Schwartz, 1999) and success in other courses. In this paper we will focus on the investigation of our first hypothesis as guided by the following research question: Does engaging in 13 Fallacies play promote students’ understanding of common fallacies in thinking?

Theoretical Framework

As described in detail below, our research was conducted with conditionally-admitted undergraduate students at a Midwestern regional state campus. Aligned with this population, we have framed the development of 13 Falla-
cies in Kuh’s (2008) high impact practices, which have been shown to be beneficial for college students’ learning outcomes, affect and overall development. These practices range from collaborative projects to service learning and have been found to increase retention and engagement. 13 Fallacies connects to Kuh’s high impact practices since it is a game-based learning approach designed to improve undergraduates’ critical thinking skills while building a community of learners.

Our research is framed by the potential cognitive benefits of engaging in social game play (Gee, 2003). We are further guided by theories of argumentative reasoning (Toulmin, 1958). Toulmin, Rieke & Janik (1984) assert that the ability to recognize fallacies in thinking is an important component of reasoning and constructing sound arguments. Framed as “a kind of sensitivity training”, Toulmin, Rieke & Janik define the distinction between recognizing errors in others’ thinking as an important component of avoiding them in one’s own thinking. Moreover, arguing to support explanations or theories is a social practice that involves communication and persuasion. Berland and Reiser (2009) recognize an epistemological distinction between the process of defending explanations and the process of creating them, two key but distinct components of sound reasoning (Kuhn, 2010). In 13 Fallacies students are expected to both advance and defend the arguments they make about common fallacies. Through immersive engagement, students will be prepared for future learning (Bransford & Schwartz, 1999).

Data Source

The context of this research was an academic skills course for conditionally-admitted incoming freshmen college students at a Midwestern regional state campus. The course, U100, focuses on the development of essential academic and thinking skills aimed at preparing these students for future college courses and promoting retention. An essential component of this broad goal is to provide rigorous, relevant and relation-centered experiences for these students. Students enrolled in U100 are the University’s most at risk population. They enter college with SAT scores as low as the mid-700’s and possess minimal skills to navigate higher education.

Methodology

To conduct our research we used a design-based research approach (Brown, 1992; Collins, 1990). Using this approach allowed us to produce an instructional intervention and systematically examine resulting student learning in a classroom environment. We have separated iterations of design into two phases: initial development and classroom implementation. Initial development involved the design and play testing of 13 Fallacies. The classroom implementation phase focused on the wide-scale introduction of the game that resulted from the initial development phase and its influence on student learning outcomes.

To evaluate the effectiveness of 13 Fallacies, we administered isomorphic pre- and post-assessments. The assessments measured students’ ability to identify the common fallacies covered in the game. 13 Fallacies was played 10 times over the course of five weeks in the Fall semester of 2014. Each gameplay session lasted 30 minutes. Before the first session students completed a pre-assessment and a post-assessment was administered on the last day of the semester. 72 students consented to participate and successfully completed both the pre- and post-tests.

Description of 13 Fallacies

13 Fallacies was designed to be played in groups of 4 to 6 students. The game is designed around a mechanic similar to that found in Apples to Apples, a popular word association card game. Figure 1 provides an illustration of 13 Fallacies. In a turn of play, each player draws 5 fallacy cards that provide a definition and example of a specific common fallacy in thinking (e.g. card stacking, appeal to pity). One player serves as the judge, and this position rotates among all players to comprise a round of play. The player in the judge role flips a “scenario” card that provides a situation that contains at least three fallacies. The scenarios are framed as relevant civic instances that relate to the experience of undergraduate students at a regional state campus. For example:

There should not be an attendance policy for college classes. Students are either trusted to show up to class, or they are treated like grade school kids. Just look at all that college students have accomplished. Be a teacher who really cares about your students and drop the attendance policy.
Results and Discussion

Phase 1: Designing 13 Fallacies

To design 13 Fallacies, we began with a merger of academic goals, theories of learning, and game design mechanics (Schell, 2008). After developing a prototype, we play tested the game through three iterations. During each play test we collected field notes, then conducted follow-up discussions with participants which were groups of four to six students. After our first test, we identified areas that needed improvement. They included the number of cards each player would have in their hand, and a mechanism for students to confirm whether the judge’s ruling was accurate for a specific scenario. As a result we modified the game’s rules to include players having five cards rather than 12; we also provided a key for the instructors in order to check the accuracy of the judge’s ruling. Evidence from field notes and player interviews supported these improvements. A new concern that arose was how to scaffold the social negotiation that occurs once all of the cards are played. After our second play test, we developed four phases of the game, described in Table 1. During a third play test we observed that both mechanism and approach were engaging students and we proceeded to produce the game for wide-scale implementation.

Phase 2: Classroom Implementation

Our quantitative analysis of student’s pre and post-test data showed that student’s ability to identify common fallacies improved after playing 13 Fallacies. The average pre-test score was 28% (SD = 14.83). This suggests that students’ initial knowledge of common fallacies prior to gameplay was limited. The post-test score average was 70.25% (SD = 12.75). The average individual gain between pre- and post-test was 36.92% (SD = 16.08). The gain in student scores was statistically significant, $t(71) = 19.509, p<.001$, which indicates that 13 Fallacies helped students learn to identify common fallacies in thinking.
Anecdotal analyses of student writing following the post-test indicated that students were able to not only identify common fallacies in others’ thinking, but to provide written justifications of their reasoning. This is illustrated by the examples in Table 2.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Identification and Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>When Max’s teacher asked why he was late for class, Max responded, “Did you get my journal graded? You didn’t have it for me last class.”</td>
<td>This is the red herring fallacy because Max changes the subject in order to direct the teacher’s attention away from her original point that he was late.</td>
</tr>
<tr>
<td>When I was young, I rode a horse and it ran me into a fence. I will never ride a horse again.</td>
<td>This is a hasty generalization. The person is saying that because an accident happened one time, that means it will happen every time they ride a horse (which is probably not the case).</td>
</tr>
</tbody>
</table>

Table 2. Student justifications of fallacy identifications.

Conclusions and Scholarly Significance

This research contributes to a larger discussion on how to promote undergraduates’ critical thinking and argumentation skills by focusing on learning about common fallacies. Through adopting a ‘lightly-contextualized’ approach, students are provided with an opportunity to actively engage with their peers while analyzing their own and others’ thinking as a means to develop habits of mind necessary for academic success in higher education. Further, since our research targeted conditionally-admitted undergraduate students, our goal was to provide a scaffold for the skills of productive argumentation that are often nuanced or bound to explicit contexts, hidden in a way that prevents abstraction and transfer to new domains (Perkins & Salomon, 1989). Through playing 13 Fallacies, we make explicit the common errors in thinking and provide an opportunity that promises to promote enduring understanding, prepare students for future learning, and create a more equitable learning experience for students who might have limited development and prior knowledge of these skills. Moreover, 13 Fallacies has the potential to be adapted to the context of other courses as a way to not only promote students’ critical thinking and argumentation skills, but to also deepen their understanding of domain-specific course content. Additionally, this study contributes to our “cognitive roadmap” (Kuhn, 2005) of the types of skills needed to improve students’ critical thinking, and connects to Kuh’s (2008) high impact practices aimed at providing engaging learning experiences for undergraduate students.

While results of initial analyses indicate statistically significant learning gains, there is still room for improvement. For our next iteration of play we plan to integrate multimedia scenarios into 13 Fallacies. Players would view the scenarios on a mobile device during game play. We hypothesize that blending multimedia with face-to-face gameplay will promote student engagement and result in a more robust, enduring understanding of the common fallacies covered in our curriculum.

References


Sick Kitty—Toward Promoting Deductive Reasoning through an Embodied Medical Diagnosis Game

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Aashish Tandon, University of Illinois at Chicago
Anushri Prabhu, University of Illinois at Chicago

Abstract: In this paper, we introduce Sick Kitty, a multimodal deductive logic game for primary school children. Sick Kitty situates students as experts with the task of disease diagnosis. They are equipped with a mix of simulated medical tools and a lively stuffed kitty as patient. Sick Kitty is an untraditional method to teach reasoning in classrooms. The main contribution of this work is the design of the multi-modal logic game that promotes scientific reasoning and inquiry. We expect that Sick Kitty will promote the development of deductive reasoning ability for students.

Introduction

The classroom offers the opportunity to teach children how to reason and use reason as a tool for learning. Moreover, children can be taught to value their capacity for thinking along with how to learn from others and share in inquiry. Much of our current interest in improving critical thinking among students stems from their developmental need for higher-order thinking ability coupled with the growing economic and political urgency for students as critical thinkers (Idol, Jones, & North Central Regional Educational Laboratory, 1991).

We have focused our efforts on improving deductive logic. Deductive logic plays an essential role in all aspects of critical thinking (Ennis, 1971). Ennis and his associates discovered that primary children vary greatly in their degree of competence in conditional logic, and the principles differed considerably amongst themselves in their degree of difficulty. The evidence here reported is taken to count rather strongly against Piaget's claims that children under 11–12 years of age cannot handle propositional logic and cannot reason correctly from premises that they do not believe. Conditional logic knowledge correlated fairly highly with Wechsler verbal IQ, moderately with socioeconomic status, and weakly with dwelling area. Boys and girls appeared to be about equal in logical ability.

Fluid intelligence refers to the use of mental operations to solve novel problems (Primi, Ferrão, & Almeida, 2010). These mental operations include extrapolating, transforming, and classifying information; drawing inferences; identifying relations; constructing concepts; comprehending implications; solving problems; generating and testing hypotheses; and inductive and deductive reasoning (Barkl, Porter, & Ginns, 2012). Sick Kitty is a learning activity aimed toward the development of deductive logic in children 10–12 years of age.

Sick Kitty situates students as experts with the task of disease diagnosis. They are equipped with an Android smartphone (or tablet), Sick Kitty application, and a modified stuffed kitty as patient. The Sick Kitty application drives the diagnosis experience via simulated medical tools and a chart for tracking diseases and symptoms. Sick Kitty differs from other research regarding in-classroom logic training as it relies on the use of children's sensory abilities and technological interactions to solve game-based deductive logic puzzles. First, this paper explores the theories regarding children and reasoning followed by a review of prior work in this area. We then introduce our approach, Sick Kitty, and detail the design and rationale, system architecture, and planned evaluation.

Figure 1: Sick Kitty Prototype (far left) and the ECG (middle) and X-Ray (right) to detect symptoms
Background

Reasoning Tasks

The nature of deductive logic is the ability to predict the outcome of a particular event given a general principle. The Sick Kitty Project allows for primary school students to develop their deductive logic in a trial-and-error fashion, an approach that is customary for their operational stage of development (Ennis, 1975). Moreover, the project emphasizes the application of this knowledge to real world problem solving, that of medical diagnosis.

Ennis’ work evaluates children’s abilities to assess the conclusions of deductive arguments in the form of the basic principles of class and conditional reasoning. The format of questions is as follows:

Suppose you know that
Premise 1
Premise 2
Then would this be true?
Conclusion

The possible responses are “A. YES,” “B. NO,” and “C. MAYBE.” This type of reasoning is essential to the activity we present.

Stages of Reasoning Development

The well-known work of Jean Piaget regarding cognitive development contends that children between 10-12 years old often struggle to attain proficiency in deductive logic (Inhelder, Piaget, Parsons, & Milgram, 1958). However, other studies show that instruction in certain principles of deductive reasoning, such as modus ponens, could begin as early as the fourth grade and yield meaningful results (Barkl et al., 2012; Roberge, 1970).

Shapiro’s work shows that elementary-school children have considerable success in recognizing logically necessary conclusions. However, primary school children, do not show the same success in their ability to distinguish between a logically necessary conclusion and a statement which is not logically necessary (Shapiro & O’Brien, 1970).

Sabinin shows that even preschool aged children can perform logical reasoning. Activities geared toward this group must have non-complex tasks, few things to remember, and few steps. A familiar context for the reasoning is also ideal for this age group. As students grow, their logical reasoning complexity increases along with their familiarity with varying contexts. Moreover, they learn to visualize and imagine more accurately (Sabinin, 2013).

Related Work

During the last several decades, there have been a number of empirical investigations focused on the development of logical ability in children (Barkl et al., 2012; McCarthy-Tucker, 1998; Roberge, 1970; Sabinin, 2013). However, none of these studies have implemented the use of a multimodal game for student training, moreover, much of the emphasis is placed on the instructor delivering a set curriculum of materials.

Roberge’s work contributed to theory concerning the development of logical reasoning ability in children. Roberge offers insight on the grade levels at which specific principles of class and conditional reasoning might be taught given children’s developmental patterns. His results suggest that formal classroom instruction in deductive reasoning, such as modus ponens, could begin as early as the fourth grade (Roberge, 1970).

The CTC program is a guided-learning paradigm in which students are talked through problems, asked questions, encouraged to verbalize their solution strategies, and practice these skills over time. Barkl et al used the CTC program to test its effect on student reasoning and mathematics achievement. The study compared the CTC program delivered to individuals, to groups, and to a no-treatment control group. Students performed cognitive abilities test, inductive reasoning test, deductive reasoning tests, and tests for mathematics achievement (Barkl et al., 2012). The results showed that both individual and small group-based training on the CTC program enhanced inductive and deductive reasoning ability.

The work of Sabinin follows a more playful approach to logic learning. Students are equipped with “Smart Cook-
ies”, a logic puzzle, and teachers follow a supplementary curriculum for puzzle instance creation and resulting discussion questions. Sabinin’s research emphasizes the importance of visualization and reasoning-and-proving. Students are able to work individually, in groups, or as a class and the puzzles cover a full range of difficulty to accommodate many levels of student preparedness and aptitude (Sabinin, 2013). Lastly, Sabinin contends that the availability of feedback from the activity as opposed to the teacher develops independent checking for students.

McCarthy-Tucker investigated whether teaching formal logic to adolescents in a U.S. public high school ameliorated their ability to think critically as measured by both standardized ability tests and student self-perception (McCarthy-Tucker, 1998). Results suggest that adolescents instructed systematically regarding components of logical reasoning improved their thinking skills. These components included the purposes of reasoning, conditional reasoning, antecedents and consequents, deductive, inductive, hypothetical-deductive, and analogical reasoning, and a discussion of laws of probability among other topics. The study also found that relating the activities to realistic events, and student concerns and questions was an essential part of instruction.

Design Rationale

At its core, Sick Kitty is a logic puzzle game with visual, auditory, and tactile presentation layers embodied in a stuffed animal, Sick Kitty, and further played out on a mobile device. Our hope is that the multimodality will be appealing to the target audience while increasing learning gains. Further, the distinct separation of layers bodes well from a design perspective and helps us develop each of the components with a high degree of autonomy.

Sick Kitty is a team game with a trial-and-error approach to play that is somewhat similar to the classic board game ‘Guess Who?’ (“Guess Who?,” 2015). In ‘Guess Who’, two players take turns in deciding which card their opponent has by a process of elimination using questions such as ‘Do they have brown eyes?’. In Sick Kitty, the teams examine a tangible patient, Sick Kitty, for various symptoms and, given a the diagnostic interface which correlates symptoms to illnesses, teams are able to discover Sick Kitty’s illness. The game accommodates varying levels of difficulty via probability reasoning. For example, an illness may have multiple symptoms, however all of them may not occur 100% of the time. This requires students to use additional logical reasoning and perhaps perform additional diagnostic tests.

We also enhance gamification by introducing a scoring element to determine team success. A monetary value is attached to a symptom’s diagnostic test. This encourages students to use the most efficient combination of steps to reach a diagnosis. For example, an X-ray could cost $1000 while a physical exam could cost $50. Students receive these costs at the onset of the activity. The scoring element is also especially useful for teachers if evaluation of performance is required.

Another key design decision for Sick Kitty is the use of fictional symptoms and illnesses. As medical diagnosis is a real domain, we recognize that students may have varying levels of exposure to medical trauma that may cause negative emotional responses. We avoid these parallels through our fictional medic world. An additional benefit to this approach is the ability to easily make new illnesses and symptoms to further accommodate student levels of learning.

Prototype Overview

During the Sick Kitty learning experience, students aim to diagnose Sick Kitty’s illness. The core activity is a deductive reasoning and elimination game that focuses on deciding what symptoms Sick Kitty exhibits and what the most likely illness could be given those symptoms.

At the start of the game, students form teams. Each team is given a Sick Kitty, which has been initialized by the teacher to have a particular illness and certain symptoms. The team is also given a mobile device equipped with a set of tools, including an X-ray scanner, ECG and diagnostic interface and shown in Figure 1 and Table 1. On the diagnostic interface, each illness’s symptoms are marked in up to three ways:

- must have symptom
- (optional) can have symptom
- cannot have symptom

Given this information, the team must systematically eliminate potential illnesses and narrow down to the most likely illness which is distressing Sick Kitty. The diagnostic tests support different modalities for interaction. For example, a student performs a heart rate test by measuring Sick Kitty’s pulse via touching her wrist and counting
the number of vibrations in a tactile fashion. Table 2 shows a list of all symptoms, how the students test for that symptom, and the type of technology we use to create a compelling educational game experience.

Table 1: Sample Information from Diagnostic Interface

<table>
<thead>
<tr>
<th>Disease</th>
<th>Symptoms</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumpkaboo</td>
<td>Groaning, Coughing, Sneezing, Sore Belly, Sore Throat, Fast Pulse, Slow Pulse, Rocky Kidneys, Funny Leg, Slow Heart, Fast Heart, Funky Heart</td>
<td>Auditory Speaker</td>
</tr>
<tr>
<td>Aromatissse</td>
<td>Press Kitty’s throat Button</td>
<td>Press Kitty’s stomach Button</td>
</tr>
<tr>
<td>Scatterbnd</td>
<td>Pulse Motor</td>
<td>Touch Kitty’s wrist Motor</td>
</tr>
<tr>
<td>Chezipin</td>
<td>Rocky Kidneys Ultrasound (mobile) NFC</td>
<td></td>
</tr>
<tr>
<td>Volcarone</td>
<td>Funny Leg X-Ray (mobile) QR</td>
<td></td>
</tr>
<tr>
<td>Ulgmenth</td>
<td>Slow/Fast/Funky Heart Electrocardiogram (mobile) USB</td>
<td></td>
</tr>
<tr>
<td>Golaruk</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cost: Free $100 $200 Free $1000 $2000 $1300 $1300 $1300

Figure 3 - Sample Diagnostic Sheet

Table 2: Symptom Details

<table>
<thead>
<tr>
<th>Name</th>
<th>Tool</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groaning, Coughing, Sneezing</td>
<td>Auditory</td>
<td>Speaker</td>
</tr>
<tr>
<td>Ticklish, Sore Throat</td>
<td>Press Kitty’s throat Button</td>
<td></td>
</tr>
<tr>
<td>Sore Belly</td>
<td>Press Kitty’s stomach Button</td>
<td></td>
</tr>
<tr>
<td>Pulse</td>
<td>Touch Kitty’s wrist Motor</td>
<td></td>
</tr>
<tr>
<td>Rocky Kidneys</td>
<td>Ultrasound (mobile) NFC</td>
<td></td>
</tr>
<tr>
<td>Funny Leg</td>
<td>X-Ray (mobile) QR</td>
<td></td>
</tr>
<tr>
<td>Slow/Fast/Funky Heart</td>
<td>Electrocardiogram (mobile) USB</td>
<td></td>
</tr>
</tbody>
</table>

System Implementation

Sick Kitty uses a distributed, modular architecture. Broadly speaking, the system is split into two pieces: (a) a single server application and (b) external devices supported by a well-defined API. The server application is responsible for the state and actions of the physical Sick Kitty. Each Sick Kitty will have a single server application and up to 16 different external devices that can dynamically connect to the server via Bluetooth. The API allows for these external devices to interact with the server application via synchronous message passing. This works similarly to web requests; a message structure is marshalled into XML, where it is sent to the server, it is then processed, and then an acknowledgement with some response is sent back to the device. A full lifecycle of the applications can be seen in Figure 3.

Server

The server is a standard desktop Java application running on a Raspberry PI (Halfacree & Upton, 2012). On startup, the server application initializes with two configuration files: a list of illnesses, and a list of symptoms. At this point Sick Kitty is put into a default state of no active game. A game activates via a message from an external device, the administration console, which dictates Sick Kitty’s illness.

Once Sick Kitty is activated with the type of illness, the game state loads the appropriate symptoms. The symptoms are assigned based on the illness configuration. When the symptom list is finalized, the game loop will execute at a rate of 20 times per second. Each call of the game loop will address three important functions: 1) process external messages, 2) update Sick Kitty’s state, 3) and give appropriate output.
To begin, the server processes messages from the external devices. This is done by querying each active Bluetooth port, reading, processing, and then writing any response in XML. The main messages include:

- Starting a new game, given an illness
- Getting a list of all illnesses
- Getting a list of current symptoms which Sick Kitty is suffering from
- Setting an antidote
- Make a charge to Sick Kitty’s account

Next, the server updates Sick Kitty’s game state. Sick Kitty will hold numerous attributes that describe the current game state. For example, an internal state variable is the value of the heart rate timer. There are also some external stimulus’ that affect Sick Kitty’s state such as button presses. Finally, Sick Kitty produces output given her current state. Outputs include Sick Kitty’s pulse vibration and sounds in the form of groaning or sneezing.

Apart from the Bluetooth interaction with external devices, the server also handles I/O via the Raspberry PI’s GPIO pins. The general IO pins can be connected to simple electronic components, such as buttons and switches. Sick Kitty uses the GPIO for responsiveness to push sensations and tactile feedback generation. For example, Sick Kitty winces if pressed on her stomach while attributing the “Sore Belly” symptom. Additionally, a vibrating coin motor in Sick Kitty’s wrist is connected to the GPIO pin. A timer turns the motor on and off at determined intervals to give the illusion of Sick Kitty’s pulse.

External Devices

External devices serve as additional interfaces to Sick Kitty. We employ our Sick Kitty android application that supports two modes: (a) administration console and (b) student interface, which contains a series of student tools used to diagnose Kitty’s illness.

The administration console provides the teacher with game setup and monitoring privileges. The console allows the teacher to start new games with specific illnesses, as well as view details about the current game, such as the duration, real-time costs, the number of diagnoses and most recent diagnosis.

The student interface provides a consistently embodied experience to students that naturally replicates medical diagnosis. A student diagnosis instrument will acquire the current symptom list, charge the team account for instrument use, and provide feedback that gives insight into Sick Kitty’s illness.
An example of a student instrument is the Ultrasound tool. This tool depicts if Sick Kitty is suffering from the symptom ‘Rocky Kidneys’. Students must slowly swipe the tool over Sick Kitty’s kidney area to activate the Ultrasound test. The tool is detected once the device’s NFC reader nears the RFID tags stitched into Sick Kitty. Once read, the tool displays an appropriate image based on the symptom list and the students can then deduce the presence or absence of the symptom.

**Future Work & Evaluation**

As stated the goal of our work is to explore how a multi-modal game can improve primary school students’ deductive reasoning ability. While we successfully implemented the overall system design and functionality, we still intend to implement the game in a local Chicago elementary school. To evaluate improvement in the students’ development of deductive logic, we will use a derivative of the Cornell Conditional Reasoning Test. The tests are based on the same principles of deductive logic we hope to enhance through Sick Kitty (Ennis & Paulus, 1965).

We are also interested in evaluating students’ level of engagement in the activity. We will accomplish this through a Likert scale survey of satisfaction. Finally, we would like to analyze students’ logic strategies. The questions we wish to analyze include: what kinds of strategies are used, and whether the strategies change over time. All these questions are important in order to understand the student’s learning process and how to improve learning gains for the game.

Lastly, there exist a large number of possibilities that can be incorporated into future iterations of the design to further enhance and improve the activity. For example, speech recognition and generation can be added to provide another mode of interaction.

**Conclusion**

We achieved each of the desired core functionality components for first prototype iteration of the Sick Kitty game. Functionality includes:

- A large stuffed kitty with the following enhancements:
  - Pressure sensors to detect touch at stomach and neck
  - RFID tags for proximity detection with an NFC enabled device
  - Vibrating coin motor on wrist
  - Speaker output capability

- Android application with administration console, diagnostic interface, and the following tools:
  - X-ray scanner
  - Electrocardiography (ECG)
  - Ultrasound

- Game server
  - Definitions of illnesses and symptoms given in an XML file
  - Kitty reacts to stimulus as appropriate to its illness and ailments
  - Diagnoses strategy score

The current prototype version of Sick Kitty is fully functional and promising for future classroom deployment. Sick Kitty accommodates varying levels of deductive learning and can become a valuable tool for classroom and individual logic development training.

**References**


Meet the (Media) Producers

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Lorraine Lin, Clemson University

Abstract: This research details the perceived influence of early gaming habits towards media production from seven students enrolled at a university in the Southeast. Participants identified as heavily involved in creating media such as anime, videos, fanfiction, webcomics, games, and digital music. Data collection and analysis included surveys, interviews, and artifacts identifying and categorizing six main themes: game play preferences, persistence, early connections between game play and media, support and feedback, creations inspired by games, and significance of games in current lives. The study found that most participants believed game play in childhood influenced increasingly complex media production habits. Six of the seven believed game play influenced their career path. The paper concludes with implications for education.

Introduction

While considerable research has been conducted on why people play and persist in games (Callega, 2010; Gee, 2007; Cole & Griffiths, 2007), the benefits of gaming to promote systems thinking, problem solving, creativity and interpersonal skills (Cayton-Hodges, 2011; Gee, 2005; Granic, Lobel, & Engels, 2014; Jackson et al., 2011; Shapiro, 2014), and the convergence of gaming and other forms of media production surrounding games (e.g. in affinity groups, modding games, creating artifacts for game play) [Gee & Hayes, 2010; Jenkins, 2006; Squire, 2011]), less research has been done directly with those who create media inspired by past game play. These media producers are ever-present, yet can be hard to find since there is no central network of “creators” as sharing media varies by genre, preferred platform or method of sharing, and whim of the producer. At times the work is considered a hobby going unnoticed unless others take interest.

Gee and Hayes’ (2010) narratives of four women gamers, in various stages of life, provides the most detailed explanation of gaming as a gateway to technical and interpersonal skills, design, writing, artistic expression and programming. In one account, Gee and Hayes trace the trajectory of a successful human resources developer to skills honed in a virtual world and its surrounding communities of practice. The authors discuss the capacity of games to influence enduring personal goals, which in turn impacted the women’s navigation of social, cultural, and economic problems. They suggest games and digital media have significantly altered the learning landscape allowing people to pursue their own special trajectory—with tremendous, but largely ignored, consequences for education. Similarly, in a literature review of gaming in education (McClarty et al., 2012), games are described as opportunities for personalized and interest-driven learning. However, the review provides scenarios rather than empirical evidence for how this might occur.

Since media production is increasingly valued as an expression of literacy and considered an important means of preparing students in the 21st century (Peppler & Kafai, 2007; Gee, 2009), understanding the potential of game play towards media production may offer insight into (a) how to provide interest-driven approaches to learning, and (b) effective ways to enhance deeper learning experiences. This study draws on the work of Gee & Hayes (2010) and adds to the literature on productive play. It provides an in-depth look at the relationship between game play and media production from the perspective of seven young adults who trace their trajectory from youth to early adulthood. Our central question was, “Has video game playing impacted your media production?” Specifically, we sought to explore if they believed the introduction of video game play in their lives influenced their production habits or career goals.

The Study

Qualitative inquiry was used to investigate “how people interpret their worlds, how they construct their worlds, and what meaning they attribute to their experiences (Merriam, 2009, p. 5); in this case how students engaging in producing media interpreted whether their current production is attributed to their game-playing experiences. The study was approached through semi-structured questions and in-depth interviews (Merriam, 2009) allowing us to analyze the relationship between game play and media production, the phenomena we wished to understand and describe. Data was collected from individuals who shared this common experienced and self-identified as video-game players and media producers.
Participants

Seven students at a university in the Southeastern United States enrolled in 4 different program areas (Computer Science, Education, Communications, and Engineering) were recruited for the study. Three were female, and all were chosen because they spent significant time in the University’s media labs and self-identified as passionate about, and deeply involved in producing media. Participants were between the ages of 19 and 24; two were graduate students, the other five were undergraduates. Most came from middle class families with 2-parent households, one student reported their household income below $25,000, and one reported a household income above $100,000 while growing up, and all had siblings. None of the students perceived their parents as media producers; one student clarified that while her father worked at Disney for a short time he did not “animate” or create media. Six of the seven participants had parents who imposed limits on time spent playing games in childhood, with one participant stating his father really “hated” video games. Participants’ common media production habits included: digital music mixing and production, webcomics, fanfiction, fanart, instructional video creation, and designing games.

Data Collection

Data was collected via in-depth surveys aimed at understanding participants’ demographics, early experiences with game playing and media production, enjoyment of games, perspectives towards the influence of games and current media production, and beliefs about the influence of game play and media production for career or life goals. The first survey consisted of 43 questions and informed questions for follow-up interviews. A Google Hangout facilitated a full-group interview with nine additional questions formulated to extend the survey responses, probing further about game play and media production habits. The interview was recorded and transcribed. Finally, follow-up emails invited participants to clarify information, and share links or artifacts to their current work. All seven participated in both surveys and the Google Hangout, six of the seven participated in the email exchanges and provided artifacts (embedded images, video, links to websites), including written narration explaining the examples of their media production.

Following the steps of qualitative data analysis, three researchers used open coding, which were then grouped into “analytical codes” to interpret the data and highlight categories (Merriam, 2009, p. 180). This provided an initial understanding of how the participants experienced game play and media production in their lives. Next, each researcher developed categorical codes or “clusters of meaning” (Creswell, p. 61) from the data, which were used to write a description of themes tied to participants’ experiences. Nvivo was used by two of the researchers to identify, sort and code themes, the third researcher read, winnowed, and sorted data into themes manually. Consensus regarding themes from clusters of meaning identified participants’ perceptions of (a) game play preferences, (b) persistence, (c) early connections between game play and media production, (d) support systems and feedback, (e) media creation; and (f) significance of games in their current life.

We highlight each theme as we recreate the essence of “how and why” these individuals believe video game play influenced their media production, referring to them collectively as “Media Producers”.

Game Play Preferences

Affinity for fiction

The Media Producers stated that they preferred games encompassing adventure, historical fiction, science fiction, role-playing or fantasy while growing up. Six of the 7 participants mentioned enjoying the genres of role-playing and platforming games, wanting to “put themselves in the character’s shoes”. The same six participants owned multiple gaming consoles, with the one participant, “Krista” (all names are pseudonyms) only owning and gaming on a PC. When asked to rate the importance of the genre to the enjoyment of games on a “scale of 1-10”, again the 6 console gamers rated the genre as highly important, assigning an 8, 9 or 10, and Krista rated the genre as a “3”.

Fantasy and role-playing

Asking participants to simply talk about their favorite games or series growing up, six mentioned games with deep narrative storylines such as Final Fantasy (Squaresoft, 1997) Blizzard games, Zelda (Nintendo, 1986) and Half-Life (Sierra Studios, 1998). One mentioned enjoying MECC (1973) adventure games such as Oregon Trail. Most of the games mentioned were in the ‘high-fantasy’ or ‘science-fiction’ genre, meaning they included magic or non-existent technology such as flying pirate ships or light sabers. When asked to specify favorite games when growing up, all of the Media Producers, without direct prompting, discussed researching a particular game’s development, and the feelings and skills the games evoked. For example, Destiny suggested she was “hooked on
the Final Fantasy franchise” (Square Enix, 2015) and admired the sole composer for the series as a “self-taught musician that I look up to”; Riley enjoyed Super Smash Bros. (Nintendo, 2014), Metroid (Nintendo, 2002) and Pokémon (The Pokémon Company, 1996) franchises saying “Pokémon singlehandedly motivated me to learn how to read when I first got it for the Gameboy”. LouAnn stated that Final Fantasy 7 and 9 introduced her to “really deep story-telling and character connections”. Krista suggested, a point and click adventure game, Spy Fox in Dry Cereal (Humongous Entertainment, 1997) had developers who understood “amusing dialogue and animations”. All of the Media Producers said they enjoyed the same type of games now as they did growing up and while they branched out into newly released games they often followed the next generation of games by the same developer.

**Persistence: Fun, Immersion and Completion**

Five participants talked about escaping the real world, immersing themselves in fantasy, and feeling a sense of completion or accomplishment by “finishing a collection” (completing a series of games). All seven participants mentioned the importance of fun when asked why they currently gamed and suggested they would continue playing particular games if they had rich story lines, were highly interactive and had well-developed characters. The Media Producers discussed the amount of development that went producing a good game making statements such as:

“I think the reason I like them (referring to Super Mario Brothers, Zelda, and Halo) the most was because of the amount of development that was put into making them good games. Poorly architected games were clear when you played them. The online multiplayer component and competitiveness—being able to beat people in fights or game play or character statistics—that was great, too.”

They believed certain game mechanics increased their persistence and allowed them to escape becoming totally immersed in the game. One participant noted gaming allowed her to take “a vacation to the game worlds in my living room anytime I wanted”, and another said she played pretend with her sister while fully immersed in game play. Leveling up, solving puzzles and taking on increasingly difficult challenges were cited as enjoyable and not tedious.

**Early Connections between Game Play and Media Production**

Interestingly, the majority of Media Producers pointed to particular types of media embedded within their favorite childhood games when asked why specific games became their favorites. They mentioned the games graphics, music, well-developed worlds or artwork. To illuminate understanding, we provide transcribed data from 2 of the participants. When talking about the Metroid franchise, a series of 11 science-fiction games played on the Game Boy, Riley stated:

Looking back on it, and replaying it within the last year, I think what kept bringing me back was the immersive and open environment that I could explore. The pixel artwork was very detailed, and the music and sound design really drew me in. Car trips to the beach and mountains would blur by and all I remember of that time are the cool, metal walls of the Biologic Space Laboratories. By the time I played *Half-Life 2* (Sierra Entertainment, 2004), I had played a lot of good and mediocre shooters. *Half-Life 2* blew my mind because, like Metroid: Fusion, it was very immersive and structured itself differently from most shooters I’d played. In many cases, I was either given a very short, paragraph length briefing on why I was either sneaking into this building or storming this village to shoot dudes, or given a more informative but immersion breaking cutscene.

James stated:

As for Zelda, my friends liked it and I thought it was cool, though until recently I’ve never been very good at them- however, Zelda’s world and designs helped spark a love for fantasy settings and characters, which show up prevalently in my work. *Earthbound* (Nintendo, 1994) hit home with my deep seated love of cartoons and silly games, and influenced that side of art.

**Support and Feedback**

Five of the seven participants talked in great detail about the social aspect of gaming playing with friends, other gamers, while exploring and conquering fantastical worlds. They expressed feelings of social support whether playing with or against “friends” making statements such as, “I enjoy being able to beat people I *like*…and totally destroying them was great, too.” “I made friends over video games, and still do”, “I played with a cast of exciting
and interesting characters who would talk to me and make me feel important", and “I’ve connected with a lot of amazin

g people through them, and many an hour has been spent going over experiences in games or story lines or characters.”

Participation in online gaming communities was mixed among the 7 participants; three participated in gaming

communities related their play such as Steam (http://steamcommunity.com/), MMO forums, and The Art of Warfare

(www.taw.net). Although we asked exclusively about gaming, many referred to games as the connection to partic-

ular online communities related to media production. For example, Arnie talked about his significant participation

creating music for Ableton (https://www.ableton.com/), LouAnn mentioned art communities such as DeviantArt

(http://www.deviantart.com/) and Furaffinity (http://www.furaffinity.net/), and Riley discussed co-hosting a monthly

online video talkshow in support of game development.

School was not considered a primary support, and in some cases not even a secondary support for media creation.

Riley and James created and shared music and artwork online; Arnie was heavily involved in music programs at

school, yet his network to share his compositions existed outside of school; Alex saw his best, most creative writing

as unencumbered outside of school; and LouAnn felt largely misunderstood by her teachers, writing fanfiction and
creating anime for her Internet fans. At the university level, few of their skills were recognized in coursework other

than a few specialized classes using 3-D modeling or game design modding.

Media Production: Creations Inspired by Games

All seven of the participants believed most of their current creations were inspired by video games, often having

been played years ago. Destiny said all but two or three of her songs were inspired by Final Fantasy and Super

Nintendo games, in particular the game Aero the Acrobat, (Sunsoft, 1993); Riley drew fan art inspired by Star-

Fox (Nintendo, 1993) and other short platforming games; Arnie, who designed graffiti art and music, believed

the biggest contribution game play had was in his interpretation of what was aesthetically pleasing; Krista wrote

several fan-fictions and drew hundreds of fan art characters based on various games; LouAnn suggested almost
every drawing and animation she created came from video game play (she was also heavily involved in cosplay,

a subculture promoting costuming and role play with particular characters); Alex said much of his fiction writing is

inspired by video games. James provided a trajectory of game-play inspired media production saying:

[Games inspired] pretty much every doodle in elementary, sketches in middle school, more com-

plex works in high school and college. When I started on deviant art, I only did Earthbound draw-

ings pretty much - 2D drawings in flash, 3D renderings in blender of pseudo n64 graphics… then

I moved on to an idea of my own that I never did anything with (hey I was like, what, 13?). Then

more complex 3D pictures, 2D digital in photoshop… then I moved on to other games like ario,

ario, ario, etc. On youtube, I have a channel dedicated to direct transcriptions of Earthbound (and

other) songs. As for more original works, any character I create I automatically think “could I put

this in a game sometime down the road?” when I was in elementary school, I tried to come up with

a game idea, creating characters and a whole world- I was a very ambitious child. As I got older,

I did a choral arrangement of the song “wisdom of the world” from the Earthbound series, and a

transcription of the barbershop rendition of “God Only Knows” from Bioshock Infinite.

Significance of Games and Media in their Current Life

The Media Producers unequivocally believed video games were important in their current lives, but not simply for

fun, social bonding, or challenge. Six of the seven participants stated game play was important for continuing inspi-

ration to guide media production. They mentioned passion, the need for creative expression, occasional profit, and

promoting a sense of happiness as reasons for their continued productivity. Their current media production includ-

ed: working on music for an Android App a friend was releasing, producing an album, creating a “logo series” using

Adobe Illustrator (http://www.adobe.com/products/illustrator.html), drawing comics for a writer, drawing charac-
ter-expression art for Dungeons & Dragons, and transcribing the orchestra parts of Pink Floyd’s, “The Trail”. Many

of them noted they were occasionally approached and paid for their current work, usually by friends or someone

who had viewed their work online. Alex said, “They inspire me to write stories. My inspiration for becoming a writer

came from seeing the great worlds created in video games, and I desired to recreate that in writing”, and James

spoke in depth about the continuing influence of games to engaging with other forms of media saying, “If it wasn’t

for games, I wouldn’t have drawn as much or got into wanting to make music, or got into pretending so much as a

kid.” Many were eager to share their current productions; screenshots from two of the Media Producers are below.

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Aspirations: Perceived influence on their future

The Media Producers are currently making media and believe they will continue to make media in the future as either a hobby or career. Lack of time or energy, time management, the capacity to learn new programs, at times, keeps them from producing as much as they would like. Three of the seven saw game-play as integral to the career wanted in gaming industry, however three others mentioned game-play inspired careers unrelated to a gaming career. LouAnn, Riley, and Destiny hoped to work in the game design industry with three separate interests: writing narratives, mixing soundtracks, and programming games. Riley was also considering a career in writing soundtracks for television or movies. James wanted a career in animation that focused on voice-acting or 3-D modeling. Alex said he wanted a career in what he loved, and what was inspired by games—writing for digital newspaper or magazine. Krista hoped to be a voice actor on animated movies even though her degree was in Engineering with a minor in Japanese. Arnie saw media production continuing to influence his hobbies but didn’t know if it would have a strong influence in his planned future as an administrator in higher education. Interestingly, four participants said that without the influence of video games they do not know what they would be doing on their “life track”.

The Media Producers offered thoughts regarding why some produce more media than others. Most of them believed their need to be creative was something they developed at a young age, and three of them pointed to “fear” as reason why some choose not to create media. Riley said some people were afraid to write (his passion), Alex suggested it was “fear of the unknown” citing the Internet as an “open door for experimentation with digital media and an overwhelming number of resources”, and Arnie commented that the competition, especially with crowd-funding was so fierce that it scared amateurs off.

Discussion

As evidenced in the themes above, the Media Producers were more likely to persist at playing games offering fantasy worlds, role-play or interaction with characters and other players through action and adventure. They believed the immersive experiences provided support, fun, “an escape,” and challenge impacting perseverance in which they completed long games or in some cases entire series. These findings are consistent with a large body of research suggesting game elements influence players’ persistence and motivation (Cole & Griffiths, 2007; Gee, 2007). Emerging from this research was evidence that most of the young gamers were drawn to types of media present within games (graphics, music, artwork) at young ages, and this exposure inspired them to produce similar types of media extending many years into the future; all of the Media Producers pointed to the strong influence of gameplay to their current production. Furthermore (as demonstrated in James detailed account) some of the Media Producers became interested in creating various forms of media, but then continued refining and learning more sophisticated ways to use the medium. These findings are consistent with Gee and Hayes (2010) and imply that early experiences with gameplay could shape the trajectory of media production (interests and products) and
in some instances influence interest in particular careers. The study points to two significant ideas, detailed in the following sections, that may impact pedagogical approaches with media in K-12 and higher education settings.

**Games as Conduits to Interest-based or Personalized Learning**

The inarguable value the Media Producers placed on game play to pique their interests, provide a means of socialization and support, and facilitate a means of escape is not novel finding, but instead consistent with research across fields (Callega, 2010; Gee, 2007; Granic, Lobel, & Engels, 2014). What is significant are findings suggesting particular games captured the Media Producers attention and then persisted with various types of media that were first appealing, and then became the focus of their work for years to come, in many cases the influence has persisted for more than a decade. The Media Producers pointed to particular games capturing their imagination, inspiring them to take on roles, write stories, draw, and create music—not necessarily tied to modding the game, creating artifacts or fanfiction around the game. Admittedly, the participants’ relatively young age makes it difficult to assess if the trend will continue, but it seems likely based on their beliefs about their future creating media. This implies that educators in K-12 and higher education may draw on game play preferences, or specific game genres important to individuals as a starting point to personalize learning. Conceivably, understanding learners gaming interests and connecting it to thoughtful media production may entice learners to hone multiliteracies, giving them a voice (Soep, 2007) and foster a sense of well-being (Andersen & Rainie, 2012) while promoting learning.

**Connecting Game Play and Media Production to Careers**

Importantly, this study demonstrated that game play could influence career paths, including aspirations outside of the game design industry. Six of the seven participants discussed the strong connection between game play as a primary influence of their media production, which in turn influenced their career paths. Early experiences with game narratives, design elements, and soundtracks were identified as highly appealing by the young adults and created a desire to increase skill development and production. This often translated to honing more complex practices with 3-D modeling, computer animation, photo editing, video editing, music composition and audio platforms. Support for refining the skills occurred primarily outside of school with the exception of a few computer science courses teaching 3-D modeling skills; the primary reinforcement to continue their work occurred through online critique and feedback. This finding implies there is value in relating game play and media design experiences to assist learners in developing career goals. It also raises the question of whether middle, secondary and post-secondary educators might offer additional supports to reinforce work shared in online communities, and whether these supports might assist students in career choices. A useful tactic might include educators beginning by exploring their students’ game play interests, connecting those interests to media production, and then guiding students to consider a wider range of careers. Further research is necessary to build theories around interest-driven learning with media.

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Applying “Deep Gamification” Principles to Improve Quality of User-Designed Levels

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Abstract: While there are many potential benefits of user-generated content for serious games, the variability of that content’s quality poses a serious problem. In our game, BOTS, players can create puzzles which are shared with other users. However, other players often find these puzzles irrelevant, unplayable, too difficult, or simply boring. This may be because content creators’ objectives when building levels differ from our own. The ‘Deep Gamification’ framework presented by Boyce et. al may help us avoid presenting players with low-quality puzzles that result in frustration, off-task behavior, and ultimately disengagement. To investigate this we have designed two new level editors for BOTS, following the Deep Gamification framework. In this paper, we discuss how the design choices made for those editors were informed by the Deep Gamification framework.

Background

Serious games and games-based learning systems have many advantages over traditional assignments. However, building educational games is costly in terms of expert time. In the Intelligent Tutoring Systems (ITS) literature it is often estimated to take between 100-300 hours of expert time to develop an hour of educational content (Murray, 1999). This estimate is insufficient for serious games for several reasons, most notably the additional expertise required to design the game and develop the game’s assets. Additionally, content must be developed to teach users how to play the game. Many serious games projects are made on small budgets by small research teams. Because of this, those serious games are relatively short in scope. If serious games were developed with enough content so that practice was not only possible but encouraged, the motivational advantages of using games or game-like systems could be amplified.

Our proposed solution to this problem is to integrate content creation (in the form of level design) as a core part of gameplay. However, our initial efforts to integrate content creation into the game met with some difficulties. Some students submitted levels in line with the game’s learning targets, while others developed levels based on entirely different objectives (Hicks, 2014). Some method of ensuring content quality is required, since providing students with low-quality exercises results in frustration, off-task behavior, and disengagement. While our initial intervention (requiring students to solve their own puzzles as a part of the authoring process) was successful at filtering out many of the negative design patterns we identified, it also somewhat reduced participation by increasing the burden on content creators, already a minority of the BOTS player base. By working within the Deep Gamification framework we believe that we will be able to design a system which accomplishes both goals, functioning as an engaging gameplay element while simultaneously improving the overall quality of user-authored levels.

Gamifying Content Creation

Gamification (or Gameful Design) is "the use of Game Design elements in non-Game contexts" (Deterding, 2011). Though the term originated in marketing and digital media, many of the motivations behind gamification align with those for serious games. "Traditional" gamification puts the focus on scoring and achievement systems, mimicking those in multi-player video games and social games. The assumption is that users are motivated to continue doing the gamified activity to preserve the relative standing on the scoreboard, or the richness of their collection of badges and achievements (Liu, 2011).

The issue with using this model in educational games, is that benefits only persist within the gamified system. Despite often being described as “intrinsic” motivators, these rewards are extrinsic from the task itself which suggests they may inhibit any intrinsic motivation the user may have had for the task (Deci, 1999). Additionally, adding rewards may increase participation for those “in the loop”, but it does not necessarily increase quality (Mekler, 2013). For an image-tagging task, implementing point rewards increased the number of tags submitted, but had no effect on the quality of tags submitted, while adding a framing device instead increased the quality.

Deep Gamification

In order to more completely integrate gameplay with the goals of the underlying system, Boyce et. al developed
a framework called “Deep Gamification” for building engaging play experiences into educational software tools. Many of the practices outlined in Boyce’s work echo earlier work by Scott Nicholson on Meaningful Gamification (Nicholson, 2012). Where Boyce’s work diverges is in his focus on building game mechanics into existing educational software. As a result, Deep Gamification expands upon the notion of mechanical integration expressed by Nicholson, outlining many of the threats to that integration posed by common gamification practices. This framework was developed from the results of research on BeadLoom Game, in which players are required to duplicate a given image by drawing beads using functions on a Cartesian plane.

Deep Gamification was originally developed with non-games-based educational tools in mind, like the original Virtual Bead Loom tool. However, because the framework was developed in an image-creations system whose learning objectives corresponded directly to the in-game “moves” available, we can also apply its principles to content creation. This is particularly true in puzzle games where players are scored on efficiency or optimality, and where individual “moves” correspond to learning objectives. BOTS is one such game.

As outlined in Boyce’s work, Deep Gamification means:

- **The core play mechanic is precisely the learning objective**, or as near an approximation as possible. In BeadLoom Game, players solve puzzles by using iterative functions. There is no reward or resource layer between the learning activity and the core play mechanic.
- **To this end, the system must sacrifice ease of use when it conflicts with learning objectives.** Though players of BeadLoom Game often requested to be able to click the canvas to add beads, this would allow them to circumvent the learning objective of the game, and decouple the core mechanic from the learning objective.
- **Where they are used, rewards must be tightly integrated with learning outcomes.** Any activity which provides players with a reward must also be a desirable player behavior with respect to the learning objective. Arbitrarily assigned rewards ensure that players who “game the system” will be driven off-task. Care should be taken to reward improvement, not simply reward replay or re-practice (Long, 2014). The best rewards should result from demonstrating high-level understanding of the learning content.
- **To this end, the system should implement creative constraints that permit sub-optimal behavior while encouraging optimal behavior.** In BeadLoom Game, players scores are based on their ability to use iterative functions, but levels can be completed even if a player does not use them, albeit with a low rating. This allows the player to revisit problems later and improve their performance. Similarly, players are constrained in the number of operations they may use to create a level. Mastering the more complex iterative functions allows users to create more complex levels under those same constraints.
- **The system must contain both ludic (structured) and paedic (unstructured) elements.** This helps the system engage different kinds of players, as some players are not engaged or motivated by the competitive play a reward-based gamification system encourages.

An important principle for Deep Gamification is to combine learning objective with content creation. In Boyce’s BeadLoom Game, a content creation environment was created to appeal to those who disliked competitive gameplay. However, despite enjoying content creation as an activity, students were not often engaging in learning material when creating custom content (Boyce, 2011). In fact, some users actively avoided learning objectives when creating custom designs, building images pixel-by-pixel even though they had used the iterative tools previously. To address this, they reworked their level editor, applying these same principles to the content creation tool as to the original educational tool. This approach is what we will apply to our game, BOTS.

**Overview of BOTS**

BOTS (bots.game2learn.com) is a puzzle game designed to teach fundamental ideas of programming and problem-solving to novice computer users. BOTS was inspired by games like LightBot and RoboRally, as well as the syntax of Scratch and Snap (Garfield, 1994; Armor Games, 2010). In BOTS, players take on the role of programmers writing code to navigate a simple robot around a grid-based 3D environment. The goal of each puzzle is to press several switches within the environment, which can be done by placing an object (or the robot itself) on top of them. Within each puzzle, players’ scores depend on the number of commands used, with lower scores being
preferable. In addition, each puzzle limits the maximum number of commands, as well as the number of times each command can be used (see Figure 1). For example, in the tutorial levels, a user may only use the "Move Forward" instruction 10 times. Therefore, if a player wants to make the robot walk down a long hallway, it will be more efficient to use a loop to repeat a single "Move Forward" instruction, rather than to simply use several "Move Forward" instructions one after the other. These constraints, based on the Deep Gamification framework, are meant to encourage players to optimize their solutions by practicing loops and functions.

![Figure 1: An early level in BOTS, demonstrating how use of loops can simplify repetitive tasks.](image)

**Application of Deep Gamification to BOTS**

In the free-form version of the level editor, players are free to drag-and-drop elements into a blank level which they must solve after they submit it. While players often created content of various negative patterns, requiring them to also provide a valid solution after submitting was successful at eliminating many of the negative patterns of content. We theorized that these negative patterns occurred when users’ objectives during content creation were very different from our own. Where we are primarily concerned with the complexity and content of the solutions, players often created structures or patterns that were more visually interesting, but did not afford desirable solutions.

Having previously shown that some levels/problems created by users are of sufficient quality to be used as practice exercises (Hicks, 2014), our next step is to make further improvements to the content authoring tools. We decided to add objectives and constraints to the level editor, in order to help align players’ goals with our own, and thus increase the overall quality of submitted content. To this end we designed two new versions of the game’s level editor, with two different types of constraints.

Both level editors adhere to the Deep Gamification framework as outlined above, but one draws additional inspiration from structured problem-posing activities used in mathematics education. We propose to evaluate level editors with two different forms of constraint added. The **Programming Editor**, where the length (in lines of code) of the solution is constrained, similarly to the Point Value Showcase in BeadLoom Game. Second, the **Block-Based Editor**, where the construction of the level itself is constrained by providing authors with a limited selection of “building blocks” for which partial solutions are provided, and requiring users to improved upon the final solution before submitting the level.

The design of the Programming Editor (shown in Figure 2) is based directly upon the level editor in BeadLoom Game (Boyce, 2012). While using this editor, players are able to create a level by programming the path the robot
will take. Players are constrained to using a limited number of instructions. This is analogous to the level creation tools in BeadLoom Game where players created levels for various “showcases” under similar constraints. This type of constraint has been shown to be effective for encouraging players to perform more complex operations in order to generate larger more interesting levels under the constraints. One challenge with this approach is that since simple solutions are still permitted, and most programs are syntactically correct, users who are experimenting with the level creation interface with no goal in mind may be able to create levels that they themselves do not understand.

Figure 2: Screenshot of the Programming Editor in BOTS. Developing complex levels is easier and less time-consuming than with the previous drag-and-drop editor.

To summarize:
- The core play mechanic is precisely the learning objective, since players use the programming interface to create levels.
- The system does sacrifice ease of use when it conflicts with learning objectives, since pointing-and-clicking to create a new puzzle would be simpler but would decouple content creation and learning objective.
- Rewards are tightly integrated with learning outcomes since the same scoring system used for gameplay is used for creation, with lower numbers of lines of code representing a better outcome.
- The system implements creative constraints that permit sub-optimal behavior while encouraging optimal behavior. Without using loops and functions, only simple lay-outs are possible. Using loops permits the construction of complex levels.

Alternatively, the Block-Based Editor constrains level creation by providing known meaningful chunks to authors in the form of “building blocks.” This is inspired by problem-posing activities as presented in systems like MON-SAKUN and AnimalWatch, in which players are asked to build a problem using data and problem pieces provided by experts (Hirashima, 2007; Birch, 2008). In this version of the level editor, players will be asked to create a level only using pre-constructed chunks of levels (Figure 3). These “building blocks” will be specific structures which correspond to opportunities to use loops, functions, or variables. Some examples of these are shown in Figure 4.
As players build a level by selecting from these blocks, each block will be appended to the last, with the new block's starting position overlaid on the previous block's ending position. At the same time, a composite solution made up of the simple solutions for those blocks will be built. Players are constrained to a limited number of building blocks, which as the final step of submitting a level, the author must provide a solution, which will be compared against the composite solution for determining score. This will encourage authors to look for opportunities to optimize while building the level, either within the building blocks, or by using the same block multiple times.

To summarize:

- The core play mechanic is precisely the learning objective. Since players must optimize the composite solution to submit their level, they must recognize opportunities for optimization while building the level. This is a more abstracted version of the learning objective than above.
- The system does sacrifice ease of use when it conflicts with learning objectives, since players are constrained to working with pre-determined elements, and cannot create the level exactly as they would like.
- Rewards are tightly integrated with learning outcomes in the same way as with the Programming Editor, since the same scoring system used for gameplay is used for creation, with lower numbers of lines of code representing a better outcome.
- The system implements creative constraints that permit sub-optimal behavior while encouraging optimal behavior. While the building blocks do contain opportunities for optimization, the author is not required to submit the most optimal solution. Reducing the size of the program by a single line is sufficient, but the level will be listed higher if a more optimal solution exists.
We hypothesize that this will lead to better levels because it explicitly promotes the inclusion of these patterns, which will lead to opportunities for players to use more complex programming constructs like loops and functions. We also believe that this will encourage students to think about optimizing the solution to the level while they are building it. One potential challenge with this approach is that students may find these constraints too restrictive, which might reduce engagement for creatively-oriented players.

Conclusion

While initially developed for use in gamifying non-playful educational tools like Intelligent Tutoring Systems, the framework of Deep Gamification can also be applied to games with elements that in themselves are not playful, such as puzzle design. We have applied this framework to develop two additional modes of content creation for our game, BOTS, and in future work we will compare levels created by players under both approaches to gain additional insight into how integrating these game mechanics with content creation affects players’ participation in and engagement with the content creation activity, as well as the quality (in terms of complexity and learning opportunities) of the content created.

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Abstract: As research about the learning that results when children play video games becomes more popular, questions arise about what methodological and analytical tools are most appropriate to access and document this learning. Thus far, researchers have mostly adopted pre/post assessments, ethnography, and learning analytics. In this paper we (re)introduce cognitive clinical interviews as a methodology particularly suited to answering many of the most pressing questions about games and learning. To that end we describe four challenges of studying learning in video games with pre-post assessments that we claim can be addressed by the addition of clinical interviews. We then consider how clinical interviews can help to explain and describe patterns detected from ethnographic observations and detailed game play logs.

Research Tools for Exploring Learning in Video Games

Across disciplines and domains, researchers and educators have a rich set of tools for exploring and documenting learning, including written assessments, observations, and interviews. For many types of learning explored in education research, the choice of which tools to use and when to use them has become relatively stable. That is, we tend to know what those tools will look like, when they are useful, and the type of data they will provide. But what happens to this picture when new types of learning enter the landscape? This is precisely the situation our field currently faces with regard to video game learning.

As video games become increasingly ubiquitous in children’s lives, researchers have begun to explore the potential affordances and constraints of learning with and through video games (Gee, 2003; Steinkuehler, Squire, & Barab, 2012). Their popularity in educational contexts has led researchers and educators to want documentation of the learning that results when children play video games which in turn prompts questions about what methodological and analytical tools are most appropriate for exploring learning from video games.

Thus far, researchers have mostly adopted one or more of three methods. Many researchers have relied on pre-post assessments of the conceptual content presented in the game (e.g. Clark et al., 2011). Other researchers have relied on ethnographic observations of game play to identify and characterize salient learning events or changes in play (e.g. Stevens, Satwicz, & McCarthy, 2008). More recently there has also been a move towards the use of learning analytics to explore large collections of detailed logs of game play (e.g. Plass et al., 2013).

Each of these tools has provided insight into the ways that learners interact with and learn during video game play. However, each of these tools also has limitations for exploring the richness of learning in video game environments. Ethnographic observations, while rich in ecological validity, only allow observation of naturally occurring phenomena and generalization is difficult. Pre-post assessments only provide static slices of knowledge at two points in time and are limited in their ability to speak to the process of learning. Finally, while logging data provides a detailed account of each action that occurs in-game, these logs mean little without a theory of how these in-game actions relate to knowledge and conceptual change.

While we have used each of the above research methods in our own work, we have found that cognitive clinical interviews (Ginsberg, 1997) are a particularly valuable and unfortunately underutilized tool for understanding learning that occurs during game play. Ever since Piaget pioneered the method (e.g. Piaget, 1929), clinical interviews have been used extensively and successfully to examine conceptual learning in science both in formal and informal contexts (Davis & Russ, 2015; e.g. diSessa, Gillespie, & Esterly, 2004; Russ, Lee, & Sherin, 2012). We argue that the lack of clinic interviews as a primary source of data in the video game research toolkit is at worst problematic and at best a missed opportunity.

Therefore, in this paper we take preliminary steps to remedy this missed opportunity. To do so we begin by briefly describing the clinical interview. We then describe four challenges of studying learning in video games with pre-post assessments that we claim can be addressed by the addition of clinical interviews. To lend plausibility to that claim, we provide examples of solutions to those challenges employed by research conducted by the first author. Finally, we consider how clinical interviews can help to explain and describe patterns detected from ethnographic
What Are Clinical Interviews?

Clinical interviews are generally one-to-one interactions between interviewer and learner and are designed to probe the mental model of the learner by gaining many small glimpses of various aspects of a learner’s conception in an effort to better understand the whole. That is, unlike traditional classroom assessments that attempt to compare learners’ understandings to a predefined standard (i.e. learners are either right or wrong), the cognitive clinical interview strives to “enter the child’s mind” and describe the nature of the learner’s inchoate construction of a concept.

To gain these glimpses of the child’s mind, Ginsberg describes clinical interviews as deliberately nonstandardized and highly improvisational (Ginsberg, 1997, p. 2). Although they begin with a carefully designed protocol, interviewers are encouraged to develop in-the-moment follow-up questions in response to the particulars of student thinking. Predetermined questions are designed to prompt likely conceptions, that is, the researcher has a understanding of what the learner might think ahead of time and carefully targets these questions to draw out one or more of these possible conceptions. However, rather than see answers as having a one-to-one mapping with conceptions, clinical interviewers assume mental models are dynamic and complex (diSessa, 2007). Therefore, interviewers use interviewees’ responses to preplanned questions to develop hypotheses about the nature of the learner’s thinking, develop follow-up questions to test these hypotheses, and then evaluate the interviewee’s response to the follow-up to decide whether additional follow-up questions are needed (Ginsberg, 1997). This on-the-fly hypothesis generation and testing is essential to the success of the interview.

Clinical interviews have been successfully utilized for many years in a variety of domains (e.g. Brizuela, 2006; Gottlieb & Institute, 2007), and our claim is that their power can be leveraged for studying learning in video games. In particular, we see four core challenges to studying learning in video games that clinical interviews have the potential to address more easily than other methods.

Challenge 1: Missing Knowledge Not Explicitly Connected to the Domain

When video games are conceptualized as “interventions” akin to curricula or new teaching practices, researchers often attempt to assess learning by comparing a player’s knowledge state before and after play. This is typically accomplished through the use of pre- and post-tests and surveys, including concept inventories and concrete questions. While using such assessments is seen as advantageous because they allow for clear quantification and standardization we see four core challenges to assessing learning in video games that we believe can be overcome through the addition of cognitive clinical interviews.

A particularly salient challenge for assessing learning in video games is avoiding “stacking the deck.” When studying learning in games, researchers cannot ask questions that necessitate the use of or prioritize the knowledge and reasoning from the game over other knowledge the student might use. That is, the “stuff” that students are supposed to have learned cannot be couched solely in game language. Doing so creates two problems: potential underestimation or overestimation of knowledge.

First, if questions are framed mostly about game action and game-specific concepts, pre-intervention measures will automatically document learners as having no useful knowledge. However, that attribution to students would be an underestimation of the knowledge they may have related to the topic but not couched in the specific language of the game. What such questions really show is something much less interesting for educators – that participants have not yet played the game.

Second, questions overtly focused on game-related knowledge in post-intervention measures cannot examine whether players apply knowledge learned in the game to non-game situations. It is certainly valuable to know whether or not players can recall game action and experiences. However, in most cases, our goal in designing educational games is to provide experiences that the player can draw on when reasoning in non-game contexts. Achieving this “transfer” turns out to be non-trivial matter (Barab et al., 2007; Clark et al., 2011), and we need measures of learning that allow us to examine whether or not it has occurred. Unless we do so, we may overestimate what students learn from our game because they are able to perform tasks close to the domain in which it was learned.

Therefore, when developing an assessment to evaluate learning in video game play, the goal should be to create questions and experiences that allow the learner to reveal their thinking without needing the intervention experience. In a game designed to engage players in reasoning around kinematics, interview questions might be framed...
around hypothetical stories of vehicle of motion and participants encouraged to use a toy car to act out and to
describe their answers (Holbert, 2013; Holbert & Wilensky, 2014). Likewise for a game designed to engage players
in reasoning around the relationship between the particulate nature of matter and material properties, participants
could be asked to describe the cause of various physical properties of tangible objects present during the interview
(Holbert, 2013).

In both examples the goal is to access the knowledge participants have about the particular topic of interest without
needing to rely on constructs, representations, or experiences encountered in-game. Of course, in an interview
conducted after game play we may be interested to see whether or not participants do talk about these “real world”
phenomena using knowledge resources related to the game. This brings us to the second challenge.

Challenge 2: Inability to Attribute Knowledge Change to a Particular Source Without
Control Groups

As the primary goal of educational video games is one of instruction or learning, it is not surprising that research
in this field often aims to trace observed changes in player knowledge to particular interactions or features of the
educational game. While in some cases randomized controlled trials (RCTs) have been used to explore various
effects of video games on psychological constructs or health outcomes (e.g. Green & Bavelier, 2003), more often
researchers have used less rigorous quasi-experimental designs utilizing control and experimental groups. These
experiments can prove enlightening for simple games with only one or two features that can be selectively manipu-
lated and activated, but less well for complex games that include a host of interconnected mechanics and features
based on learning theory. For these educational games, researchers face a real challenge when attempting to
attribute knowledge change to the particulars of the game.

To evaluate the learning that happens in video games researchers often rely on comparisons between an experi-
mental condition, where learners play the game as part of instruction, and a control condition, where learners are
exposed to a “typical” classroom experience, an identified popular “innovative” curriculum, or some “equivalent”
digital experience (e.g. Squire, Barab, Grant, & Higginbotham, 2004). Findings from these studies then are able to
claim the educational game is “better” or “worse” at various measures than the classroom or alternate activity, but
are unable to draw a clear line between what has changed and the various features of the game. In other words,
the researcher is unable to identify impactful features of the game (which is central for iterative development in
designed experiences) and is only able to make tenuous claims about the relationship between the learning and
the game.

Clinical interviews offer an alternate solution to this common problem. Because these interviews are necessarily
composed of rich and descriptive language, in-the-moment reasoning, and artifacts (such as drawings) created by
the interviewee, they provide a host of potential markers that can more clearly identify the game as a source of a
particular conception (Holbert, 2013; Holbert & Wilensky, 2014). For example, after playing Particles!, a game
designed to engage players in reasoning around the particulate nature of matter, players were more likely to suggest
the relative hardness of blocks used in the interview was due to increasing bonding between the atoms that make
up the block. When asked why this might be, participants frequently references in-game mechanics and repre-
sentations. One participant, indicating a plastic Lego block in his hand suggested, “So this one’s kind of like the
hard block from the game and like the atoms, if you like—they’re like, more connected. Like in the game to make a
harder block you had to connect them” (Holbert, 2013). Likewise, player drawings of the particles that might make
up Lego and Styrofoam blocks included features of in-game objects, tools, and representations (Holbert, 2013).
The ability to make a direct connection between learners’ conceptions of target phenomena and game features
allows the researcher to not only argue with more confidence that the game is a useful learning environment, but
also to identify the particular representations, tools, interactions, and so forth that are most effective. This in turn
strengthens theory development, which is the central goal of such work.

Challenge 3: Reductionist Nature of Descriptions of Knowledge States

While carefully designed pre- and post-intervention assessments provide some insight into changes in the learn-
ners’ conceptions, relying solely on such pre- and post-assessments to characterize learning often reduces learn-
ers’ knowledge states to coarse categories that tell us very little about the nature or structure of those states.

When using standardized assessments to evaluate the learning that occurs in video game play we are able to state
to some degree that learners do or do not understand a topic but not to describe the nature of that understanding.
For example, after playing a game on Newtonian Physics a learner may be able to successfully answer a subset
of questions on the Force-Concept-Inventory (Hestenes, Wells, & Swackhamer, 1992) that she was unable to
answer before playing the game. Such a result would suggest the learner may have gained some knowledge of
the relevant topic through gameplay (though there might be other explanations for her changed test score), but would not tell the researcher what that knowledge is made up of or how it is connected with other knowledge in the learners' conceptual system.

The learner may be able to accurately predict the motion of a moving projectile but is that knowledge connected to any other knowledge? Is her understanding of projectile motion disconnected from her intuitions about and experiences with watching objects fall or has she integrated particular physics formalisms into these intuitions? To answer these types of questions clinical interviewers engage interviewees in questions that encourage and allow them to draw on multiple pieces of knowledge. Doing so allows interviewers to gain a rich description of the particulars of the learner's knowledge in relation to her other knowledge that can supplement judgments about learners' "knowledge states" gained from pre-post assessments.

As an example, we turn again to Particles!, a game designed for players to explore the particulate nature of matter. One could imagine using standardized assessments to assess whether or not players have basic knowledge about atoms, molecules, or even states of matter. For example, participants could be asked to identify diagrams of particles in each of the three states of matter, or even to choose between various descriptions of particle motion for a particular state of matter (both are common evaluation of learning in this domain, see AAAS, 2002).

However, in clinical interviews Particles! players were asked to compare and contrast properties of real world objects such as a block of hard plastic and styrofoam. Follow-up questions asked players to describe the particles that might make up the blocks, in doing so, the interviewer used the term offered by players for these particles (i.e. "atom," "molecules," etc.). This question allows the researcher to see not only students' understanding of canonical science properties but also how those properties are related to more intuitive ones. For example, when asked about the particles that might make up a bouncy object, one participant replied, "I think the atoms are bigger [...] it's bigger—it'll be easier to bounce, or like, give when it bounces, or like spring back out" (Holbert, 2013). By shifting the topic of the questions to be about the relationship between particles and the properties of tangible, real world objects, the participants' answers move beyond simply a static description of how particles move in a liquid versus a solid. These answers allow the researcher to gain insight into how the participant perceives the relationship between particle properties and object properties, as well as the participant's understanding of emergence.

Challenge 4: Tapping Inert Rather Than Usable Knowledge

A final challenge for studying learning in video games is that the knowledge valued and exercised in games is knowledge that is constructed in the moment. Games allow students to engage in learning by doing something: saving the princess, building a civilization, etc. In most cases, the in-game tasks are not simply about recalling memorized knowledge or replicating a specific series of actions, they are about putting ideas or processes in connection with one another to do something new or to overcome a novel challenge.

Given that the learning we are interested in is inherently couched in a task, research seeking to document and study that learning must also be task oriented. By designing interviews around tasks and not questions, interviewers can see how learners construct knowledge through drawing on a range of connected resources and integrating it in the moment of the interview. These resources might be in-game tools, representations, or experiences or they might be equations, definitions, or heuristics learners have encountered in more formal spaces. By engaging interviewees in a task, we allow participants to dynamically use—and researchers to see—a range of knowledge resources accessed.

As an example, we offer data collected from participants interviewed after playing a racing game, called FormulaT Racing (Holbert & Wilensky, 2010), designed to engage players in reasoning around kinematics. A typical pre-post assessment question for such a game might ask students to describe speed at different points in an object's trajectory. While answers given to such a question might indicate an understanding of changing speeds or of the relationship between speed and acceleration, the answers themselves privilege inert conceptual knowledge.

In contrast, using a task-oriented approach researchers asked participants to construct a velocity versus time graph based on a changing speedometer. When engaging in this task, participants must coordinate multiple representations and tools (speedometer, line graph, pencil & paper, etc) and connect these representations to their intuitive knowledge of motion from real-world and in-game experiences.

Graphs created by 7-13 year old players before and after playing FormulaT Racing for only two hours revealed most players gained expertise creating qualitatively correct velocity vs. time line graphs. These graphs included complex features such as areas of constant velocity as well as areas of changing acceleration. Furthermore, in describing their created graphs players frequently drew on language common to video game action, such as "getting a boost," as well as formal physics vocabulary such as "constant velocity" and even mathematical constructs.
such as “slope” (Holbert & Wilensky, 2014). Rather than simply suggest players “learned” kinematics, or even developed skill in graphing, these task-oriented clinical interviews provide a detailed account not only of the myriad knowledge resources players draw on (Challenge #1) but also how and when learners see these resources as relevant and useful.

### Triangulation with Ethnography and Logging

We have spent a substantial amount of time exploring how clinical interviews address some of the challenges associated with pre-post assessments. However, researchers use other methods—including ethnographic observation and logs of game play—to provide evidence of learning in educational games (Pliss et al., 2013; Serrano-Laguna, Torrente, Moreno-Ger, & Fernández-Manjón, 2014; Stevens et al., 2008). These methods are particularly valuable because they provide detailed accounts of learning in action across game play and as such are not limited to examining static knowledge at two time points (pre and post). However, one challenge faced when employing these methods is the selection and analysis of this massive quantity of qualitative and quantitative data.

For example, “big data” from game play logs can tell us the locations in a game level where players stop moving for an extended period of time, how many players used a particular in-game feature, or even provide an overview of patterns of actions employed by learners in researcher-identified “important points” in the game. But what does that information mean for learning? Without direct access to the players themselves—not merely their actions—we cannot make strong arguments for how, why, and when learning occurs. Similarly, data from ethnographic studies can document how players interact with game mechanics and can provide a window into the role played by the specific game-playing context. However the way in which these resources and interactions are mobilized, and the extent to which they lead to conceptual change is not as easily identified through observation alone.

How can clinical interviews flesh out and support those data sources in developing rich accounts of learning in video games? We suggest that clinical interviews of the type described in the previous sections are particularly effective for developing theories that help us make sense of these data sources. In the example of the game logs, one must have a theory about game play to know that if the player stops moving it may indicate they are confused, or that not using a particular feature might indicate the feature is not understood or may instead indicate it’s not as valuable to gameplay. Clinical interviews can provide insight into what that theory might entail by giving researchers a chance to probe links between behavior and learning. Likewise, performing clinical interviews in conjunction with ethnographic observations allows researchers to test hypothesis derived during observations by directly interacting with the participant. This strengthens the research by providing avenues for the exploration of disconfirming evidence and on the fly theory-building.

### Conclusion

The use of video games in education is both popular and contested. Solidifying their place in the educational landscape will require substantial research that explores and documents the type of learning that can happen during game play. For that research to be meaningful, the field will need to draw on a variety of methodological tools and techniques. In this paper we have set out to (re)introduce cognitive clinical interviews as a methodology particularly suited to answering many of the most pressing questions about games and learning.

### References


Distributed Teaching and Learning Systems in Dota 2

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Abstract: Teaching and learning are often distributed across many different sites and across time, and teachers and learners can intentionally create and customize trajectories through these encounters. However, we often tend to focus on one site or design for learning. Furthermore, we often fail to recognize the teaching acts used by games and only focus on the rich learning. This paper argues that we can think about “Big ‘T’ Teaching” (using Gee’s “Big ‘G’ Games as a model) where teaching is a distributed system; this view allows us to trace an “ecology” of teaching and learning systems (borrowing from Jenkins’s approach to media). Using the game Dota 2, this paper demonstrates one way of thinking about the way teachers and designers can make compelling, distributed systems of teaching that extend through and even beyond the game, and how players and learners can customize their learning experiences.

One theme that has been somewhat underdeveloped in the games and learning literature is the role of teaching in and around games. Many studies tend to focus on the rich learning that happens through gameplay without directly addressing these as teaching interactions as well (Holmes, 2015). Gee’s seminal What Video Games Have to Tell Us About Learning and Literacy (2003) is a prime example; it outlines a range of good learning principles but never acknowledges that many of these are also good teaching principles. The principles Gee outlines, such as “designing multiple routes to participation” or the “amplification of input,” are not just ways in which good learning occurs but also key strategies for good teaching. Squire’s excellent Video Games and Learning: Teaching and Participatory Culture in the Digital Age (2011) similarly tends to privilege the kinds of learning that happens through gameplay while underselling the specific ways these games function as teachers in their own right. While much maligned, the gamification literature seems to capture something about the ways games teach, although it is often limited to issues of motivation and engagement. Gamification interventions such as Sheldon’s The Multiplayer Classroom (2012) or Kapp’s The Gamification of Learning and Instruction (2012) tend to get tangled up in the metaphors of gaming (like levels and points and roles/classes) which can interfere with the truly meaningful insights games provide into teaching (Holmes, 2015). Salen et al. (2008) perhaps addressing most clearly the ways games teach in their Quest to Learn program by leveraging game-like design in their instructional practices, though again the relationship between games and teaching is still left somewhat tacit. I don’t doubt that these and other game-based learning theorists recognize that game design features are teaching features, though it is striking how few explicitly address the issue. One main goal of this article is to directly describe the ways a game (in this case, Valve’s Dota 2) teaches and to point out what that might tell us about teaching more generally.

I also want to extend a pair of related concepts—Gee’s (2003) notion of “big ‘G’ Games” and Jenkins, et al.’s (2006) idea of an ecology of media and communication technologies—to think about both the designed and emergent teaching and learning that happens in and around games. Big G Games, for Gee, include not just the game itself (what happens on the screen) but also a range of other activities and sites like YouTube walkthroughs and tutorials, guides and FAQs, web forums, “theorycrafting,” cosplay, machinima, fan fiction and many others. Together, these activities make up the Game, and by considering the many different sites for participation we might gain a better understanding of what playing games really entails. Jenkins’s idea of an ecology of media technologies follows a similar epistemological bent, where the relationships between various media forms and participants and the “cultural communities” (2006, p. 8) that form and negotiate practices around them serve as a more informative and meaningful way of thinking about media interactivity. I believe both of these views provide an interesting lens to think about the way teaching happens in games, and especially a game like Dota 2 where there are many sites where teaching happens.

This article is meant to address these three things: to show, briefly, how Dota 2 is designed to both teach explicitly and to provide additional “channels” for emergent teaching to occur; to sketch a rough outline of the ecology or relationships between these designed and emergent teaching systems in- and beyond the game; and to suggest some broad implications for teaching that transcends games. I will first look at what Dota 2 teaches since this deeply influences how it teaches. Then I will look at designed teaching systems in the game (such as the in-game tutorial and knowledge library), designed-for-emergent teaching systems (including the “coach” mode and the streaming/spectator mode), and outside-the-game emergent teaching systems (especially Twitch and the theorycrafting site Dotafire.com) in order to show how these teaching systems are distributed across the Game (after Gee’s term) and form an ecological network of teaching systems (in Jenkins’s terms).
**Dota 2 and Teaching**

*Dota 2*, officially known as *Defense of the Ancients 2*, is a Multiplayer Online Battle Arena (MOBA), a sub-genre of Real-Time Strategy (RTS) games, and is published by Valve Corporation (2013). MOBAs, as the name indicates, are online games played in cooperation with and competition against other players. *Dota 2* is played by two teams of five players each who must attack the opposing team's base while defending their own. There are many different strategies possible in each match depending on the composition of each team and their plan of attack ("rushing" the opponent with all 5 heroes, fighting a battle of attrition, playing “hit-and-run,” and so on). *Dota 2* also has a very large “professional” competitive scene, which is one of the most important factors in *Dota 2*’s popularity since it is both a participatory and spectator sport.

*Dota 2* faces a particularly difficult challenge in that it is a very complex game with over 100 heroes, countless strategies and abilities and so on. The game must teach the player the basic elements (what the goals are, what success and failure look like, the techniques to achieve these). Players must also navigate multiple semiotic domains (the mechanics of the game as well as interface elements) so a player needs to learn how to operate both the operational and conceptual levels of the game. To play successfully, they must also learn somewhat abstract strategies for reacting on-the-fly as the game changes through the course of play. Furthermore, because of the highly social nature of the game, there are complex practices around playing the game that players must learn in order to participate fully in the gameplay experience. These include things like terminology, team composition and strategies, trends in play styles, social conventions and others. Participating in the Game (in Gee’s term) requires navigating these social realities as well as the “technical” ones of the “little ‘g’ game.”

To tackle all of these messy teaching realities, Valve has introduced what I believe is a relatively unique set of solutions by designing multiple teaching “channels” or systems. Some of these are designed explicitly as teaching scenarios; the in-game tutorial, for example, is a common feature of most games and *Dota 2*’s tutorial is well put together though not highly innovative by itself. The tutorial only covers an almost superficial amount of the actual learning necessary to master the game; it introduces some key features, ones that are absolutely necessary to playing but which hardly account for the deep and sophisticated knowledge it takes to “learn” the game. The tutorial modules are there to begin the learning process for the player, and to shape their initial experience and give them a frame for their continued play, but mastery requires tremendous effort by the player. Of course, it’s possible to argue that the joy of gaming is in discovering rules and strategies on your own (Koster, 2007), and no tutorial will completely cover every possible concept fully. It is no surprise, perhaps, that the tutorial is only a starting place regardless of the complexity of a game.

The truly clever way that Valve has designed *Dota 2* as a set of teaching systems to overcome the limitations of something like a tutorial is by organizing these other teaching channels to leverage other players as teachers; that is, Valve includes features which are “activated” by other players who perform the role of teacher in cooperation with the game. For example, the game includes a “coach” mode where a player can invite another player into their game and the “coach” can mark up the player’s map, control their camera, and has a dedicated chat channel. As I’ll describe in more detail below, the game includes a number of these “emergent” teaching systems that are designed by Valve but left to the players themselves to fulfill the role of teaching. And, like many modern games, there also exist a number of emergent teaching sites like YouTube or theorycrafting sites which are outside of Valve’s direct designs but which still serve as vital channels for teaching and learning. What is especially illuminating are the relationships (the “ecology” in Jenkins’s terms) between these various designed and emergent teaching systems and the way they work together to help teach the complex nature of *Dota 2*.

**Designed Teaching and Learning Systems in Dota 2**

I use the term “designed teaching and learning system” to refer to many of the overt teaching features of the game; these might pass as obvious or common sites of teaching across many videogames, including tutorials, didactic showing/telling, descriptive text, and so on. Most games contain variations on these designed systems, although not all games do. These designed systems are insightful for two important reasons: first, they are intended explicitly by the game maker to perform the function of teaching the player how to play (in all the ways “play” might mean); and second, the relative ubiquity of these designed systems across games points to their perceived importance (if not their exact efficacy in every game). *Dota 2* contains several of these designed systems; I will primarily focus on two (the in-game tutorial and the knowledge library) but recognize there are more examples within the game; these two simply provide compelling cases in their own right.

**In-Game Tutorial**

*Dota 2*’s tutorial is an optional, multi-part tutorial which covers everything from basic camera and character move-
ment to complex, multi-player battles (essentially, the “real” game). The tutorial is completely optional; players can choose to complete it—in its entirety or only portions of it—or not. The tutorial is broken into eight scenarios, each covering a different topic but also organized sequentially so that the scenarios build on top of what previous tutorial sections covered. Players can play any of the tutorial modules only after “unlocking” them by completing the previous module, but they can repeat previous modules as many times as they’d like. The tutorial section also includes two special modules designed as “testing grounds,” where players can play a match against the computer to work through the material they just learned in a safe, low-risk environment.

The eight scenarios cover increasingly complex play events. The first scenario is actually non-interactive, instead containing a 4-minute overview of the basic mechanics and goals of the game (the dialogue of which is transcribed above). The second scenario introduces basic movement controls and actions as well as the first instances of melee combat. The third scenario introduces ranged combat and a different hero from the previous scenario. The fourth scenario covers the concept of “lanes” and “towers” (two central features of the map and strategic elements of play). The next two scenarios are skirmishes/practice; one is constrained to just the middle lane, while the other is a “full” match with all three lanes open. The seventh scenario expands on a more specific skill, “last hitting” or killing an enemy to gain gold, as a key feature in high-level play. The final scenario is a practice focused on last hit practice.

It is worth noting that the tutorial section, especially Module 2, is often highly didactic in that the game is focused on core or baseline knowledge and explicit instruction; the game tells the player how to do something specifically and directly and then waits until the player complete that task.

In-Game Knowledge Library

The game also contains a great repository of information—and teaching—outside of the tutorial modules or gameplay called the Library. This is another optional section of the game client where players can look up information about all of the heroes (currently 109 of them) as well as items and more (easily several hundred items).

Within each character “page,” there is detailed information similar to that contained in the tooltips but expanded in terms of narrative description. Each character page also contains a description of the hero’s various abilities accompanied by a very short video clip of the ability in action. These videos show a specific example (model) of the ability in action, tied closely to some statistical information; it shows what the attack “should” look like in order to let the player know when the ability works and, potentially, how it should be used (in what situation, against what enemies, and so on).

Designed-For-Emergent Teaching and Learning Systems in Dota 2

Valve includes another kind of designed system that is, arguably, unique and which makes Dota 2 such an illuminating case. They have designed a number of systems that are not as explicitly for teaching directly; instead, they are designed to create the conditions for teaching to occur but rely on players to actually do the teaching. In other words, Dota 2 includes several different features which help enable teaching but the game itself doesn’t teach; players “enact” the teaching on their own through the designed affordances of these emergent teaching systems. This is a very interesting relationship between designer/game and players in which players are supported (and even expected) to some of the work in teaching, especially of the various social features like terms, strategies, and etiquette but also of more basic gameplay as well. Like designed systems, Dota 2 includes several different designed-for-emergent systems, of which I will only focus on three. These range across a spectrum of nearly explicit teaching (the “coach” mode) to implied teaching (the community “build” feature) to a highly emergent channel (the streaming/spectator mode).

“Coach” Mode

Players have access to a feature called “coach” mode where another player can help them play the game in real time. Players can invite friends to perform this role of coach, and they use their own game clients to network together to use the feature. Coaches can “take over” parts of the learner’s game interface (remotely) and control aspects of it for the player. The coach can, for example, make marks on the players map or action bar that call attention to themselves clearly, a feature not found in the “normal” game interface. This special mode also includes a separate chat channel for the coach and player to use that no other player has access to; it is a tool that they can use to interact “safely” removed from the view of others. Through this coach/player channel, the teacher (coach) can communicate concepts, terms, and the like to the learner (player), who can use in turn use it to ask questions and so on.
This designed-for-emergent teaching system is meant to give players both access to a more-knowledgeable peer and to provide specific tools for teaching; while there is no prescribed teaching on Valve’s part, they have designed tools which support the teaching performed by players. They have also identified or assumed what kinds of tools are important to perform these functions (interface control, marking and highlighting, a “protected” space for learners and teachers to communicate with less fear of calling attention to the learner’s status and so on). In essence, they have created special conditions for teaching to occur, though it is up to players to complete the teaching act.

**Community Character Builds and Guides**

Another way for players to share their knowledge and to teach other players is through the community character builds and guides features. These are interrelated features; the build feature is an interactive tool found in the game client where players can “spec” heroes with different equipment and abilities. They can access these builds within a game and apply it while they play; they can also publish these to the community. The hero builds often (though not always) form part of the guides feature. Guides can be accessed both through the game client as well as Valve’s Steam platform. Guides often feature builds that players can import into their game client, though they often also contain a great deal of explanation, commentary, strategies and suggestions, and even debate through a comment system.

Not all players use either feature, of course. Some players may only use the build feature to test out various configurations on their own, and so the game allows them to “teach” themselves by interacting with the tool, although this is not a particularly deep level of learning since the tool is primarily meant to “plug in” to guides or for convenient access during the course of gameplay. The guides provide a sanctioned space to share knowledge and teach other players not unlike a forum but with the additional connectivity of interactive tool tips and the ability to “plug in” to the game client. Once again, Valve has built systems where the conditions for teaching are present and provided additional tools that might be used by players such as the interactive modules and connected platforms or the comment feature on guides but which require players to fill in the content and perform the teaching. Like the coach feature, these are channels where teaching is meant to occur, but they have additional functions that are less-clearly aligned with teaching.

**Streaming/Spectator Mode**

Many games have vibrant streaming spaces, a feature popularized in part by YouTube and especially Twitch (discussed below). Valve has added an in-game streaming mode which leverages the native interactivity of the client as an additional feature to a “normal” steam site; that is, players use their own game client to watch the games, but have features such as the ability to change their screen to an individual player (including their interface), to a free-roaming camera, and even to a “directed” camera that is controlled by a commentator. Some streams do not include a commentator, but most professional or semi-professional tournament streams do. Stream channels also have a separate chat channel visible only to other streamers and not to the players.

Players enact the teaching in several different ways. In the least direct way, they serve as demonstrations or guides through their play; a player can watch their view and interface and follow along with one particular player (even across many different games) in order to watch an expert play. They witness models (although indirect and often not explicitly intentional) or good players and can learn through watching them make choices, alter strategies and so on. These expert players are teachers in the sense that they model actions, though they may not even be aware that they serve this role; they are, in some sense, “oblivious” teachers and it is up to the player to learn by watching (and, hopefully, have some strategy in their own mind as to how to learn through this watching).

Another, somewhat more direct, form of teaching through the stream feature is through commentators. Much like a good sports commentator can break down, explicate, or analyze some part of the game, many *Dota 2* commentators provide a great deal of insight into the thinking of players, description and explanation of the game in action, and “meta” commentary on the game and on *Dota 2* play in general. They almost certainly use much jargon appropriate to the player base and can create or perpetuate these lexical or thematic touchpoints. For example, during competitive matches teams take turn choosing and excluding heroes, and many times commentators will discuss the choice one team made, options for countering it, strategic planning on what teams might do in their next pick or in their overall composition, and even about trends by a team or in the game. Again, these commentators may not directly recognize that they are teachers (though some might), but they do a variety of teaching acts throughout the course of their discussion at several various levels (discursive, mechanical, strategic, meta). Valve has built various tools into the streaming client that must be activated by players.

**Emergent Teaching and Learning Systems Around *Dota 2***

It is common that most contemporary games spawn a great deal of Game sites, from lore-based discussion sites to
streams to cosplay and many others. *Dota 2* is no exception, and is indeed not all that remarkable in the sense that the kinds of activities happening in the Game are not terribly different from, say, *World of Warcraft* or *Minecraft* or *Pokémon*. Still, these are extremely important sites of teaching and play a large role in creating, perpetuating, and changing the Game and the game. It is possible (though outside the scope of this article) to consider the various affordances of sites like forums or YouTube, but it is important to at least gesture that various sites are used differently for different purposes and have different affordances and limitations which influence the kinds of teaching and learning that occur through them. There are many, but I will look briefly at Twitch streams and the theorycrafting site Dotafire.com to highlight a few important threads.

**Twitch Streams**

Twitch is a major site for live game streams, including *Dota 2*. Streams on Twitch are similar to those within the game client expect they are generally locked to one individual player’s view or on a commentator’s screen (it is not interactive in the way the in-game stream is). Many players also include a small webcam video of their face overlaid on the game screen and use a microphone to talk to their stream audience or to other players. Streamers have a dedicated chat channel to communicate among themselves and often the streamer. Much like the in-game streams, these spaces serve as teaching through modeling, commentary, and player communication. Unlike the in-game streams, Twitch often focuses on the personalities of individual streamers and groups form around popular streamers; here a great deal of social maintaining happens, and these popular streamers often drive community practices by using particular builds or strategies or other practices (like terms or jokes).

**Dotafire.com**

Dotafire.com is a forum site where players can post hero builds and discuss strategies (among other things). Like most forums, the site is primarily designed for threaded conversations between many members. Many members engage in a practice known as “theorycrafting” where they formulate often complex models of how various abilities relate and work to maximize performance. These discussion, like many of the hero guides, are often quite didactic (take X ability, perform Y action at a given time) in the sense that these players are explicitly telling others what to do and how. In some ways, theorycrafting is very much akin to traditional in-school teaching; it is interesting that we malign it in an institution but laud it on a videogame website. However, theorycrafting usually requires that the player provides concrete, demonstrable evidence that players can then test out. It is a kind of “prove it” scenario in which other players can validate a theory to make a more reliable or accurate model. In a sense, theorycrafting is a rich scientific practice that relies on evidence and falsification as a core feature. A website like Dotafire.com also has features which enable debate and discussion as a native affordance.

**Implications of Distributed Teaching and Learning Systems in *Dota 2***

Let’s step back and take a look at these various designed and enacted teaching systems. Within the Game of *Dota 2* it’s possible to see many different channels through which teaching happens, from explicitly designed systems to player enacted teaching outside of the game. While this particular analysis is meant to illustrate various sites for teaching, it is also possible to conduct traces of specific teaching and learning across various channels; indeed, this article is meant as an outline to show how it might be possible to conduct such research. Further, *Dota 2* is a complex and dynamic game, and no single event, nor even a set of teaching events can teach all of this complexity. An ecological view of these teaching systems would show that teaching is a deeply interconnected practice, and learning happens at many various sites. In particular, tracing a learner’s journey through various teaching and learning sites could uncover important information about the relationships between the various kinds of sites and the kinds of teaching and learning that occur there; it could also demonstrate that it is the act of moving across sites that is the valuable part of the learning transaction.

Indeed, what makes *Dota 2* so compelling is that it shows that learners have some control over how they encounter and organize their learning within a Teaching system. It’s easy enough to imagine the tutorial as a teaching intervention(s), where a player learns the basics of the game in a series of events designed by Valve. But that same learner may also watch a YouTube “how to play” video instead of playing the tutorial and learn many of these same things (and others not included by Valve). They also might watch some professional competitive matches and learn a great deal about strategies and hero builds. They could follow-up on these strategies by looking at the in-game build guides. They might then try them out in a match, where they get a great deal of feedback about their play with that particular build, and they could iterate in a series of matches to perfect their play or try alternate solutions (possibly after consulting theorycrafting guides or by posting their build and receiving feedback from other players). They might even be inspired by the game to create some artwork around their favorite character, and dive deeper into the in-game library for more background on the story or their character’s history. They could take this artwork to a fan site and connect to another fan to write a story or a comic around the game, and share not
just their passion but their knowledge about Dota 2. Further research may validate or complicate this learning trajectory, but this is not a terribly unlikely path through teaching around Dota 2. It shows that players can customize their experiences across a network of distributed, interrelated teaching sites that the player can configure in a way which matches their interests and their need for more specific knowledge. It also hints at the many different kinds of systems that are configured to teach players as they go. Ultimately, I believe we could think of teaching as "big 'T' Teaching" in the sense that teaching happens across a range of activities and various times and sites with many different people.

This model also suggests something profound about teaching in general beyond videogames. Elsewhere in this collection I have outlined several game-inspired design principles (Holmes and Ingram-Goble, 2015), and these principles are certainly manifest in the Dota 2. From that perspective, the way the game is designed—the way it allows learners to customize their experience or creates a compelling narrative journey for the learner—reflects not just good game design but also good teaching design. A distributed teaching and learning perspective adds another dimension to what a Game like Dota 2 can tell us about teaching, however. From this perspective, it’s possible to think about ways in which teachers can organize networked nodes of teaching, where learners access different teaching acts in different contexts (some didactic, some demonstrative, some hand-on "messing about"). These different nodes can serve different functions towards some Teaching goal. Admittedly, this may not be too far off of what many teachers do; a science classroom often has didactic teaching moments, course readings, lab time and so on, each of which is serving a different function in the Teaching network. While I don’t have the room to engage in any lengthy critique of formal or informal education, it’s worth considering the claims about the inauthenticity of these kinds of environments (that many of these activities are meant to lead to “real” science but to fulfill some mandated competency) and contrast it with games (generally learning is always aimed at playing the “real” game).

That is not, however, the real power of a distributed teaching and learning model in terms of teaching more generally. This perspective suggests that teachers can design and organize some of these nodes (in the same way that Valve can design and organize some of the Teaching nodes in Dota 2) but not all of them; players/learners have some control and can organize these nodes to fit their needs as described above. For teachers, then, one opportunity is to leverage Teaching systems (which include emergent or non-sanctioned sites) in such a way as to enhance and support the learner’s trajectories. In other words, teachers can plan, design, and organize some Teaching events as well as recognize (and hopefully integrate) other sites learner’s may utilize in order to create a dynamic and complex system of learning. It is important to reflect here, of course, that this also implies that teachers are not alone in this process but are integral agents networked with other teachers, learners, tools, and pathways. It is a bit of a double edged sword in this regard—if learners can customize their trajectory, especially through sites and teachers outside of the “control” of a teacher—they may learn something completely unintended by the teacher. This can be daunting to a traditional classroom teacher indeed.

Finally, let me linger on that last point. One potential afforded by a distributed teaching and learning system—and one problem for an institution such as school—is that control is also distributed and, in many regards is ultimately left up to the learner. Good designs (such as the kinds of teaching channels found in Dota 2) help shape the experience, but players can watch YouTube walkthroughs, talk to other players, and otherwise learn a great deal about the game outside of Valve’s control (including things Valve may not want, such as cheats, hacks, or exploits). Distributed teaching and learning systems demonstrate that it is possible to organize all kinds of learning events outside of the control of any institution. This article is meant to emphasize that something like Dota 2 is tantalizing in the way it might connect learners to many various knowledges, practices, people, and contexts that transcend one teaching and learning site (like school, for instance). It is just as important to think carefully about how those connections are made. On the one hand, we might rethink what a “class” is, how it is arranged, and who participates in the acts of teaching. If we consider that all kinds of people and things can teach, and these various teachers can be arranged and activated in particular configurations to support a broad array of learning needs, we might arrive at very different in-school teaching interventions than what “traditionally” passes for teaching in a classroom. On the other hand, learners who can organize and navigate complex distributed systems outside of the control of an institution like school challenge how we think about the purpose of school in the first place. Instead of a primary site of public learning, it may become just one of many sites where people go to learn, teach, and participate civically. It also changes the relationship between teachers, learners, content, and practice. In short, Dota 2 just might serve as a model for what 21st century Teaching could look like, in all its complexities.

References


Teaching as Designing: Creating Game-Inspired Classes

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Abstract: Good teaching is a form of design. Yet, while there has been a significant increase in game-based learning approaches over the last decade, little work has been done to bridge the good pedagogical principles of games with a robust theory of teaching and course design. This paper describes the implementation of two “game-inspired” undergraduate courses which leveraged the conceptual and organizational principles of games to structure each course. While both courses established student roles aligned to content goals, one course emphasized collaboration structures and specialization, while the other iterated roles in the service of supporting a broader dispositional development. We argue that course design is one way of meaningfully orienting learners’ engagement with the course content and their own participation.

This paper describes the design and implementation of two “game-inspired” undergraduate courses which leveraged the conceptual and organizational principles of games to structure the courses. Groups like the New Media Consortium (Johnson et al., 2014) and MacArthur’s Digital Media and Learning initiative have consistently highlighted the significance—and increasing use—of game-based learning (GBL). There is a growing body of research and practice in which teachers, scholars, policy makers, and game designers have used videogames as a method of augmenting or even replacing instruction. The tremendous variety of these instructional models highlights the unsettled territory of GBL and of the need for rigorous analysis of any game-based instruction.

One core insight of game-based learning—though often neglected—is the potential to conceptualize teaching as designing. In particular, theories of embodied and situated cognition stress that learning is experiential, so we can think of teaching as a way of designing experiences that are good for learning (Holmes, 2015). Thought of in this way, games have a great deal to tell us about teaching. Games are “designed experiences” (Squire, 2006), where game makers create opportunities for interacting with interesting, well-ordered problems. Players then “enact” these designs and receive copious amounts of just-in-time and on-demand feedback (see especially Gee, 2003) which in turn informs their continued interaction. Games model what good learning looks like, as Gee argues, but also ways in which good learning experiences (i.e. teaching) can be designed. Many existing GBL models, however, emphasize the games themselves and the kinds of learning that occurs, with much less attention paid to the teachers or the design of the game intervention (e.g. class set-up, support materials, follow-up lessons and so on) and how those designs are a method of guiding the instruction (and learning).

One method of unpacking the relationship between course design and teaching and learning goals is design research (see especially Cross, 2006) in which the decisions made during the design illuminate the underlying philosophy. Both courses examined here sought to embed meaningful structural elements utilized by good games (such as identity play and collaboration), but in strategically different ways. We discuss the design rationale behind each course, provide a set of design principles which leverage the power of videogames as models for teaching, and suggest implications of using games not just in the class but in designing the class to capture the effective pedagogical methods videogames demonstrate.

Theory

For more than a decade, there has been increasing focus in videogames as models of good learning. In particular, as interest in out-of-school learning has increased, scholars, policy makers, and game designers have turned to videogames as one particularly insightful field of study for good learning. One of the most coherent—and influential—works on the nature of game-based learning is Gee’s What Video Games Have to Tell Us About Learning and Literacy (2003). Much of the research cited below is based, directly or indirectly, on Gee’s analysis. Gee lays out a compelling case for games as models for deep learning tied to empirical research into cognitive development, which he develops into 36 learning principles. In particular, Gee describes a series of game design features—such as providing multiple pathways to success and giving copious amounts of just-in-time feedback—that support learning and shows how these mechanisms align with theories of how the mind works. Game design (and even the nature of videogames as enacted designs) works in service of good learning. While Gee articulates a clear view of how games demonstrate good learning, he also largely neglects the teaching components which support that learning. Perhaps the most interesting observation about Gee’s 36 learning principles is how closely they align to good teaching practice without explicitly connecting the two.
The way game designers build engaging experiences which capture the mind’s need to seek patterns, build associations, face (not too difficult) challenges with clear goals, and develop intrinsic motivation from solving those challenges seem to mesh very well with current theories of the way the mind operates and the way learning works best (Holmes, 2015). Although we have not traditionally thought of game designers as teachers, they often demonstrate very effective teaching methods. It is especially telling that many game designers have identified not only the importance of designing experiences (learning opportunities) but also recognizing many of these features of good learning, if not always in those exact terms (see especially Costikyan, 2002; Salen and Zimmerman, 2003; Koster, 2007; Shell, 2008; Fullerton et al., 2008). As Gee (2003) has pointed out, game designers have intuitively developed deep learning goals and teaching methods as part of their design process by necessity, as players must learn how to play the game and understand their performance in order to remain engaged. Game designers have “caught on” to many fundamental principles of good teaching, and the methods that game designers use to promote and sustain engagement, model action, and tell the player how they are doing in their participation can be quite illuminating when considering teaching of all kinds.

Many educators have used games in their classrooms across a range of disciplines (see Tobias and Fletcher’s [2011] comprehensive literature review). One trend that has more directly addressed issues of games and teaching is gamification, or turning the learning situation into a game (see Deterding, et al., 2011; Reeves and Reed, 2009; Dignan, 2011, Zichermann and Cunningham, 2011, Schell, 2010). Much of the literature around gamification focuses on features that make games motivating, engaging, and enjoyable and not necessarily because they represent good teaching and learning platforms. Indeed, gamification of classrooms and other domains are somewhat controversial and have been critiqued for this and other reasons (see Duncan, 2012 and Bogost, 2011, for example). Gamification often co-opts features of play in “inauthentic” or meaningless ways. Gamification frequently serves simply as a “re-skinning” of a classroom rather than a real innovation.

More importantly, gamification suffers from several problematic design flaws. Many gamified courses include terminological or metaphorical tropes from videogames such as guilds (semi-formal groups of players), quests, bosses (difficult enemies roughly akin to a mid-term or final exam), and strong narrative arcs (see Sheldon, 2010 and Hodgson, 2013, for example). While these tropes may serve as organizing elements (indeed, both courses described in this paper use some forms of these metaphors) to help connect students to the structures of the course, many gamification models wrap these metaphors so tightly with gameplay “mechanics” in the course that they simply introduce an additional metaphorical layer on top of what may already be a confusing space such as a classroom. Assigning roles common to videogame tropes such as “mage” (designer), “ranger” (writer), “warrior” (programmer), as Sheldon does, can be arbitrary and opaque; while these are common roles in games they have little relation to the content goals or skills a teacher may want to cultivate. Game metaphors can obscure the concept and hinder the student, especially when they are not already deeply engaged in gaming practices and may not understand these tropes. Judicious use of these metaphoric tropes can help orient students, but often gamified courses rely too strongly on making a game that they become potentially confusing.

Indeed, gamification often focus so heavily on making a class into a game that students may end up “playing” the course game and not engaging with the course material. How students “level up” and earn experience can serve as a meaningful metaphor, but it can also be arbitrary or misaligned with the learning goals at the expense of making a working “game”. A game layer can interfere with the student’s engagement and lead them to focus on maximizing their game performance rather than engaging in any meaningful learning. Duncan (2011) provides an example of students “gaming” his course in such a way as to get out of doing entire assignments (thus avoiding the actual learning objectives of the course).

Finally, making a game is very much an art form (Schell’s influential book is even titled The Art of Game Design [2008]). Creating balanced systems of play, engaging mechanics, rules and win states and other game features require a great deal of work. Requiring teachers to master not just instructional design but good game design principles is a tall order indeed, particularly because they are not always aligned. Gamification often suffers simply by asking teachers to take on tasks that they are not necessarily good at and which may or may not actually help their course design (and may even negatively affect it).

For these reasons and more, we propose here that instead of making classes into games, teachers—as designers of good learning experiences—can use insights from GBL research in developing their courses in relatively lightweight ways which avoid some of the problems of gamification. The principles developed here do not require any game mechanics or play elements; they do not even require the course to be about games at all. Instead, what we intend to provide are methods of designing good learning experiences using videogames as a model for what good, effective teaching looks like based on more than a decade of GBL research.
Course Examples

The courses we discuss below sought to create a disposition towards learning and participating in class that revealed and strengthened a connection to the course content, not just one which seemed motivating or engaging. We also consciously avoided a pervasive “game” layer to the courses layer to avoid the problems described above (namely adding metaphoric complexity and students “gaming” the class), though we did often include some terminology and orientational metaphors which helped connect the topics and actions as well as explicit videogames play as part of each course.

Course 1: Videogames and Digital Rhetorics: Using Games as a Lens of Study

In this upper-level undergraduate English elective, students explored rhetorical concepts through examples in videogames as well as their collaborative play as a class using World of Warcraft (WoW); in this way, students had a practically grounded experience “playing” the topics they studied. The course was designed around the WoW “party” concept in which students became experts in a specific conceptual area (identity, design, teaching and learning). A cohort of experts in the same conceptual area collaboratively developed a weekly principle that they shared with the rest of the class. Students from the other disciplines did the same, and then utilized the various principles to tackle a weekly challenge. By sharing out their knowledge to the other cohorts, students served as masters/experts and teachers; they provided enough information for the other students in the other cohorts to understand (at least superficially) the particular perspective in order to both incorporate it into their own perspective as well as to synthesize as a class around a weekly problem. The course design resembled Aronson and Patnoe’s (1978) concept of the “jigsaw classroom,” the most significant difference being that this particular course focused on the learning of the class as a whole rather than as small groups of learners. This design stresses that learning is highly interpersonal (Hattie and Yates, 2013) and the human mind is geared for social collaboration in knowledge building tasks. In modern classrooms, however, students are often simply parallel learners (learning side-by-side) with various instances of shared labor (group work). The design included multiple assumptions: that students learn best by learning as part of social groups; that students could cover more ground as a group than individually; that students collectively co-created knowledge both as experts in a domain and by supplementing their knowledge with that of their peers; and that the “work” of the class required the knowledge and practice of all class members.

Course 2: Designing Courses as a Journey Towards a Critical Disposition

This course design model focused on a game-based course that aimed to help students understand the relationship between technology and society through a series of Quest Lines. In each Quest Line, students took up a role (i.e. critical consumer, ethnographer, game designer, etc.) and progressed through thematic quests to develop the skills that are necessary for them to succeed in the boss battles (project assignments). While this may read simply as a re-skinning of the standard layout of a course, these small design tweaks lead to larger dispositional shifts whereby students came to see their coursework as moments of their own larger professional trajectory beyond the course itself. That realization is the central intent of this design, and critique of the existing paradigm of course design. Drawing on the rhetoric of “life-long learning,” and the observation that at the university level curricula are enacted as separable building blocks that should assemble into something useful by the end of the student’s degree program but is often only addressed tacitly or not at all, this course design is an attempt to provide a trajectory for students to conduct that assembly as part of their participation in the course. This design draws from the work on Transformational Play (Barab, Gresalfi, Ingram-Goble, 2010), research that illuminates the relationship of games to education and learning. Transformational Play suggests that video games provide opportunities to render the dynamics among person, content, and context as particularly valuable educational experiences.

Game-inspired Teaching Design Principles

Both courses were designed to adopt many of the insights of GBL research aligned to theories of embodied and situated cognition. Both courses began with the assumption that good classes—like good games—are problem solving spaces, and that learners should have agency over their experiences within these spaces. To guide our designs, we developed a set of principles inspired by videogame design and GBL research. Importantly, these principles take advantage of insights from game design while remaining “lightweight” enough to apply to a range of classes rather than being tied to one or two very specific instances. That is, utilizing these principles does not necessarily require major reconfigurations of normal classroom set ups (although it does not preclude it, either) nor a tremendous amount of additional work on the part of the teacher (Holmes, 2015). Indeed, many of these design principles are not terribly different than things teachers already do; we have simply organized them in such a way as to call attention to important design features that may go unnoticed or unaddressed in more traditional course
design. Teachers don’t have to be game designers (worrying about play mechanics and balance and metaphoric cohesion and a range of other game-specific issues). Instead, these principles are intended to remove game-specific problems while still benefitting from the meaningful organizing structures of games and allowing teachers to see themselves as designers of good learning experiences.

**Design Principle: Cultivate and resource distributed knowledge and abilities**

Many good videogames consist of complex problem spaces which provide opportunities and resources for players to work towards successfully solving these problems within the game; high-level mastery, however, requires social interactions and sharing of knowledge that go beyond “just” the game. *World of Warcraft, Dota 2, the Pokémon series,* or *Minecraft* are good examples. Players contribute to wikis and frequently asked question (FAQ) sites, discuss tactics or theories on forums, share “how to” videos on YouTube, stream their own play on Twitch.tv and collaborate through many other sites and methods. Games provide the “shell” for play (the play space, the challenges and goals), and give players tools to play (the mechanics, game features like group chat), but often it is up to players to pool their expertise in order to really play the game.

Good course design can also leverage this kind of distributed knowledge and resourcing of different learners. Learners (like videogame players) often have a range of different skills, abilities, previous experiences, interests, motivations, and goals; a teacher can help connect and cultivate these differences towards some common or shared goal in order to not only amplify the kinds of learning happening but also to provide opportunities to see new perspectives and to capture varied interests. In Course 1, for example, this was a primary goal—borrowing the *World of Warcraft* party model as an organizing structure of the class helped students gain deep knowledge around a specific idea of way of seeing a problem but also broad knowledge across several perspectives by relying on each others’ learning and teaching. The teacher, in this scenario, established the weekly challenge and provided resources (such as readings and specific gameplay experiences) to the various groups to help them develop their principles, and facilitated the interactions between the various groups.

Course 2 similarly promoted sharing of knowledge and opportunities for learners to critique other student’s work. The course adopted a design studio model in which groups of students worked throughout the semester together. While each student was responsible for their own production of course assignments, the studio teams reviewed each other’s work, provided feedback, and also worked on tasks collaboratively. Further, students had plenty of opportunities to evaluate their work against their peers in order to gain a sense of where they were in their own learning as well as to learn from the other students’ as well. Both course designs provided ways of promoting distributed knowledge among the students (either by requiring them to jointly develop and share their work or to act as peer-mentors) and to resource learners in different ways.

**Design Principle: Allow learners to explore and customize their learning**

As noted above, there are many different kinds of videogames players (much like there are many different kinds of learners), and many good videogames allow players to customize the game to their preferences. Some customization features relate to things like difficulty (players can make the game easier or harder) or the appearance of their in-game representation (choosing a gender or changing the face and so on). Other customization features are more nuanced; some games allow players to use different styles of play or tactics (*in Deus Ex: Human Revolution*, for example, players can play stealthily and non-lethally or they can focus on heavily-armed combat), while other games change the narrative progress based on players choices (*the Walking Dead* game, for instance, provides many opportunities for players to make choices that affect how the story unfolds). Customizing their play experiences gives players agency in aligning their interests to the possibilities of the game, which in turn helps promote engagement and motivation in their participation since they “own” the experience.

The example courses handled exploration and customization somewhat differently. Course 2 was designed around a conceptual progression of gaming from critical consumer to ethnographic participant to game designer and finally to “entrepreneur,” where students had to “pitch” their ideas developed in their game design, accounting for thinks like marketplace analysis, social impact alignment, and the overall player experience. In this way, students developed a multi-faceted understanding of the breadth of approaches to videogames, from the player and maker perspectives. Each student produced materials at each point but had the opportunity to focus on a particular frame in their final project design. In this way, students gained insight about several different perspectives but could customize their effort towards a particular perspective that meshed with their own interests.
Cases, students were co-creating the course within structures of the course design but in active, meaningful ways. In both courses, students were tasked with playing games throughout the semester (in particular thematic “impact guides” and their game designs) which other students would respond to. In both courses, students opportunities within their design studios to structure their conversations and to develop the course materials and structures for their classmates. The instructor facilitated and supported these moments through timely interventions (planned readings and activities as well as ad-hoc discussions on the course forums and in class) but allowed students to create and execute many of the core teaching acts throughout the course. Course 2 allowed interventions (planned readings and activities as well as ad-hoc discussions on the course forums and in class) but promoted active choices from students in how they would participate and what their learning experience would look like. Course 1 provided students not only the chance to “specialize” in a thematic framework but in developing their own principle which they shared with the other groups. They, in some senses, developed the teaching materials and structures for their classmates. The instructor facilitated and supported these moments through timely interventions (planned readings and activities as well as ad-hoc discussions on the course forums and in class) but allowed students to create and execute many of the core teaching acts throughout the course. Course 2 allowed students opportunities within their design studios to structure their conversations and to develop the course materials (in particular thematic “impact guides” and their game designs) which other students would respond to. In both cases, students were co-creating the course within structures of the course design but in active, meaningful ways.

**Design Principle: Treat learners as Co-Designers and Agentive Participants**

This principle closely relates to the previous one. Part of the function of customizing their game play experience is that players get to co-create the game; that is, game designers create opportunities for players to engage the game and provide resources for their play, but players have some responsibility to enact the design in the ways they see fit. This is true in the literal sense (as “interactive” media, games need players to do something for the game to progress). But it is also true in the sense that players can make choices (supported by the game design) in how they want their experience to unfold and have the means to enact those choices. Some games do this more radically than others; a game like Minecraft is heavily based on providing tools for players and then letting them build and explore a great deal, whereas highly scripted games like the Final Fantasy series are relatively linear and provide far fewer opportunities for player agency. These designs vary depending on the intended experience (Minecraft is a “sandbox” game whereas Final Fantasy games are primarily narrative games) but nearly all games allow players some control over how their participation unfolds.

Both courses, as described in the preceding principles, show varying levels of learner co-design. Both designs promoted active choices from students in how they would participate and what their learning experience would look like. Course 1 provided students not only the chance to “specialize” in a thematic framework but in developing their own principle which they shared with the other groups. They, in some senses, developed the teaching materials and structures for their classmates. The instructor facilitated and supported these moments through timely interventions (planned readings and activities as well as ad-hoc discussions on the course forums and in class) but allowed students to create and execute many of the core teaching acts throughout the course. Course 2 allowed students opportunities within their design studios to structure their conversations and to develop the course materials (in particular thematic “impact guides” and their game designs) which other students would respond to. In both cases, students were co-creating the course within structures of the course design but in active, meaningful ways.

**Design Principle: Structure Moments to Gauge How Learner Is Doing and Where to Next**

One key feature of most good games is that they perform deep assessment throughout gameplay and provide meaningful feedback to players on their performance (see, for example, Shute and Ventura, 2013). Players learn about how they have just performed on a task and on their overall progress (the Guitar Hero games provide real time assessment and feedback on the player’s performance; missed notes are accompanied by buzzing noise, flashing icons, and the “audience” booing, while successful play provides different feedback responses, for example). Furthermore, good games also provide information on what the player should do next, either to improve their performance or to progress through the game (in Batman: Arkharm City, the game will pop up “tips” if a player struggles to land a hit or perform some combo; similarly, the game includes narrative audio tracks indicating the next part of the city to go to during the story as well as a marker/indicator on the players map to help guide them to the next task in the game). Both kinds of feedback—on how they are performing and what they should do next—are important to keeping players progressing through the game successfully.

Beyond the somewhat “normal” assessment and feedback used in each course (grading papers/projects, for example, and leading class discussions), each course included several organizing structures for students to gauge their own progress and to understand upcoming tasks and expectations. Course 2 used several game-like metaphors which framed the student’s experience as a “journey” with “quests” (thematic sections of the course). Both courses used the terms “boss” and “mini-boss” to indicate an important or more difficult challenge. Course 1 used the metaphor of the WoW party to help students understand their organization and their interdependence, tied to in-game activities. While both courses did adopt some of these terms from games, they were not “game” elements per se; rather, they were quick metaphors for understanding how the pieces of the course related to the whole. These metaphors provided a shorthand (particularly to “gamers” but also to non-experienced gamers since they were tasked with playing games throughout the semester) to help students know what was expected and what they should be doing at any given moment. Adopting these terms is not necessary, but we both found the convenience of melding game terminology with key elements of the course useful and effective.
Design Principle: Provide Ways to Develop a Critical Narrative for Learning Trajectories

Most games are, at their core, narrative experiences. Some games, of course, are about the story on the screen (the journey of the protagonist in Bioshock or the personal consequences of World War 1 in Valiant Hearts). Some are primarily about the player’s experience (their epic Flappy Bird run or Drop 7 game). Most games balance the designed and emergent narratives. In many important ways, games are about the way the player and the game together create some kind of meaningful story. Like any compelling narrative, players should feel somehow changed by the experience, that they know or feel something different than when they began; perhaps not always profoundly (a game of 2048 may not be life changing), but at the least the player has some new critical understanding of some phenomenon and some sense that their participation has mattered.

Good learning should do the same, though often the “story” of the learner’s experience is ignored. Indeed, one of the most compelling factors in learning, as mentioned above, is that the learner has something at stake and that they feel that what they are learning matters (see Hattie and Yates, 2013, for more). Both courses took this design principle as the foundation for all the other design choices, that the students should develop some kind of critical narrative over their learning and that the story of their journey is of the utmost importance. Course 2 provided the most concrete articulation of this; the course was described as a “journey” to students, and throughout students took on “roles” (critical consumer, ethnographer, designer, entrepreneur) which promoted personal investment and identity building. Course 1 was designed to connect students in-class and in-game experiences to their other courses and their other non-academic experiences and promoted engagement with people and activities beyond the classroom so that students could see their learning as part of their everyday life in meaningful and critical ways. Both courses were intended to orient learners not just to facts or content or even to general themes but to help students learn to incorporate their learning into broader personal stories about their experiences and their participation as critical citizens in the world at large.

Implications and Further Research

This paper is primarily a theoretical paper intended to synthesize GBL research with a models of game design in order to create classes which capture the good teaching present in many good videogames. Our chief aim is to highlight two important ideas: first, that videogames provide models of good teaching and good experiences for learning and that teachers should conceive of themselves as designers of good learning experiences; and second, that using games as a model for course design does not necessarily rely on including game components but can still benefit from the insights of videogames in their design. In other words, we want to provide design tools to teachers inspired by videogames without forcing them to necessarily become game designers, thus avoiding many of the problematic issues of game design often found in gamification models.

We have not directly provided evidence from the actual implementation of these courses here, although this is an important next step in determining the effectiveness of these models. We do believe that our design principles are built on more than 10 years of research into GBL and have a strong empirical foundation, but more robust analysis of the way these courses run may validate (or invalidate) these design theories. We have collected data from one implementation of Course 1 and two implementations of Course 2. Further instances of both classes are planned for in upcoming semesters in which we plan to collect more qualitative data from students participating in the courses. The design principles developed here illuminate how these designs played an integral part in the instructional process, and our continued data collection will show to what degree the structure of these courses influenced student dispositions towards their learning. Ultimately, we believe that by seeing teaching as a form of designing good learning experiences, based on evidence born out in the GBL literature and in our own course designs, that we can open up new and effective instructional approaches.

References


Abstract: **VerilogTown** is a game about cars, crashes and hardware design. The game allows players to learn, practice and play with the Verilog Hardware Description Language (HDL). The game asks players to solve a variety of traffic puzzles using digital logic designs specified through an HDL, which is what hardware designers use to create applications synthesizable to integrated chips. This paper outlines the design and final product, including the fundamental benefits of such approach. It is provided as a case study in domain specific game design that should prove useful to other researchers looking to employ the potential of play to facilitate learning of complex systems, models and theories.

Introduction

One of the core foundations in continued support of STEM educational research is an appreciation for understanding logic. Logic pervades a variety of disciplines and practices ranging from writing to mathematics, from hypothesis to synthesized solutions. It is no surprise that games have provided an appropriate solution for practicing logic. Traditional games, like Chess, have been championed as appropriate ways to practice logic and envision multivariate outcomes (Ferguson, 1995).

The core benefit of such play are also outlined by Brown and others (2009). Psychology and allied disciplines have demonstrated that a playful mindset supports flexible problem solving and a focused state (Brown, 2009). The research findings, state simply—we are at our best when we are at play. One challenge is that many traditional games, like Chess, rely on a single model of logic. Such games, like many non-digital games, are sequential games, where player logic is the sequenced response to another player’s decision. It is also difficult to transfer the direct experience of solving logic problems in such games to the practical challenges of non-game contexts.

Digital games clearly extend the possibilities of education and training, particularly through practicing logic. It is clear that the future of learning is likely to involve game solutions, whether viewed from the last decade or from a contemporary perspective (Shaffer et al, 2005). The foundation of computer science certainly supports the execution and practice of sequential logic, but it also affords for other approaches. Digital play extends the traditional bounds of game logic by affording for experiential and multivariate logic. Players of digital games can test and retest logical hypothesis. They can also isolate and refine their logic through simulation. Examples of this include everything from squad management in *Call of Duty* to urban planning in *Civilization*, or balancing social and psychological needs in *The Sims*. The potential and demonstrated benefit of such games based learning has been demonstrated by Kurt Squire (2005) and others in domains as varied as psychology (Tannahill, Tissington, & Senior, 2012) to creative writing (Gerber and Price, 2011).

Games also include more exotic examples that change, through epistemological effect, the nature of knowing and how logic is executed. Imperfect knowledge, for example is the cornerstone of such games as Battleship, which require players to logically deduce location but obscures those locations physically (by placing a panel between players). Practicing logic through imperfect knowledge is a structure common to both games (via obscured data) and educational assessment (e.g. fill-in the blank or argumentation contexts).

Digital games take this epistemology further, by offering perfect knowledge and creating play from a perfect knowledge scenario. Beyond providing omniscient views of complex situations, as many aerial perspective games do, digital games afford for increasingly complex opportunities. Jonathan Blow’s Oracle Billiards (2003) is one such example. The game allows players to see where billiard balls will land before the player hits them with the cue ball. In such a design, the nature of billiards is fundamentally changed. The game matriculates from simple physics simulation, to an exercise in longer term strategic planning. What the digital game affords is a series of long term decisions normally only available to the most experienced professional billiards player. Players aren’t worried about one ball, they are worried about the result of two or three steps after sinking a target.
In this history of blending the benefits of games and education, several examples illustrate its potential. Of particular relevance is the LOGO (Feurzeig 1969) language system, which coupled a simple programming language with the ability to express creative computer graphics. LOGO inspired a generation of young learners to see the logical and even mathematical relationship of rendered graphics and code. Modern compliments like Scratch (Resnick et al 2009) offer similar appeal.

While much of the discussion about teaching logic has focused on the merits of learning software programming this research offers a solution in hardware programming. The constraints of hardware programming have often made such work less than accessible. However, the obvious opportunity in Arduino (Jamieson, 2010) and similarly intentioned solutions has made the opportunity more alluring. Likewise, the continued use of LOGO technology (Weinberg and Yu, 2003) indicates the value of such experiential education. These are commercial, software programmable, hardware solutions. They are playful opportunities to learn relatively complex logic systems. They allow people to problem solve by playing with their solutions.

Recent work in human computation games has inspired a variety of researchers and game designers to harness the problem solving in these games to address real world issues. In short, human computation games (HCG) not only allow people to practice problem solving in games, they record and apply player solutions to real world problems. Games such as FoldIt have resounded in the academic research community as offering an entirely new paradigm to employing play to solve a myriad of non-game problems (Cooper et al, 2010). This has resulted in an explosion of such games of which the most common activities are labeling data (Grace and Jamieson, 2013).

The researchers set forth to tap the potential of playful learning and human computation games by developing a game. The game, VerilogTown employs the Verilog hardware description language to create synthesizable logic designs. The solution our team of researchers created is a distinct combination of these two approaches. It brings the power of playful learning to the problem solving success of human computation games. The researchers developed VerilogTown, as an experiment in making synthesizable logic more accessible. Players must manage the flow of traffic in the virtual world, to avoid accidents and traffic jams. The solutions they develop in-game can be used for digital hardware solutions outside the game.

The game’s problem, managing traffic, is one that is commonly understood. It also serves as an analogy for the solutions the players are generating. By employing, synthesizable Verilog HDL to solve problems in the game, players are producing real synthesizable circuits. Put simply, these circuits can be configured on a device and deployed in the field. The means of circuit design is via a hardware description language (HDL) created by designers, which is a more efficient way of designing circuits compared to schematic entry.

This research was conducted as a collaboration between subject matter experts in their respective fields. It includes a well-respected researcher in FPGA, or field programmable gate array, one of several programmable integrated circuit technologies. VerilogTown is also the product of efforts from a well-respected academic game designer, several artists, and computer engineering researchers. The game serves as an appropriate case study for highlighting specialized, playful learning. By sharing this research, we hope to make such work more accessible and encourage others to apply similarly designed solutions to their specific domains.

**Game Overview**

VerilogTown is a game about cars, crashes and hardware design. The goal of VerilogTown is to get the cars safely through the streets to their intended destination. As shown in figure 1, cars drive toward intersections that are managed by traffic lights. Players create rules for the traffic lights, which manage the intersections. The rules, are articulated in Verilog to control each of the traffic lights in a level’s puzzle. Puzzles range from simple, single intersection challenges, to multi-intersection, multi car calculations.
Figure 1: Screenshots from the game. Section A demonstrates a simple, single car intersection. In B, multiple cars come to an intersection with the possibility of collision. C demonstrates a complex 10 intersection puzzle.

Much like a typical tower defense game, players cannot control the non-player characters. Instead, players must design logical solutions that balance the fastest solution with avoiding a collision. Players, could for example, choose to hold all the cars at a single intersection for a long period of time. However, much like conventional traffic management, doing so may result in a longer than necessary waiting time for everyone. Likewise, changing a signal while cars are still in intersections can also create problems. Players must edit the traffic light logic (including directional management) to optimize solutions. Figure two demonstrates how editing a signal works.

Figure 2: Players edit logic by selecting a signal at an intersection and adjusting the Verilog code in the editing window.

Embracing the research literature on play, players learn by failing. The game is designed for players to run through the scenario, see the complex multivariate scenario and then experiment for a solution. Each iteration through executing logic and seeing the result drives toward an optimal solution.

The game also provides players the ability to create their own puzzles to solve or map to existing challenges they have in synthesizable circuits. The ability for players to create their own puzzles affords for a virtual playground supporting understanding, experimentation and practice of the relatively complex logic employed in digital circuit
design. This is one of the hallmarks of the approach. Instead of merely subscribing to a set of prescribed challenges, players are supported by player generated content and self-initiated challenges. This simple design decision did complicate development, but it ultimately provides for a far more robust, scalable and engaging game.

The game is provided as a free download on the website. The game can be played on any Microsoft Windows machine supporting Java. The interface is minimal and supports key problem solving actions. These include zooming in and out, panning through the level map, starting pausing, restarting, and requesting basic help files. On the website players can also provide their solutions and learn about the programming structure.

**Game Design Highlights**

The game is designed to take advantage of three key characteristics. These are the, the clarity of analogy, simultaneous visual representation, and playful learning. The analogy of cars moving through traffic maps nicely to circuit routing. Without knowing the science of circuits, players have a clear sense of their goal, the multiple factors impeding their goal and how to meet their goals. They must simply manage the gates, or traffic signals, that manipulate flow.

The visual representation of this process provides a second layer of learning support. Circuits employ multiple activities at once. Asking players to envision such activity in their minds is both taxing and distracting. Thinking through states with only a mental model works for low complexity tasks, but it is immediately complicated by the addition events or additional gates. Seeing a representation of what is happening aids in understanding the process, the multiple factors, and the solutions required.

Lastly, the analogy and visualization are designed to support a play state. Instead of reprimanding players with error messages and negative feedback, the players experience crashes. More importantly, they are supported in one of the hallmarks of play’s value—experimentation. In the VerilogTown environment players are encouraged to try and learn from their mistakes. It is very much founded on the principle that play is an educational playground (Brown, 2009).

Because of the nature of circuit design, VerilogTown serves as a playful way to learn two relatively complex notions in logic design. The game supports both combination and sequential circuit logic.

**Practicing Complex Logic: Combinational and Sequential**

The game’s content focus is in the playful execution of digital circuit theory. There are two important models in digital circuit theory, Combinational and Sequential logic. The former is a subset of the latter and can be considered divergent ways of understanding logic design for digital circuits. The game supports both. Unlike the following paragraphs that explain such logic, players are afforded experiential learning. They can play through these two approaches, fail gracefully within the game system and continue to experience the difference in these logic approaches.

Combinational logic is continuously processed. It is a time independent logic that has no means for storing state. On analogy is that Combinational logic is a waterway where the water is never stopped and always flows from start to end.

By analogy, sequential logic is controlled by a clock which serves as the heartbeat of a circuit. In sequential logic, the present state of the logic input and the sequence of inputs are a factor.

To adapt the water analogy, it is helpful to think of sequential logic as water flowing. That water is stopped by a dam and then released every time a second ticks. When this second ticks, we would have a 1Hz clock frequency for the circuit. In its simplest, sequential logic can be considered as combinational logic with state. The state is the dam, which can store for a limited amount of time. The concept is somewhat similar to timer based software operations common to games, computer graphics and monitoring systems as sequential logic is the basis for constructing finite state machines. Finite State Machines (FSM) are commonly employed by computer software.

Combinational and sequential logic can be mixed together in a sequential circuit. This is normal. In reality, any sequential logic circuit will have combinational elements. However, a purely combinational circuit has no sequential logic.

VerilogTown provides two templates for players to use in understanding, practicing and playing with the difference between combinational and sequential logic. The first template is a combinational template. It demonstrates checking an in-game traffic signal and executing turn one direction to Go if there is no car in the intersection and
there is a car waiting. The second Verilog template is a sequential template that changes the light every 3 seconds in a counter-clockwise pattern. Using these two templates, players can experiment with how to solve the gradually more complex puzzles in the game. Figure 3 provides an excerpt of the Verilog logic, demonstrating the core programming logic required.

```verilog
begin
  if (rst == 1'b0)
    begin
      count <= 8'd0;
      start <= 3'd0;
      outN <= Go;
      outS <= Stop;
      outE <= Stop;
      outW <= Stop;
    end
    else
    begin
      count <= count + 1'b1;
      if (start < 3'b111)
        begin
          outE <= Go;
          outN <= Stop;
          if (count == 8'd255)
            start <= start + 1'b1;
        end
        else
        begin
          case (count)
            8'd0 :
              begin
                outN <= Stop;
                outE <= Go;
              end
            8'd64:
              begin
                outE <= Stop;
                outS <= Go;
              end
            8'd128:
              begin
                outS <= Stop;
                outW <= Go;
              end
            8'd192:
              begin
                outW <= Stop;
                outN <= Go;
              end
            endcase
          end
        end
    end
end
```

**Figure 3: Verilog code excerpt used to solve an in-game puzzle.**

As expected, players can cut and paste their *VerilogTown* solutions into other tools for use on synthesizable circuits. In short, they can play with an in-game solution until they solve their non-game needs.
Conclusion

The goal of this brief case study was simply to illustrate the designed solutions for incorporating domain specific logic into a playful game experience. The research team sought to move beyond the feared, chocolate covered broccoli solution. We did not want to merely cover the challenging task of programming synthesizable circuits with sloppily applied set of game-like sweetness. Instead, we aimed to apply the contemporary theory in human computation games with the overarching mantras of engaging educational game design. The game aims to make this complex task accessible by embracing the hallmarks of playful learning and experiential education. Players are encouraged to experiment, supported in their failure, and provided an experience that maps directly to real world application. The hope is while this specific application is not widely understood, this case study provides design reference for game makers seeking to address similar challenges in narrow, but essential domains.

References


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http://www.users.miamioh.edu/jamiespa/verilogTown/
Abstract: Digital games and media resources are often designed to teach particular skills or concepts, and mediation can have an impact in supporting those intended learning outcomes. We refer to mediation to describe the role that an adult plays in supporting, guiding, and demonstrating game play as well as curation, or the sequencing or grouping of game play activities in targeted ways. We examine and describe ways in which educators, parents and families can mediate children’s game-play and media use that can support positive learning outcomes in formal and informal learning environments. We also discuss how the curation of digital media experiences for children that are engaging and that integrate elements of a particular skill area can promote learning. To inform this discussion, we draw from multiple studies examining preschool-age children’s use of digital media and the impacts on learning.

Introduction

The role of digital play and digital games in young children’s learning lives has been both championed and challenged as the future of learning. Within this context, developers, designers, educators and researchers are just beginning to attend to the integral role that adults can play in mediating children’s experience with digital media, as the questions shift from whether digital media can impact learning to the conditions under which it is possible to do so. What kinds of mediation are needed and in what environments? Findings from recent research suggest that adult mediation—such as selecting, curating, sequencing, supporting, guiding and demonstrating use—can play an important role in extending, enriching, and improving children’s learning outcomes (Moorthy et al., 2013; Media and Learning Group at SRI Education, 2010; Stevens & Penuel, 2010; Takeuchi & Stevens, 2011). The studies described in this paper advance this line of research by identifying the extent to which educators and families adopt and utilize mediation strategies and promote interactions that increase the opportunity to learn in the moment.

This research is part of a summative evaluation of Ready to Learn, a children’s public media initiative supported through the US Department of Education and conducted by EDC and SRI, that seeks to develop engaging, high-quality educational programming and supports for two- to eight-year-old children from low-income households. A core aim of the initiative is delivering early mathematics resources for new and emerging digital platforms such as tablet computers, interactive whiteboards, and smartphones, as well as better-established technologies such as computers, video displays, and gaming consoles, and to create learning experiences that leverage the unique capabilities of these various technology platforms for young children’s learning.

This paper examines the role and impact of mediation in the context of early learning and digital media, including digital games, apps and video. We consider two kinds of mediation: content curation, which includes the sequencing or grouping of videos and game play activities in deliberate ways that are intended to target specific learning objectives, and joint engagement with media (JEM), which includes selecting, supporting, guiding and demonstrating digital media use. We draw on findings from two studies examining how games and media can support very young learners to acquire mathematics skills across learning environments. These studies include a Classroom-based Study that examined digital media use in daycare and prekindergarten classrooms and a Lab Study that examined preschool-age children’s learning and digital media use in informal or “lab” settings. Across both contexts mediation emerged as a central component that expanded the impact of digital content on children’s learning of target skills and concepts. Specifically, our results indicate that young children can learn targeted skills when they are engaged with well-designed media that takes into consideration children’s developmental and learning trajectories and is supported through mediation.

Theoretical Background

Preparing children for school and learning across content and readiness domains presents a continual challenge. Many children enter kindergarten lacking important skills that predict later success in school, particularly mathematics achievement, which is an even stronger predictor of children’s later school achievement than even
early literacy (Claessens, Duncan, & Engel, 2009). Digital media learning experiences, including developmentally appropriate educational digital games and videos, may provide an important means to develop young children’s early learning skills.

Media, in the form of videos and games, can offer dynamic, multi-sensory representations of concepts, places, or people that would not be practical (or possible) otherwise. For example, children can use digital media for virtual field trips to remote habitats, or use interactive virtual manipulatives that provide immediate feedback and prompts to support mathematics understanding. Children can be intrinsically interested in and motivated by media and technology experiences, and this increased motivation is associated with deeper engagement and processing (Renninger, 2000). Children’s engagement with these kinds of digital resources is associated with gains in literacy, science, and math and skills related to school readiness, such as approaches-to-learning (ATL) and problem solving (Fisch, 2004, Penuel et al., 2012; Pasnik & Llorente, 2013). Although digital games and media clearly hold potential for influencing learning, there is less consensus in the literature about the characteristics and conditions required for effective use. We hypothesize that adult mediation of children’s use of digital games and media provides a central support for children’s learning and conceptual understanding.

In addition to representing and organizing ideas in a different medium, educational technology and media can also foster social interactions, increasing communication and collaboration between and among teachers and students that can lead to the co-construction of deeper or extended conceptual understanding (Hong & Trepanier-Street, 2004). Joint engagements with media (JEM) builds on research showing that co-viewing educational television programming with adults or older siblings enhances young children’s learning (Reiser, Tessmer, & Phelps, 1984; St. Peters, Huston, & Wright, 1989). JEM includes experiences in which adults and children interact with one another while simultaneously attending to a media artifact, such as viewing a video, reading a digital book, or playing a game on a mobile device. The collaborative conversations that occur in the context of a shared media experience may help children clarify concepts, internalize knowledge and develop deeper reasoning skills, and provide an opportunity for adults to assess and scaffold student thinking by asking questions or requesting elaboration and providing feedback; and model various strategies, such as thinking out loud and modeling discourse strategies. Adults can also provide basic support by guiding the use of technology and prompting interaction (McManis and Gunnewig, 2012). Reflective of the extensive research on the positive impacts of student-centered classroom discourse (e.g. Chin, 2007; Hiebert & Wearne, 1993), research on joint engagements with media suggests that this type of collaborative use can provide powerful affordances for learning beyond what the media resources may support through solo engagement (Moorthy et al., 2013; Media and Learning Group at SRI Education, 2010; Stevens & Penuel, 2010; Takeuchi & Stevens, 2011).

This paper also examines a second type of mediation related to the curation of content. We hypothesize that creating digital media experiences for children that are engaging and that focus on a particular target skill and are organized in a set learning sequence can provide distinct learning opportunities. Although there is limited research on use of content curation and digital media, literature related to instructional design and curriculum sequences suggests that the organization of learning experiences into a cohesive sequence is consequential for children’s learning. Specifically, students who experience mathematics curricular interventions that are focused on a particular concept and that include a set of learning experiences and instructional tasks that are closely aligned to evidence about students’ conceptual development learn more than students who experience more typical curricular approaches (Clements et al, 2011; Presser et al., 2010; Sztajn et al., 2012).

Research Questions

These studies address a core set of questions about the role of digital media (games, apps, video), mediation of that digital media experience, and how it can affect early learning among preschool age children. These questions include:

1. What are the ways in which educators, parents and families mediate children’s game playing and technology use in formal and informal settings?

2. To what extent does attending to mediation throughout children’s game-play and media use experiences impact learning outcomes?

3. To what extent does sequencing or grouping digital media (games, apps, and video) in targeted ways impact learning outcomes?
Data and Methods

Two recent studies demonstrate the role that mediation can play to support mathematics learning for four-year-old children. These studies took place in two distinctly different contexts and environments. The first, a Classroom-based Study, took place in typical early-learning classrooms where educators were asked to implement a series of digital media activities, designed as a curriculum supplement over several weeks. The second, a Lab Study, took place in an informal, controlled environment or what we describe as a “lab” setting, where children were exposed to a sequenced set of digital activities targeting specific math skills with minimal intervention from adults in the room.

Study 1: Classroom-Based Study

The classroom-based study was designed to investigate whether the experience of implementing a 10-week curriculum supplement that curated media-rich as well as non-media activities in a set learning sequence would support children’s growth in target mathematics skills including counting; subitizing; recognizing numerals; recognizing, composing, and representing shapes; and patterns. Teachers and children in New York City and the San Francisco Bay Area from 86 preschool classrooms serving diverse, urban, and predominantly low-income populations were randomly assigned to one of three conditions: a Media-Rich Math Supplement condition, a Technology & Media condition, and a Business as Usual control condition. The Media-Rich Math Supplement condition provided classrooms with digital tools (i.e., interactive whiteboards and tablet computers), instructional support (i.e., coaches), and a structured curriculum supplement that supported teachers in integrating digital media into regular classroom instruction and routines. The Technology & Media condition provided the same digital tools and instructional support as the Media-Rich Math Supplement condition, but did not provide a curriculum supplement for guiding the selection and use of the digital resources. Teachers in the Business-As-Usual condition continued to engage in their typical mathematics activities without the addition of any digital tools, instructional support, or curriculum supplement.

Teachers in the Media-Rich Math Supplement condition enacted a 10-week curriculum supplement, which included media-rich activities, centered on videos and games available via public media broadcasting and online services, and non-digital, hands-on activities. A Teachers’ Guide provided sequenced activities across the 10 weeks focused on targeted math skills, as well as scaffolds for instructional mediation, including; suggestions for when teachers should pause videos and game play to initiate discussion, prompts for facilitating discussions with children, and facilitation notes for warm-up and wrap-up discussions to extend and enrich learning. These scaffolds were designed to support classroom discourse and a shared media experience.

Child outcomes were measured through two early mathematics assessments: a short version of the Research Based Early Mathematics Assessment (REMA short form) (Weiland et al., 2012), which served as a standardized assessment of children’s mathematics skills, and a supplement-based assessment (SBA) developed by the research team to be closely aligned to the mathematics concepts targeted in the Media-Rich Math Supplement and the Technology & Media conditions. Teacher outcomes were measured through administration of a pre and post teacher survey.

Study 2: Lab Study

The Lab Study was designed to explore, in a controlled environment, the extent to which children can learn mathematics from PEG+CAT resources outside of instructional environments and relationships; how parents perceived the resources; and how well children engage with these resources independently. The study used a pre/post design with no comparison or control group and included 59 child participants and their families from the New York metropolitan and San Francisco Bay areas. The treatment included five weekly sessions, each lasting approximately one hour. These sessions occurred in a laboratory setting and each week children and their parents met with a researcher who administered pre- and post assessments and guided viewing and gameplay of the PEG+CAT resources.

Prior to the beginning of the study, researchers conducted a detailed review of all learning materials developed by PEG+CAT producers, closely attending to focal mathematics skills and the strategies designers used to support learning. Following review, researchers selected specific PEG+CAT content that targeted two mathematics skills—patterns and shapes (3D/2D)—and the videos and games children engaged with during the study were selected and sequenced in a carefully curated experience to address these skills. Researchers selected and sequenced the videos and games such that children would have more than one opportunity to engage with a particular mathematics skill.
To examine children’s mathematics knowledge, the research team relied on two tools. One was the REMA, (Weiland et al., 2012), and the other a researcher-developed assessment. Researchers needed an additional measure because the PEG+CAT resources addressed mathematical skills that are not necessarily the focus of the REMA (e.g., auditory patterns and 3-D shapes). Researchers were also interested in assessing children’s understanding of focal mathematical skills immediately following the opportunity to learn them through exposure to the PEG+CAT resources. Therefore, researchers developed the PEG+CAT Item Sets (PCIS), which were closely aligned to PEG+CAT experience and administered before and after the sessions during which children engaged with media that targeted specific skills.

Findings

Findings across the two studies indicate that digital media interventions that: (a) are designed to present activities in a particular sequence and target specific skills or concepts, and (b) include scaffolding for engagement in rich discussion and interaction with adults regarding the digital media (JEM), hold significant potential for increasing preschool-age children’s learning.

Children who engaged with the media-rich classroom curriculum incorporating a curated set of digital media experiences improved significantly in their understanding of key early mathematics skills essential for early school success. While teachers whose classrooms received an infusion of digital resources (Technology & Media condition) integrated new technology tools and media resources into the mathematics lessons at quite high rates, and teachers whose classrooms were unaltered by the study (Business as Usual condition) spent considerable time and effort supporting children in learning basic math skills, it was only the children in the Media-Rich Math Supplement group who improved significantly in their mathematics skills (see Table 1).

Observation data from the classroom-based study indicate that teachers from the Media-rich math supplement typically implemented the distinctive features of the curriculum: the warm-up and wrap-up, pause points where teachers engaged children in discussion about content, and the JEM instructional strategies emphasized in the curriculum supplement. Teachers used pause points as specified in the Teacher’s Guide 95% of the time during video viewing, often adding additional pause points of their own to reiterate ideas, check children’s comprehension, and ask questions to spark discussion, which centered on the mathematics knowledge and skills that were highlighted in the Teacher’s Guide. Moreover, teachers typically incorporated the recommended JEM instructional strategies into their enactment of activities: teachers modeled activities for children in 89% of observed activities, thought out loud in 85% of observed activities, encouraged children to think out loud in 73% of activities, re-voiced children’s ideas in 80% of activities, and encouraged children to provide feedback to their peers in 58% of activities. This focus on attending to mediation, in the form of JEM strategies, supported children’s improved understanding of early mathematics skills.

**Table 1: Summary of PBS KIDS Transmedia Math Supplement Impact Estimates**

Results from the Lab Study indicate that children who participated in the curated media experiences delineated in the study design, showed positive shifts in identifying some geometric shapes on a researcher-developed measure aligned to the media-based intervention and in overall math skills on the REMA short form. Children’s per-
formance improved significantly from pretest to posttest on a shape identification task on a researcher-developed measure aligned with the resource study experience. On additional shape identification and pattern tasks children showed positive but non-significant gains on the same measure (see Table 2).

<table>
<thead>
<tr>
<th>PEG+CAT Episode/Game</th>
<th>Target Skill</th>
<th>Description of Item</th>
<th>Pretest % Correct</th>
<th>Pretest n</th>
<th>Posttest % Correct</th>
<th>Posttest n</th>
<th>Change Pre to Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big Gig Attentive</td>
<td>Pattern</td>
<td>Completion</td>
<td>35.5%</td>
<td>21</td>
<td>54.2%</td>
<td>32</td>
<td>18.64%</td>
</tr>
<tr>
<td>The Golden Pyramid</td>
<td>3D Shape recognition</td>
<td>The assessor places the following 3D shapes in a basket: sphere, cube, cylinder, and pyramid, then asks the child to point to or pick up the cube.</td>
<td>36.58%</td>
<td>23</td>
<td>54.24%</td>
<td>32</td>
<td>15.25%</td>
</tr>
<tr>
<td>The Golden Pyramid</td>
<td>3D Shape recognition</td>
<td>The assessor shows the child images of various 3D and 2D images from the PEG+CAT video, The Golden Pyramid problem, and asks the child to point to the cylinder.</td>
<td>36.58%</td>
<td>23</td>
<td>54.24%</td>
<td>32</td>
<td>15.25%</td>
</tr>
<tr>
<td>The Golden Pyramid</td>
<td>3D Shape recognition</td>
<td>The assessor places the following 3D shapes in a basket: sphere, cube, cylinder, and pyramid, then asks the child to point to or pick up the cylinder.</td>
<td>54.24%</td>
<td>32</td>
<td>67.80%</td>
<td>40</td>
<td>13.56%</td>
</tr>
<tr>
<td>The Golden Pyramid</td>
<td>3D Shape recognition</td>
<td>The assessor shows the child an image of Mermaid holding pyramids from the PEG+CAT video, The Golden Pyramid problem, then asks the child what shape Mermaid is holding.</td>
<td>3.39%</td>
<td>2</td>
<td>15.25%</td>
<td>9</td>
<td>11.86%</td>
</tr>
</tbody>
</table>

Table 2: PEG+CAT Item Sets items for which noteworthy pre-post gains were observed.

Mediation: Adult Intervention, Support, Guidance and Demonstration

Two specific themes emerged from these studies: (a) the role of mediation in the context of children’s experience with digital media; and (b) the substantial role of content and sequence in a child’s experience of the media and, by extension, exposure to and understanding of identified target skills.

Findings from our classroom-based study point in particular to content curation as an important mediator. Children who were part of the Media-Rich Math Supplement group significantly improved in their mathematics skills as a result of their participation, in contrast to children in a condition where similar technology devices and content were available, but not mediated through any curation of content. This suggests that organizing content into a cohesive learning sequence and providing support for teachers to enact joint engagement with media strategies (pausing to ask questions, making connections) can lead to positive child learning outcomes.

The differences in learning outcomes across the two groups suggest that for digital games and media to impact learning, the design must attend to both the content focus and the sequence in which it is experienced. Without the benefit of a set of sequenced activities, teachers in the comparison Technology and Media group were required to first locate and then match resources to classroom mathematics activities and then had to continue this process over 10 weeks in order to create larger arcs of lessons to ensure children had the repeated, linked opportunities to learn a set of target math skills. Few early childhood educators have the level of intimate knowledge about a set of digital resources that would allow them to construct such a multi-week experience for their students without the benefit of substantial planning time and guidance from content area experts.

Our Lab study of the PEG+CAT resources provided the opportunity to further explore the role of mediation. While the initial structure of this study sought to eliminate all mediation from children’s experiences during the study, researchers acknowledged the hidden mediation built into the experience for all participants. For example, children engaging in a completely “natural” media experience can leave or click away from a particular resource at any time—however the design of the study website made this very difficult. Children engaging with content are constrained by the content’s public release, however in our study we had access to all content and could make viewing selections based on knowing the full range of available options. Each of these instances requires input from adults that mediates children’s experience. Given this fact we designed the lab study to emphasize the curation of content (which did not require direct contact with an audience) and de-emphasize the role that could be played by JEM (which requires direct contact). The resulting study and findings suggest that children can gain new skill and content knowledge through exposure to a well curated and sequenced set of interrelated activities, even when JEM opportunities are not available.
Conclusion

Results from our studies suggest mediation is a crucial component to any digital experience that targets young children and has as its goal a specific learning outcome. Key mediators include: adult intervention or support and curated content that is developmentally appropriate for the target audience and structured in a systematic way that introduces concepts and skills sequentially—for example introducing new concepts or skills during the first experience, and offering practice opportunities during later experiences. Much effort has been expended on the development of well crafted and engaging digital media that attempts to blend learning with gaming or play activities, yet few studies have been able to document strong positive learning outcomes from these experiences, particularly for young children. We suggest mediation can play a substantial role in supporting children’s learning in digital environments, and that attending to the role of mediation in its various forms can benefit children and the adults working with them. If digital tools are to play a role in supporting learning for all students, then careful consideration must be given to the circumstances that make these tools usable by all students. Providing children and their care-providers with access to content that is both well made and thoughtfully organized based on understandings of developmental and learning trajectories, can give children a chance to grow skills, and move forward the role of digital media in children’s learning.

References


Design Decisions and Educational Games: Insights for Acceptance

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Ahram Choi, Teachers College, Columbia University
Shu-Yi Hsu, Teachers College, Columbia University

Abstract: This study extends previous work (Kinzer, Turkay, Hoffman, Vicari, De Luna, & Chantes, 2013), through a survey of game designers. The work presented here provides insights into decisions made by game designers designing educational, as opposed to entertainment-focused games, in an attempt to link design and development decisions to the infusion of games into classrooms by addressing barriers to classroom adoption. Questions and issues addressed include: What are the decisions that go into determining what games are produced, what educational theories are embedded in designs (and how those decisions are made), what determines the content areas targeted by design decisions, and how game designers' use of educational focus groups and marketing strategies influence the adoption of educational games.

Background Assumptions and Rationale

Many educational practitioners, scholars, and researchers suggest there is great potential and educational benefit to digital games (e.g., Gee, 2003; Squire, 2011), and the past decade has seen a continuing effort to implement educational games into classrooms. Often, these efforts cite research showing that students tend to better assimilate their lessons if they are able to experience what they are to learn through simulated worlds that encompass computer games, which require learners to address content, presented at appropriate levels, within a fantasy world experienced by the player/learner (Malone, 1981; Gajendra, Sun, & Ye, 2010; Gee, 2010; Duncan, 2010). In arguing that games are a new kind of literacy aimed at honing students' cognitive interpretive skills, Connelly (2010, p. 3; see also Steinkuehler, 2007) refers to computer games as a way to challenge and engage sometimes ineffective, conventional procedures of school-based learning. Yet, although use of games in classrooms is increasing, Schwartz (2014) notes that “many teachers still use them primarily as supplemental material or as a reward when the ‘real work’ has been accomplished, not as the main instructional tool.” (para. 2)

From this perspective, when compared to the growth of games played by school aged children generally, there is a somewhat less optimistic view about progress toward the use of educational games in classrooms. Consider, for example, that “There is an average of two gamers in each game playing U.S. household and the average U.S. household owns at least one dedicated game console, PC, or smartphone” (ESA, 2014, p. 2), and that the prevalence of games in general use involves a huge part of disposable income: $15.4 billion in 2013 was spent on computer and video game purchases (ESA, 2014). Similar, exponential growth has not occurred for game-use in instructional situations in schools. Thus, while computer games, particularly online or digital games, arguably enhance students’ metacognitive capacity and learning as they require students to continuously assess, reflect, evaluate, amend and rectify their thinking in the learning process, it is important to come to understand what issues, especially from game designers’ perspectives, may be factors affecting the relatively slow growth seen in educational game-based implementation. By examining the influences and manner in which educational game design decisions are made, we hope to gain insights that could provide recommendations to designers and information to educators leading to productive ways to increase acceptance of educational games in schools. To this end, through a survey of educational game designers, this paper presents work that examined challenges and issues related to educational game design and development from conception to production, with a view to understanding the barriers and difficulties that prevent the implementation of those games in educational settings.

Procedures and Description of the Study

A survey was created with educational game designers as the target audience, as distinct from game designers who produce other types of games (e.g., entertainment games). Twenty-seven questions were tested by two game designers who rated the questions and overall survey for length, flow, and clarity. Based on their feedback, the survey was finalized and divided into three sections: “conception of,” “design and development of,” and “distribution of” educational games. The survey included Likert scale, multiple choice, and open ended responses. Likert scale and multiple choice responses were analyzed as numerical data, while open ended responses were coded through a qualitative content analysis that served to extend and triangulate the numerical data. The survey was deployed electronically through listservs, social media platforms, personal contacts (along with requests to for-
ward the survey to appropriate colleagues), and fliers with a link to the survey posted at game designer meet-ups, conferences, and so on. Participants received a reminder email for survey completion three weeks after their first invitation email or link to the survey. A total of 122 people answered part or all of the survey; 55 (45%) answered all questions. This completion rate is due, in part, to the structure of the survey (recall, above, that there were four parts). As not every part would be applicable to all respondents, perhaps because of their specific job responsibilities (some designers, for example, have input to decisions about final game distribution while others do not), we were not surprised that not all participants completed the entire survey.

Analysis
 Responses were analyzed by frequency for multiple choice questions. As not all parts of the survey were completed by each respondent, where we report percentage of respondents we also report the number of respondents who answered a given question and, if applicable, the percentage of respondents within that question’s multiple choice categories. To clarify, in a yes/no question 15 of 55 respondents may have responded “yes,” while in a different yes/no question, 10 of 50 may have responded “yes.” Thus, we make clear, in Table 1, the number of respondents for a given question when presenting subcategories of results. For written, open ended responses, inductive content coding was used. Four members of the research team separately coded the responses based on an initial coding scheme, adding codes as needed. In subsequent meetings, coding categories were added or removed depending on consistency of coding across coders, with disagreements resolved by mutual agreement. The written responses were then recoded, based on the agreed upon final coding scheme.

Results and Discussion
 A number of studies provide information about what teachers see as barriers to the classroom implementation of games (e.g., Rice, 2007; Schwartz, 2014; Fishman, Riconscente, Snider, Tsai, & Plass, 2014; Takeuchi & Vaala, 2014). While such studies confirm teachers’ concerns about technology infrastructure, these concerns are ebbing as technology in schools, and the availability of games on mobile devices, become increasingly available. More germane to the study reported here are findings that “Most teachers…report using short form games that students can finish within a single class period…[and] may also find shorter-form games to be easier to map to curriculum standards” (Takeuchi & Vaala, 2014, p. 5), and that “nearly half of teachers report they are unsure of where to find quality games and that it is hard to find games that fit their school’s curriculum” (Fishman et al., 2014, p. 4).

Summarizing across such studies and findings, teachers appear to resonate with games that link to their curriculum, that can be played in class during short periods of time (with longer play occurring in out of class settings), that explicitly match State and core curriculum guidelines, and that match their instructional approach (which we interpret as games that are explicit about their use of learning theory). Teachers also state a desire for help in locating games that might be appropriate for their use. Thus, the results reported below come from portions of our survey designed to explicitly address the above-noted areas, which can be categorized into the appropriateness of content, explicitness of links to curriculum and standards, explicitness of links to implementation of learning theory, and marketing that reaches teachers and targets awareness.

Choice of Content and Subject Area Decisions
 Several questions addressed issues of content, including questions that asked how decisions were made to develop and create a game, how a game’s content and content area were determined, and whether content experts were used in a game’s design and development. Our survey revealed that the factors resulting in the development of educational games were based on perceived (immediate) needs and specific requests (see Table 1, No. 1), rather than long term, sustainable curricular implementation plans. Respondents shared information on 41 unique educational games; the majority of games being developed were in STEM subject areas.

Respondents’ team members’ expertise in game production played an important role in determining the content of games. The majority of Other responses (see Table 1, No. 1) reported content based on personal interest or expertise. This was also true when there was a team working on the game content: expertise and the group’s interest were the determining factors for game content. In relation to this topic, when the survey asked what specific expertise was needed in developing the game (see Table 1, No. 7) the highest response was content experts. In addition, with the need for content experts being the most desired area of expertise, teachers (who would be considered educational experts) may be crucial from an early stage in educational game development, but are often absent.
For our respondents, market research seems to be of relatively little consideration in determining the subject area in educational games. This is different from entertainment game development (EGD), where Competitive Analysis (as part of a pitch document) includes details about how the game may fare in the marketplace by listing the unique features of the game being developed, number of other games that have been shipped recently that are similar to the one under consideration, and a detailed synopsis of how those similar games performed in the marketplace (Rouse, 2005, p. 309). If EGD is chiefly driven by potential profit, educational games appear to be driven more by perceived subject area needs and requests, with educational games often being developed “on spec” with the hope that monetary returns will follow. We believe that this downplaying of market research is linked to relatively low incidence of educational game advertising, thus impacting awareness of a game’s availability, and encourage more emphasis in this area to build teachers’ awareness of games to positively affect infusion into classrooms.

Table 1: Comprehensive results from the survey

<table>
<thead>
<tr>
<th>No.</th>
<th>Question and [Total Responses]</th>
<th>Response Choice</th>
<th>No. of Responses</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>How did you choose game content? (Choose all that apply.) [68]</td>
<td>Needs analysis</td>
<td>30</td>
<td>44%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Client request</td>
<td>25</td>
<td>37%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Market research</td>
<td>18</td>
<td>26%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other</td>
<td>24</td>
<td>35%</td>
</tr>
<tr>
<td>2</td>
<td>How did you choose your target audience? (Choose all that apply.) [50]</td>
<td>Needs analysis</td>
<td>22</td>
<td>44%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Client request</td>
<td>15</td>
<td>30%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Market research</td>
<td>14</td>
<td>28%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other</td>
<td>21</td>
<td>42%</td>
</tr>
<tr>
<td>3</td>
<td>What are your or your team’s thought processes before moving towards designing a (educational) game? [54]</td>
<td>Objective of the game</td>
<td>13</td>
<td>24%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Client request</td>
<td>9</td>
<td>17%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>What is needed in the market</td>
<td>7</td>
<td>13%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Choose core game mechanics that go well with learning objectives</td>
<td>6</td>
<td>11%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engagement</td>
<td>6</td>
<td>11%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other</td>
<td>13</td>
<td>24%</td>
</tr>
<tr>
<td>4</td>
<td>Which one of these drives the design process? [47]</td>
<td>Game mechanics</td>
<td>14</td>
<td>30%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Game content</td>
<td>18</td>
<td>38%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Equally across both</td>
<td>15</td>
<td>32%</td>
</tr>
<tr>
<td>5</td>
<td>What primary methodologies did you use in developing core game mechanic (Select top two) [50]</td>
<td>Literature review</td>
<td>18</td>
<td>36%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Playtesting</td>
<td>39</td>
<td>78%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Market research</td>
<td>7</td>
<td>14%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other</td>
<td>36</td>
<td>14%</td>
</tr>
<tr>
<td>6</td>
<td>What learning theories did you implement in the design of the game mechanic? [42]</td>
<td>Constructivism</td>
<td>10</td>
<td>24%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Constructionism</td>
<td>6</td>
<td>14%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Instructional design</td>
<td>6</td>
<td>14%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Social learning theory</td>
<td>4</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other</td>
<td>16</td>
<td>38%</td>
</tr>
<tr>
<td>7</td>
<td>What kinds of expertise were needed in developing the (educational) game? (Choose all that apply.) [86]</td>
<td>Content expertise</td>
<td>31</td>
<td>36%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Programming</td>
<td>21</td>
<td>24%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Game design</td>
<td>19</td>
<td>22%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Graphic design</td>
<td>15</td>
<td>17%</td>
</tr>
<tr>
<td>8</td>
<td>Which strategies would be the most effective way to market your game? (Select top two) [32]</td>
<td>Conference/Convention</td>
<td>14</td>
<td>44%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Website(s) and social media</td>
<td>20</td>
<td>31%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Word of mouth</td>
<td>9</td>
<td>28%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other</td>
<td>21</td>
<td>65%</td>
</tr>
</tbody>
</table>
Links to Curriculum and Standards

As noted earlier, a barrier that prevents games from entering classrooms is that most games are not well and explicitly aligned with school curricula. A recent national survey indicates that integration of games to curricula, except for time and cost, is the greatest barrier for in-classroom game use (Takeuchi & Vaala, 2014). In most cases, teachers have to infer and develop the alignment between a game and their curriculum, with little time available to do so (Squire, 2004). Moreover, when a game is not explicitly linked or adaptable to National or State standards, teachers often resist adoption (Deubel, 2002). Although National Standards were mentioned in the Other category in Table 1’s No. 1, integration into the school curriculum was rarely mentioned. Given other work that indicates teachers make game-integration decisions based on links to their curriculum (e.g., Fishman et al., 2014), these results support the possibility that game developers’ lack of attention to specific alignment of a game to its target curriculum content is holding back teachers’ adoption of educational games.

One way to ensure curriculum links is to ask professionals who are potential adopters, i.e., teachers in the content areas targeted, to test the game for playability, appropriateness of content, and fit with State standards and curriculum. Our survey showed that respondents did indeed playtest their games, and did so with a game’s targeted users (learners), and educators. Developers themselves also playtested their games. However, playtesting was done mainly for playability—only 17% of responses noted that playtesting occurred with content providers who could state whether content was appropriate to the subject area being addressed. Overall, our results show that the developers utilize playtesting as a critical part of their iterative design process, but that they tend to focus on the game-side aspects, and not the content, curriculum, or learning aspects of the game in a playtesting process.

A majority of respondents stated that games best support interactive and constructivist-based pedagogy or instructional strategies, within inquiry and project-based learning (see Table 1, No. 6). Dynamic interactivity and feeling of agency were mentioned as frequently as pedagogy and instructional strategies. These responses did not particularly mention educational merits of interactions (e.g., cognitive engagement), but tended to emphasize the play experience itself rather than how the experience related to learning. It is notable that some respondents explicitly stated that they are game developers and do not perceive games as a type of "instructional media." Only one respondent claimed taking existing curricula into consideration within the game development cycle, and only one explicitly indicated seeking to provide curriculum-supporting materials (such as lesson suggestions or lesson plans) along with the game, although teachers report that having such materials available is important to their adoption decisions.

Links to Learning Theory (and Integration of Mechanics to Content)

Literature suggests that game mechanics grounded in learning theories yield better learning outcomes (Plass et al., 2012). However, teachers’ beliefs about learning and appropriate methods (e.g., on continua from child centered to teacher centered, holistic to. skills based; behaviorist to constructivist, situation to decontextualized) must match teaching materials, or they are less likely to be used (Kinzer & Carrick, 1986; Kinzer & Yount, 1991). Absent an explicitly stated link to earning theory, teachers may have doubts about how a game might fit into their curriculum (as described in the following section), or how a game’s approach to learning fits with their own pedagogical beliefs and approach. Thus, our survey asked several questions aimed at understanding how learning theory fits into game design and development.

We asked what learning theories guided decisions about game mechanics. A majority of participants identified constructivist approaches as their guiding learning theory, although responses varied from instructional strategy level (e.g., inquiry learning) to larger frameworks (e.g. constructivism), see Table 1, No. 6. This pattern of responses corresponds to claims that game based learning has been receiving growing attention because of learner-centered learning paradigms, the basis of constructivist learning approaches (e.g., see Garris et al., 2003), and that well designed video games provide spaces for social interaction, collaboration, and experimenting with new ideas, which can support learning through experiences (Kolb, 1984). A cross-examination of responses related to game descriptions and mechanics showed that respondents’ stated game mechanics reflected their learning theories: e.g., simulation games were related to situated learning, inquiry based learning or constructivism. Some respondents (14%) gave specific examples related to constructivist learning, such as having players create a tangible artifact (e.g., a storyline) throughout gameplay. Very few respondents stated that their games are not guided by any learning theories.

In educational games, game mechanics must relate to learning outcomes to achieve desired learning gains (Plass et al., 2012). The game context should have an integral, endogenous relationship to the learning material (Malone & Lepper, 1987), so that the game context does not overload player’s cognitive capacity (Killi, 2005). Thus, we asked whether, and if so to what extent, a game’s content guides the game mechanics or vice versa to see what
the respondents considered more important in game creation. Among the 47 responses 15 participants gave equal weight to content and mechanics, while 32 felt that game mechanics or game content was most important, respectively (see Table 1, No. 4). Game mechanics are inevitably tied to players’ learning as, of course, is content. Yet, game mechanics are central to learning content, as without playability content cannot be foregrounded. This is related to Gee’s (2008) claim that learning is a fundamental part of all games, and to Plass et al. (2013, p. 697), who note that “At a minimum, players must learn the basics of a game’s mechanics in order to play...The mechanics of the game not only define the behaviors and actions players take, but directly facilitate players’ understanding of the game and what the game may be representing or aiming to teach.” In this way, game mechanics and learning are tightly related and depend upon each other. That 30 of our respondents foregrounded content over mechanics may thus be a concern to teachers who are most concerned with learning and who would examine how content is addressed through game mechanics.

The list of game mechanics participants provided also gives insight into this area. For instance, storytelling or story generation was a very common mechanic in literacy games. This also corresponds to the overall trend that respondents tend to view content driving the mechanics in educational game development. Playability of the game—whether the game mechanics are simple, easy, and age appropriate—are the second primary standards. Interactions that are engaging were certainly an important consideration, but not as much as simplicity of mechanics. Based on these standards, developers select core game mechanics, and playtesting is the most common method to select them (see Table 1, No. 5). This is indicative of the iterative game development process. Given that playtesting and prototyping are the core of iterative design processes (Salen & Zimmerman, 2004; Squire, 2011), these responses capture the essence of iterative design, where design decisions are made based on gameplay experiences (Salen & Zimmerman, 2004).

To summarize our results in this area, we were left with the impression that game mechanics related to learning were implemented intuitively or for motivational purposes, with little conscious awareness of the need to apply learning mechanics explicitly, in ways that teachers could see. As noted earlier, some respondents explicitly stated that they did not perceive games as a type of instructional media. Such beliefs imply that the need for understanding learning design in ways that are explicitly applied to educational game design and development is less important than understanding gameplay. However, we would argue that without clarity about a game’s underlying learning theory, teachers cannot easily realize how a game being considered would fit their teaching approach or their personal beliefs about good instructional practices, and the lack of such clarity can have detrimental effects on adoption decisions.

Marketing and Distribution

In terms of marketing and creating awareness of educational games in the general public, responses suggested the developers felt that the most effective marketing strategies related to attending conferences/conventions, followed by advertising on websites and social media, and word of mouth (see Table 1, No. 8). Few game developers reported that they had to deal with marketing and distribution, because their clients would take over once the game is developed. To initiate the circulation of educational games, more effort could be made through efficient and organized distribution strategies of bringing available games into classrooms.

Conclusion and Implications

Educational game developers were surveyed to examine the game design and development process from conception to distribution. Throughout the survey questions, responses consistently showed that the ultimate goal of the game development process was to meet educational objectives. However, only one third of the participants responded that they were partnered with subject matter experts or educational researchers to receive guidelines regarding factors related to concerns of teachers who might adopt games into their classrooms.

Systematic collaboration between teachers and game developers can aid successful game implementation as well as development of better educational games. Teachers can partake in the conception stage as sources of needs analysis, guides in the design of overall classroom experiences involving a game, and playtesting. The present survey revealed a lack of such partnerships, although the game developers desired more collaboration with experts in content and learning theories. Given that many teachers are using games that they do not themselves develop, collaboration even after the initial game design and development stage can improve the adoption of games into classrooms. Game developers should consider systematic ways to collect feedback from teachers. Creating a well-publicized, and perhaps crowdsourced repository of game-reflective activities and materials could also assist in publicizing the curriculum linkages and learning theories used in games, and result in greater in-class game integration.
Our survey results, consistent with previous work, found that the majority of funding for educational games has been put into the process of design and development, with relatively little funding for marketing, publicity, building awareness of availability, and distribution once a game is completed. Yet, a major part of adoption considerations is related to awareness—if teachers don’t know what’s out there, they can’t adopt it. We found that while educational games often received significant amount of time and effort during development, there is often little effort made to publicize a game’s availability. Perhaps more important, however, is what to publicize. It is imperative that teachers know (1) how an educational game fits into their curriculum, (2) whether or not ancillary guides and lesson plans are available, (3) how the game links to core standards, and (4) what learning theory is incorporated into the game. Being explicit about these areas will do much to address teachers’ concerns and will facilitate the implementation of educational games into classrooms.

References


Abstract: When we want to think big, take risks, and act quickly, why does it drive communication to awkward fumbling and cause intellectual wallflower-ing? Why is innovation restricted to the zany Google-phile or the garage-tinkering stargazer? What if everyone could have the mind of an innovator? What if we could get there together? Innovation is best played with others. It should be an engaging and collaborative exploration into what could be, propelling minds forward. Games are a great way to get some collaborative engagement, so we created a game that rewards recognizing and doing key innovation behaviors. It is a game that you can play while you are working on the innovation itself. It is *Mind of an Innovator*.

A Game of Innovation

Imagine there was a game being played in your organization. Everyone was a player, and the game was integrated into your daily work. In order to succeed in the game, you needed to pay attention to specific things other players said or did. And when they did or said these things, your goal was to be the first to recognize them with a tangible item, a reward. You, yourself, are also being paid attention to by the other players and are being rewarded for displaying these very same behaviors. So, success in this game occurs when you both, perform these behaviors at a high level, as well as, recognize these behaviors being performed by others to a high degree — both behavior performance and behavior identification have an extremely high value towards behavior integration and ultimately changing ones mindset towards that of innovation.

In our *Mind of an Innovator* game, the behaviors that are rewarded relate to those foundational innovation behaviors found in *The Innovator’s DNA* (2015). One of these foundational behavior, divergent thinking — a key element of innovation — requires keeping an open mind, exploring possibilities, and seeking deeper understanding. When are you looking for new solutions to persistent problems, or you are looking for solutions in unfamiliar territory, an innovator’s mindset will serve you well. Getting into such a mindset requires a shifting of gears from the usual focus on work efficiency and productivity. This systemic promotion of behavior change and mindset change requires a little extra to increase an organizations motivation and engagement in the changes. This is where the game comes into play.

On Fertile Ground

Our innovation center offers workshops and trainings to develop innovation. Participants are introduced to these key concepts, and engaging in experiential activities that put the concepts into practice. At the end of the workshop or training, most everyone is enthusiastic and eager to apply these innovation practices to their everyday work. Unfortunately, once these people return to the daily grind they find themselves swept up in the inertia of the standard practice, and all of those wonderful innovation habits fade to the background. How do we help participants go from “knowing” innovation habits to “being” innovators? We decided to make a game of it.

Our plan is to test *Mind of an Innovator* in the workshops and trainings offered through our innovation center, with the goal of expanding this game to any meeting within the organization. We started testing this game, and in the tests we observed a few things. We need to start smaller. Five tokens are too many for participants to keep track of. Early on the game needs to be highly structured. It takes longer to get rolling because you are asking participants to do two things at once: the task at hand and play the game. The goal is to integrate the game into the task at hand. Innovation mindset is a switching of gears, and warming people up for the game helps them switch gears.

The Beginnings of the Game Design

The design began with identifying five key innovation behaviors that support divergent thinking, big ideas, and the boundaries of what is possible. We assigned each of the behaviors a token. These tokens are different colored cones and discs, which are pieces from the board game, Talisman (see Figure 1).
The “Yes, and…” token is awarded when someone shares an idea with you, and you affirm the idea while also expanding the idea further. Imagine you are in a group is discussing how to improve engagement in a basic online class. So when someone shares the idea to have learning in the class rotate leading the lesson, you respond Yes, and it could be on any topic the students want as long as they can related it to the class someone in the group would give you a “Yes, and…” token.

The “???” token is awarded when someone poses an excellent, open-ended question. When you are discussing how to improve engagement, and someone asks What do we know about the most engaged students in the class? and you think that is an excellent question, you can award them a “???” token.

The “Openness” token is awarded when a person is receptive to ideas. So in the flurry of ideas flying during this brainstorm of how to increase engagement you notice someone who is nodding and affirming basically everything coming down the pipe, you would award them one of your “Openness” tokens.

The “Deep Space” token is given to a person who presents an off-the-wall-out-of-the-box idea that gets people thinking in a new direction. Like when someone suggests We could offer virtual pony rides to our students during class, someone in the group can offer a “Deep Space” token for that truly original idea.

The “But Kicker” token is given when a person turns around your closed thinking. So when a person in the group suggests that you send engaged learners coupons for ice cream, and your response is “But lactose intolerant learner wouldn’t want that,” and then another person says “Let’s kick that but aside because we’re exploring all the options,” that person kicked your “but…” and you should give them one of your “But Kicker” tokens.

Players are given a few of each type of token at the start of the game, and these are the tokens you give away to other players when you observe them being innovative. One goal of the game is to give away as many of your tokens as you can. You are also trying to earn tokens by other player by demonstrating innovative behaviors, and the second goal of the game is to accumulate as many tokens as possible. You keep your token to give and your tokens received separate.

You can tally up at the end of the meeting. At the end of the meeting the group can tally up tokens given and received. Badges are awarded for most tokens given, most overall tokens received, and most tokens received in any one of the five token categories.

Prototyping and Experimenting

Our test groups are comprised of teams of folks that are going through an innovation-training workshop or an innovation design session. In most cases the test participants had little or no background information about Mind of an Innovator until the introduction of the activity within the workshop. Our insights came from direct observation and general “how’d it go?” questions after the test sessions were completed.

Test #1

Our first test group was a small IT group (5 people) in a session designing a hackathon. We limited it to 3 categories: yes, and; the questioner; and the deep space idea. This is a group that knows each other and has been working together often on this design and project and are relatively familiar with innovation. What we observed was a couple of enthusiastic early adopters who were helpful at engaging other members of the team. They definitely favored the “yes and…” tokens, as it seemed the most intuitive category; the easiest to recognize or identify. No score tracking, just wanted to see if they were using it and engaging with the concept.

Test #2

The next test group consisted of members of an innovation training workshop (11 people) who had one previous meeting together, but otherwise did not know each other. They used the same tokens as the previous test, but were in a different atmosphere than the previous test. They took longer to warm up, but utilized all three categories more broadly. Participants provided feedback: enjoyed the game, wanted to keep score to know who won.

Insights
After these tests, we confirmed that the categories were resonating, particularly the “Yes, and…”. But we wanted to make it easier to track what tokens were for which category, and track progress of giving and receiving.

Test #3, Part A

The third test was an unexpected screw up. For an innovation workshop that contained a mostly intact team (know each other) of 12 participants, we mistakenly left the Talisman game at home (after suffering a crushing defeat at the hand of a child), so we improvised by using colored index cards in replace of the tokens. Fortunately, the test group not only participated in the game, but also were the most enthusiastically engaged group to date. The exchange of cards (slapping them down like in the card game Slap Jack) started early and was a vital part of the activity until the session ended.

Test #3, Part B

We tested the game with the same group a week later, this time testing colored poker chips as tokens. We observed, despite our hopeful assumptions, they appeared less enthusiastic about the game. Following the session we spoke with some of the team members. We found they preferred the crude cards, enjoying having a deck and the physical aspect of the slapping down the cards made for a more engaging game play, and suggested/asked to write the categories on the cards.

Insights

We then took this feedback and begin to design cards, identifying engaging, funny, associative images and descriptions relating to each of the card categories. For the next test, we only had 4 cards as we were still working on the 5th at the time. At this point, the 5 categories are: “Yes, and…”, “Openness”, “Out There” (revised from “Deep Space”), the “Inquisitor” (revised from “???”), and the “But Kicker”.

Test #4

We had a new test group going through the innovation workshop series, and we test with the 4 cards. Smaller group (4 members) with some familiarity with each other (acquainted). They liked the cards, but it took them longer than the other groups to warm up to using them, and they struggled with keeping track of the categories. We provided a crude homemade tracking sheet (2 areas, given and received), but this still gave them trouble tracking.

Insights

We better understood the problem the players had with keeping track of their cards and their score of given and received. We met to design a point tracking system and came up with 2 versions to test, a game board and a travel version.

Test #5

The game board was tested with the same group mentioned above. We found they were still slow to warm up, the challenge being a small group size. Considering setting a minimum number of players for the game. Planning on doing a “I do, We do, You do” introduction method.

Test #6

Next game board test is with a new innovation workshop (7 participants) of a team that knows each other. For this test, we kept things basically the same to see if we would get similar results as test group #5.

Insights

We realized that even with the “I do, We do, You do” introduction, we still did not get the level of engagement from groups that we were hoping for. Groups were still focusing on the actual activities of the workshop and neglected to readily exchange cards as part of the game, even with the demo.

Test #7 (Travel Version)

The travel version (aka bar game) was meant to be mobile and not sitting, and having networking/sharing type conversation. We wanted to track progress (recognizing and performing behaviors). We developed a rules card that explained the steps to play, participants (N=15) were assigned a number that they would track on the back of their card as they gave them away, to understand how they received and gave away the cards. Points were given
based on each of those actions.

**Insights**

Board game test results: Players liked the concept, and liked the categories. Teams that had a dynamic player or some direct coaching had a more vibrant game. Other teams the game became an afterthought. Tried more onboarding, more detailed examples, but the result was the same.

Travel version test results: People loved the concepts. People liked the categories of the cards.

Similar to other test sessions, there was too much overhead with the activities and the game fell to the wayside. Categories were not adhered to because players were busy talking and sharing ideas. The game was an afterthought.

**Test #8**

Tried to simplify by removing the different categories and replacing them with a single, generic Innovation card. The test group was going through the innovation workshop series. This was a smaller group (7 members COPS and co-author, Justin Lee) with some familiarity with each other (acquainted), and included two offsite participants.

**Insights**

We noticed less confusion, but still did not generate the level of engagement we wanted.

We decided to add another dimension – make the topic of conversation fun and low-risk (not relevant to daily life). Similar to *Apple to Apples* and *Cards Against Humanity*, we came up with Problem Cards (running the gambit from whimsical to mundane) and Thing Cards (again, random things). Players take turns drawing one Problem card and two Thing cards (see Figure 2). The players use this as the innovation content to which they apply the innovation behaviors on the cards.

![Figure 2: Example set of Problem and Thing cards (left), and example game board (right).](image)

**Test #9**

First test group (3 people) showed high engagement. There was 25 minutes of play.

**Insights**

We noticed immediate improved engagement when we added this new dimension. The addition of Problems and Things made it funny and interesting. The players traded innovation cards in all five categories, but had suggested changes for the “But Kicker” and “Openness” cards. The players were easily riffing off of each other’s ideas, and no one negated another player’s idea, deeming them almost useless. The test group suggested adding in a card that introduced an artificial “But…” The “Openness” card was too…open. The players suggested changing it to “Affirmation”.
Test #10

We expanded to a larger test group (21 people) for a longer time (40 minutes of player) with similarly high levels of engagement. We did NOT make any of the suggested changes from test group #9 because we wanted to see if this larger group would affirm #9’s suggestions. With this larger group we introduced mixing up the groups from time to time.

Insights

They did confirm #9’s suggestions! We saw the same level of high engagement (see Figure 3), the desire to replace “Openness” with a card of general affirmation, and the “But Kicker” going essentially unused. Participants reported that they felt more comfortable with the innovative behaviors after the game was played, and felt this would be an excellent activity to play before the start of a meeting.

Test #11

An innovation workshop group (9 people) played as a warm-up activity to kick off their meeting.

Insights

The groups were a little slow to start. We figured a practice round of the game involving the entire group would be helpful for participants to get a feel for the game.

Test #12

Member of the previous large group test reached out asking if we could host a gameplay session for his team to work on and build innovative behaviors. For this group we are incorporating the new “But Bomb” card which a player can use to create an barrier to the innovation with a creative constraint, an affirmation card named “Good Neighbor” which a player can simply “thumbs up” another player’s idea (see Figure 4), and a whole-group warm-up round of play to start off. After a handful of rounds of gameplay, we began to relate these innovation behaviors they have been “playing” with to their daily life, by having them suggest real Problems that their team works to solve, playing a couple rounds. After that, we had the teams suggest actual resources and characteristics of their teams that they would use to replace the Things in the game. In this way, we begin to make a full transition to relevant problems and real resources for the players.

Insights

We still see a need for a better introduction to the game play, but we are seeing incremental improvement with
the use of the “I do, We do, You do” method. Participants felt that the transition from the abstract Problems and Things to real Problems and Things (resources) had resonating value to them. The “But Bombs” were too vague and difficult (relied on players coming up with a constraint themselves), so we plan to create mildly generic “Buts” for each Problem to enable the game play to go more smoothly.

Challenges… or Opportunities? Where do we go from here?

The next areas that we want to focus on are: making the transition from theoretical to practical application; game introduction and how-to-play; delivery of the game via an online platform.

We will continue to explore ways to transition the Mind of an Innovator experience from recognizing and demonstrating innovative behaviors around abstract, random problems to demonstrating these behaviors with problems and resources that are real for the players.

We will be experimenting with scripting a more official introduction (possibly record a video of it) to the game play specifically for use in introducing the concepts and how to play. By documenting the introduction, we can begin to test it out with different audiences in a more standardized way while integrating feedback after each time.

We are trying to figure out a component for online participation because we have a significant number of remote employees in the organization, who usually connect with other through either audio or video conferencing. We see potential in expanding beyond innovation to other skills (leadership, change management, etc.), and to track and display badges in some sort of forum.
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Playing to Survive, Surviving to Play: The Role of Games in Dystopian Young Adult Literature

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Abstract: Dystopian young adult literature has become wildly popular over the past decade, and, interestingly, many of these novels employ games and gaming elements as major plot devices. Analysis of these books reveals a close connection between play and power. Using Trites’ analysis of power relations in young adult literature and Rigby and Ryan’s characteristics of engaging games as frameworks, we show that in four recent dystopian novels both protagonists and readers (albeit vicariously) build competency, exert autonomy, and relate to others as they learn to beat the game and negotiate the power dynamics of the dystopian systems they are in, whether real or virtual.

Introduction

Dystopian fiction for young adults has become so popular in recent years that it has garnered the attention of such mainstream publications as The New Yorker and Wired Magazine. Why the popularity? Interestingly, many dystopian novels for young adults involve games, either virtual or real, as major plot devices. In fact, much YA dystopian fiction mirrors the world of video games, a world where players must hone their skills, fight the system, fail, and try again in order to succeed. Conor Kostick’s Epic (2007) and Ernest Cline’s Ready Player One (2011), for example, employ virtual games, Veronica Roth’s Divergent (2012) features guild-like factions and intense simulations, and James Dashner’s The Maze Runner (2009) depicts a fiendishly designed physical game. How can we account for this connection between games and dystopian novels? The answer lies in the pleasures and functions of play—the thrill of competition and the joys of mastering the complexities of the game. The games in all of these books have a dual role, serving as a means for controlling and oppressing, but also empowering, their YA protagonists. In these books, playing the game is closely associated with negotiating power relations, and mastering the game is both a means of survival and a source of pleasure, one that young adults can experience vicariously through reading the books. Whether through slaying monsters, solving puzzles, facing one’s fears, or finding one’s way, young adults who read these books are thoroughly immersed in the games and, as a result, can gain a greater understanding of how games work, the skills they foster, and the connection between games and learning.

Playing Against the System

Trites argues that “teenagers are repressed as well as liberated by their own power and by the power of the social forces that surround them” (2000, p. 7). These books, then, serve to socialize young adults into the power relations within which they will have to function in adult society—power relations that are manifested in institutional discourses, various authority figures, sex, and death. Negotiating one’s place in adult society is partly a matter of understanding the rules, just as becoming a successful gamer is partly a matter of understanding the rules of the game. Juul (2005) notes the importance of rules even within the fabricated worlds of video games. Regardless of the fictional nature of the game itself, the rules governing the game are quite real, and one must master them in order to be successful within the game. According to Juul (2005), a game is a “rule-based system with a variable and quantifiable outcome, where different outcomes are assigned different values, the player exerts effort in order to influence the outcome, the player feels emotionally attached to the outcome, and the consequences of the activity are negotiable” (p. 36). In video games, play entails the development of skills to overcome the challenges created by the rules of the system (Juul, 2005). Learning to operate within these rules and negotiate desirable outcomes, in fact, is a major source of pleasure for many gamers, according to Rigby and Ryan (2011). Specifically, players experience satisfaction if three criteria are met: they have the opportunity to improve their competence, they are allowed some autonomy within the game, and they are able to relate to—that is, interact with—their peers. Additionally, Gee (2009) argues that playing games helps players learn the skills necessary to survive in the 21st century: “embodied empathy for complex systems; “grit” (passion + persistence); playfulness that leads to innovation; design thinking; collaborations in which groups are smarter than the smartest person in the group; and real understanding that leads to problem solving and not just test passing” (p. 4). Playing the game or fighting the system ultimately facilitates a mastery of skills needed to overcome challenges and push back against the system. The books under discussion here are so compelling for young adult readers precisely because they allow their readers to experience these satisfaction criteria vicariously as they watch the protagonists learn and master the rules of the game while also negotiating their place within the kinds of power relations Trites discusses.
Slaying the Dragon

Epic (Kostick, 2007) describes New Earth, a planet where everyone plays Epic, a virtual game used by the government to determine and control both the real and virtual qualities of life. The novel’s protagonist and focal player, Erik Haraldson, creates as his in-game character a rare, charismatic female swashbuckler named Cindella, and sets off on a treacherous quest to slay a dragon in the virtual world and rescue his father from government-sanc tioned exile in the real world. The only hope the citizens of New Earth have to lead somewhat successful lives in the real world is to excel in the virtual world of Epic. As a result, most citizens create safe and dull characters and avoid risky challenges. While death in many games means simply restarting from a nearby checkpoint, dying in Epic results in the loss of one’s character as well as access to resources and services both in- and outside of the game. Erik, though, deliberately kills his characters as a means of gaining knowledge and developing his competence within the game. For example, by sacrificing several characters in training simulations, he is able to formulate a theory on how to defeat the Red Dragon, which eventually proves to be successful, a rare feat within the world of Epic.

Erik’s tempting of his virtual fate and bucking of trends not only allow him to exercise his competence, but also his agency and autonomy. As mentioned before, most citizens of New Earth opt for safe and dull characters; in Epic points associated with beauty and aesthetics are not considered helpful for success. Erik challenges this norm by not only creating the most beautiful character possible, but also choosing a relatively unheard of player class, the swashbuckler. These choices allow Erik to express himself and explore Epic in new ways. The beauty of his character and the charisma of the swashbuckler class allow Erik to tactfully outwit his opponents and ultimately change the fate of New Earth by shifting power away from the government.

Erik’s journey, however, is not a solo one. He is unable to defeat the dragon without his friends: an elven fighter, a healer, a warrior, and a witch who also happens to be Erik’s love interest. Moreover, Erik’s own quest bears resemblance to the trials that his father endured during his own glorious and mysterious past adventures. Erik is able to relate to and benefit from his friends and family when it matters most, defeating the dragon, challenging the government, and, ultimately, changing the fate of Epic itself. In the company of allies, Erik is able to act out his own unique role in the game and use his skills to shift the power from a few corrupt government elites to the players and citizens of New Earth.

Solving the Puzzle

Ready Player One (Cline, 2011) also takes place primarily within a virtual world. The novel tells the story of Wade Watts, who escapes the bleak reality of a world decimated by a Global Energy Crisis by playing games in the sprawling online world of the OASIS. The crux of the novel involves Wade trying to solve a series of virtual puzzles created by the recently deceased OASIS founder, in order to find a special Easter Egg and thus gain power and fortune. Wade’s real-world reality is bleak indeed, but his life in the OASIS, he says, is simple: “It’s just you against the machine. Move with your left hand, shoot with your right, and try to stay alive as long as possible” (Cline, 2011, p.14; italics in original). Through his avatar Parzival, Wade is able to gain competence in the virtual world by playing a variety of games over and over and also indoctrinating himself in the popular culture trivia that the OASIS founder loved and incorporated into the puzzles he designed. In his quest, Wade competes with many other players, but his most formidable opponent by far is a mega-corporation called Innovative Online Industries, or IOI for short. For all practical purposes, IOI is the only government in this society, at least the only one with any real power. As Trites observes, government politics is one of the institutional power structures that dominate and repress young adults, although young adults can also exert influence on those power structures. Recognizing his competence, IOI tries to get Wade to join them in their quest to take over the OASIS. When he refuses, they try to kill him by blowing up his aunt’s trailer where they think he is living. It is through his increasing competence, however, that Wade is able to survive and ultimately defeat IOI’s efforts.

In addition to competence, Wade also experiences autonomy, for within the rules of the games, he has a variety of choices. What he gains from having agency within the OASIS transfers to his experiences out of the games as well. For example, in one particularly inspired move, he creates an alternate identity for himself, gets himself inden tured to IOI outside of the game, and then reprograms their computer systems so that he can escape his servitude and more easily defeat IOI within the game.

Finally, Wade experiences relatedness within the OASIS—and ultimately in the real world as well—by befriend ing and teaming up with other players, including Artemis, on whom he develops a serious crush, and Aech, his best friend. These relationships, aside from helping Wade defeat IOI, also highlight the power structures concerning identity politics and sex. The power of identity politics is evident in Aech’s in-game and out-of-game identities. Wade has developed a deep friendship with Aech within the game, and is somewhat surprised, then, when he
meets Aech in real life and discovers that “he” is actually a she. While her avatar is a white male, she is in reality an African American female. Wade learns that Aech’s mother encouraged her to mask her race and gender precisely in order to have more power within the world of the OASIS. The power of sex is evident in Wade’s crush on Artemis. When they break up for awhile, Wade purchases a virtual sex doll, but later discards it “out of a combination of shame and self-preservation” (Cline, 2011, p. 193). As Trites notes, “Sex leads to disaster for many adolescent characters” (2000, p. 93). But knowledge of sexuality can lead to a sense of empowerment (Trites, 2000, p. 96). Wade avoids disaster, and, furthermore, he gains a sense of empowerment by learning more about sex as well as himself. Shortly after this experience, he dedicates himself to working out, getting in shape, and preparing for the battle that is to come. The most important benefit of the relationships Wade develops within the OASIS is that they provide comrades with whom he can team up to defeat IOI, locate the Easter Egg, and gain fortune and power for himself and his friends.

Facing One’s Fears

While Divergent (Roth, 2012) does not involve video games per se, it does involve a series of intense simulations that serve as training exercises for the main character. The novel is set in a post-apocalyptic Chicago, in which society has been divided into five factions based on people’s dominant personality traits—Abnegation, Amity, Candor, Dauntless, and Erudite. The protagonist, 16-year-old Beatrice (or Tris) Prior, is initiated into the Dauntless faction, a process that involves a grueling series of training sessions. The novel depicts governmental power relations in that it is the government that has determined that society should be divided into factions and that, when young people turn 16, they must choose the faction to which they want to belong. Identity politics are evident not just in the connection between one’s chosen faction and one’s identity, but also in the fact that people who do not fit neatly into one faction or another are considered “divergent,” a trait that can be punishable by death. Power relations surrounding parental authority are also evident, especially for Tris who, in choosing Dauntless, is going against her parents’ faction of Abnegation. And the power relations surrounding sex are evident in Tris’s relationship with her instructor, a handsome boy who at times seems to be an ally, at times a stern mentor, and at times a competitor.

The novel also depicts the three aspects of player satisfaction, as described by Rigby and Ryan. The simulations that Tris and the other initiates undergo are designed to allow them to develop competence in various skills that will help them to overcome their fears. A final fear landscape simulation, a final exam if you will, requires them to draw on all of the skills they have developed in order to defeat their basic fears. The society itself allows some degree of autonomy in permitting young people to choose which faction they will apply to. Of course, this is not complete autonomy, as there are only five factions, and there is a high price to pay for failing to pass the initiate training: a person who fails becomes factionless, which essentially means homeless. Relatedness is provided in the relationships formed among the various initiates. Some of the people in Tris’s cohort become fierce competitors with her, while others become her friends and allies. No doubt, Tris’s success in the training is due in part to what is at stake, but it seems equally likely that her adeptness at training stems from the fact that she experiences a degree of satisfaction in developing competence, making choices, and forming relationships with other members of her cohort. This satisfaction not only helps Tris in negotiating the power relations in which she finds herself, but also provides satisfaction, and perhaps a measure of recognition, for young adult readers who are also negotiating the power relations in their own lives.

Finding the Way

The Maze Runner (Dashner, 2009) does not involve video games or simulations, but it does illustrate the same principles of game design and player satisfaction traits as seen in the other books. In the novel, a group of teen-aged boys are trapped in a gigantic, shifting labyrinth patrolled by vicious techno-beasts called Grievers as part of a torturous grand experiment conceived by a group called WICKED. The story follows Thomas after he is brusquely deposited into the Glade at the center of the Maze, where he struggles to regain his memory and solve the pattern of the Maze, while avoiding the excruciating death promised by the Grievers.

Trites notes that one of the hallmarks of young adult literature is that death “is a threat, an experience adolescents understand as a finality” (2000, p. 118). The threat of death and the fear created by it coerce Thomas and the others into the Maze. Trites (2000) goes on to argue that the acceptance of losing others and the awareness of mortality “serve in the power/knowledge dynamic to render the adolescent both powerless in her fear of death and empowered by acknowledging its power” (p. 119). Knowing full well that he might die, ‘Thomas voluntarily stings himself on a dead Griever, something that, if he survives, can unlock his memories. This action illustrates Thomas’ autonomy in that he clearly does have the agency to make this difficult choice.
Thomas experiences relatedness as he interacts with some of his fellow Gladers. In order to survive, the Gladers assign people to different roles. Thomas is immediately drawn to the Runners, an elite group dedicated to exploring and mapping the Maze, but he is not allowed to join them until the Keeper of the Runners sees potential in him after he saves two other boys from a near disastrous incident in the Maze. By running each day through the Maze in order to map it, Thomas and some of the other boys develop the competence needed to survive and ultimately outwit the game makers. With help from the other Gladers, Thomas is able to break the code of the Maze and win the game, but not without the loss of several of his friends, suggesting that progress is not achieved without sacrifice and that the rules of life often exact a steep price.

**Conclusion**

The elements of play—specifically, games and gaming—employed in these young adult dystopian novels help account for their popularity because they offer another way for young adults to directly access compelling stories and connect with characters whose needs resonate with their own, all while experiencing the challenges and pleasures of learning through play. Regardless of whether the games in these novels manifest as virtual or “real” in the eyes of the protagonists, they eventually succeed by developing and applying their competencies, exerting their agency and autonomy, and relating to others in meaningful ways. The young adult reader, by extension, vicariously satisfies these needs by identifying with these protagonists and gaining a deeper understanding of the connections among games, skills, and learning—an understanding that can extend beyond the virtual world. As Juul (2005) argues, games are not only a combination of rules and fiction, but also the experience of the player interacting with and operating in both the game and the real world. While games and young adult dystopian novels may be fictional, the rules and themes depicted therein are all relatable to the real world, in which young adults are characters in their own very real, and sometimes dystopian, stories.

**References**


A New Model for Producing and Deploying Learning Games

Justin Leites, Amplify

**Abstract:** Amplify, a new publisher of digital educational products, uses an innovative model to produce and deploy a large number of ambitious learning games for grades 4-9. The model produces games suitable for outside-the-classroom use, with a focus on how best to achieve high levels of voluntary engagement. Key features of the model include a studio system inspired by practices from art galleries and Montessori pedagogy; agile/iterative development; students participating as active participants in the design process; extensive use of “explore, build and share” game mechanics; virtual worlds tying together dozens of games from different designers; and extensive integration of a large virtual library as part of one of those worlds. Early feedback is promising, including higher than expected levels of teacher and parent engagement. Many schools are initially anxious about students sharing user-generated content with each other, and seek best practices for deploying games that enable such sharing.

**Three Problems the Model Seeks to Address**

**Learning Outside the Classroom**

Educators and school systems across the United States are being held accountable for student performance. But, as has been shown by decades of research, differences in academic growth and achievement are mostly the result of how students spend their time when they are not in the classroom.

Reading skills are an obvious and well-documented example of the consequences of what happens outside the classroom. By middle school, summer reading losses, plus a relatively small achievement lag that carries over from pre-school, produce a cumulative lag of two years of reading achievement, despite the fact that lower- and higher-socioeconomic-status children learn at essentially the same rate while in school (Kim, 1994; Alexander et al., 2007; McCombs et al., 2011).

The outside-the-classroom learning gap is increasingly a problem for middle class as well as disadvantaged students. (The rich now outperform the middle class by as much as the middle class outperform the poor.) Family investments in outside-the-classroom learning account for much of the growing educational gap between the rich and the middle class. Since 1972, wealthy parents have been piling on cognitive enrichment activities outside of school from preschool on up, at a rate that is leaving everyone else in the dust (Reardon, 2013).

Simply assigning more homework won’t solve the problem, because (as we have been told by teacher after teacher) the current generation of American students typically won’t do the extra work. There is more resistance now to additional required homework is more than in the past, because students (and parents) increasingly see schools (and teachers) as service providers rather than sources of authority. This is part of a larger cultural shift in American society. As one researcher put it: “where once organizations could dictate, today they must entice” (Rigby, 2014, p. 114). Moreover, research shows that “extrinsic” enticements intended to increase completion of school work - such as badges, bribes or verbal praise - are not sustainable and often counter-productive (Kohn, 1993, 1999; McQuillan, 1997; Deci et al., 1999; Fryer, 2011).

Traditionally, schools tried, with some success, to address the outside-the-classroom learning gap through school libraries and by sponsoring various extra-curricular activities such as math teams, science clubs and student theatre productions. These solutions, while potent, typically only reached a minority of students, were rarely active over the summer or during other long vacations, and in many places have now been severely curtailed due to budget pressures. Games, by contrast, can motivate a very high percentage of students; and digital games can be deployed at a low per-student cost (especially when schools use BYOD as one of their deployment strategies).

**Game Quality**

Many stakeholders see the potential value of games for learning, but are dismayed by the quality of the typical educational game and the typical portfolio of educational games. As more and more educators and parents play commercial games themselves, it is increasingly obvious to them how lame most educational games are, especially from the standpoint of engagement:
Most educational games do not offer players the kinds of meaningful within-game choices that they would have in a leading commercial game such as Legend of Zelda. (Miyamoto et al., 1986), Grand Theft Auto III (DMA Design, 2001), World of Warcraft (Blizzard Entertainment, 2004) or Minecraft (Mojang, 2009). And, of course, schools do not offer the variety of games that can be easily found today on Steam, Google Play or the Apple Store.

Most educational games do not make failure engaging. In a great commercial game, when you fail, something interesting or amusing happens; but in most educational games, when you fail, all you get is not-playful feedback indicating your error and perhaps how you might do better.

With many of the games that are currently used by schools there is a huge disconnect between the game play and the learning: the "fun" part and the "learning" part are grafted onto each other in ways that seem arbitrary and manipulative.

The games currently used by schools tend to provide mostly solitary activities. They provide few opportunities for peer-to-peer learning or to allow teachers to participate as players. In particular, they don’t take advantage of what for forty years has been the most engaging game mechanic for ages 10-14: the “explore, build and share” process at the heart of games from Dungeons & Dragons (Gygax & Arneson, 1974) to Little Big Planet (Media Molecule, 2008) to Minecraft. These sorts of open-ended peer-to-peer interactions are often to the key to games-enabled learning (Gee & Morgridge, 2005).

Improving Production Processes

Institutional vs. Individual. Related to the above deficiencies in game quality, and perhaps most daunting, is the ‘authenticity’ problem. A great commercial game, like a great work art and great design more generally, is typically the result of a single person’s highly idiosyncratic (weird) and highly coherent vision and sensibility (e.g. Dungeon & Dragons’s Gary Gygax, Nintendo’s Shigeru Miyamoto, Minecraft’s Notch). For adolescents especially, their experience of games and other media tends to be linked very closely with their experience of the creators of those experiences (and so game designers such as Notch are increasingly treated as rock stars). Educational games, by contrast, tend to emerge from institutional production processes similar to the ones involved in the production of a secondary school textbook (weird is not the path to government grants or funding from foundations) and as a result tend to lack both coherence and personality.

Agile vs. Waterfall. Put in terms of software development methodologies, educational games tend to be developed in an exceptionally rigid version of “waterfall”, as compared to (most successful) commercial games which use methodologies closer to “agile.” For instance, educational games tend to be built according to the initial specifications of the original grant proposal or other funding document; whereas commercial games often undergo fundamental changes during an iterative development process. Dungeons & Dragons began as a variant of the rules of a medieval miniature wargame. Grand Theft Auto (DMA Design, 1997) started as a racing game. Minecraft began as a team-based competitive game, where the goal was to locate and excavate precious metals, and bring your findings to the surface to earn points for your team (Zachtronics, 2009).

$7,600 Coffee Pots. Government procurement processes sometimes leads to legendarily bad design decisions as a result of having too many initial design constraints and requirements (see notoriously Baker, 1984). This is also true with educational games (many of which depend on financial support from government or foundations whose behavior can be similar). For instance, it is currently fashionable to insist that educational games must include rigorous in-game assessments of student learning progress; most major funders would not consider a proposal for a new game unless those assessment methods were already specified. This is surely putting the cart before the horse: what matters most is the fundamental quality of the underlying activities with respect to learning and engagement – if you don’t get those qualities right, the rest may not matter. (So, for instance, it might be better to prioritize collaborative and other forms of peer-to-peer learning, even in those cases where including such features might make in-game assessment far more difficult.)

Seven Things We’ve Done Differently

Portfolio/Studio Approach

Drawing on a production model more common in the art world, we work with more than a dozen “indy” commercial game studios around the world, sometimes on a game-by-game basis, sometimes on time-and-materials contracts
that cover work across a series of games. Some of these studios include:

- Schell Games, creators of *ToonTown Online* (Schell & Disney, 2003), the first MMO for kids;
- Finji, led by the creator of *Canabalt* (Saltsman, 2009), the first “endless runner” game;
- Zachtronics Industries, creators of *Infiniminer* (Zachtronics, 2009), the forerunner to *Minecraft*; and *SpaceChem* (Zachtronics 2011), which has been used to teach teaching concepts related to both chemistry and programming;
- Asymmetric, creators of the browser-based, multiplayer role-playing game *Kingdom of Loathing* (Asymmetric, 2003).

We initially approached these (and other similar) studios based on the quality of their published work. In a “pre-contract” phase (before any commitment to provide funding), we provided them with a long and varied list of educational objectives and pedagogical insights - e.g. the math learning progressions from NC State University (Confrey, 2011). We then asked these studios to submit one or more ideas for games related to one or more of these objectives. Initial ideas were submitted informally – typically just a few paragraphs and perhaps a few sketches for each one. We provided quick feedback on all of these ideas (usually over the phone or in person) – both the ones we liked and the ones we didn’t. The ideation process then continued with elaborations of some of the initial game concepts, as well as new ones that emerged in response to our original feedback. Even in these early stages, students were involved as active participants in the design process (see below). The elaborated write-ups for the most promising ideas then became the basis of statements of work for an initial round (paid) software development.

A key aspect of this review process was that the initial feedback was rarely dispositive. One noteworthy example of this was an idea for an algebra game from Bossa, an up-and-coming British studio. We were initially somewhat skeptical of the idea, in part because we felt that such a game might only cover very basic math concepts, and in part because we felt the game would be engaging only if the level designs and environments were extraordinarily well done. We initially encouraged the designer to focus on other ideas that he had submitted, which we thought were more promising. The designer overcame our initial skepticism about the math game by flying over and spending a week working out of our office, elaborating and further explaining his proposal. Despite continuing reservations, we decided to fund an initial round of development, largely because the designer was (so talented and) so passionate about the particular project. Several rounds of development later, the game, *Twelve a Dozen* (Bossa, 2014) is now one of the crown jewels of our portfolio, winning accolades as an outstanding landmark in the history of educational games.

One of the American designers who participated in this process, and was accustomed to more rigid expectations from funders, was initially perplexed by the extent to which we were letting the game designers lead the creative process. But within a few weeks he enthusiastically embraced what he came to call “the Montessori method of game design”.

### Iterate, Iterate, Iterate (and Allow for Failure)

As in the ideation phase, we take an Agile approach to the prototyping and subsequent stages of game development that require building software. The goal is rapid iteration. Typically, we arrive at a playable version of a game, with a build that includes the key game mechanics, within 4-6 months. Within that 4-6 months, most sprint is punctuated by feedback from play-testing. Subsequent phases of work on a game can be considerably shorter.

Across the whole process, we have been willing to cancel game projects at any point, in cases where it became clear that a game has no promising path forward. Crucially, we understand (drawing on Dweck, 2006) that risk-taking is essential and failure is part of the learning process, for ourselves and also the game designers with whom we work. We explain to our design partners that we’d rather have one spectacular success and one complete failure, than two mediocre games.

One memorable indication that we had establish a “growth mindset” culture in working with our game designers came when one of them, Zach Barth, went out of his way to share an unintentionally hilarious initial prototype of the game he was working on for us. As he had hoped, we all laughed about it together, agreed to halt work on the game immediately, and had him set to work on another of his ideas, which has worked out quite well and published as *HabiTactics* (Zachtronics, 2015).
Game World as the Unifying Element

With the studio model, we have had some 40 games, from more than a dozen developers, in the pipeline at once. Nearly 30 of them have already gone out to students. We did not want to present students with all these games as a series of experiences each disconnected from the next. The easiest way to make connections across all the games would have been a light layer of gamification, similar to Apple's Game Center. But we were concerned that this would ultimately backfire, as do many attempts to use “gamification” to manipulate behavior (Deci et al., 1999; Rigby, 2014). In particular, we worried that such a gamification layer, even if successful in the short term, would eventually cause players to “optimize for boredom” (Woodward, 2012) with dreadful long-term consequences in terms of their attitudes towards the underlying skills and subject matters. So instead, we commissioned two ambitious game worlds - Lexica (Schell, 2015a) for ELA and Planet Planners (Schell, 2015b) for STEM - that provide across-game connections which players (or at least, our play-testers) find to be more intrinsic.

As Schell (2008, 2012) has observed, successful trans-media worlds tend to be rooted in a single medium - Sherlock Holmes in print (Doyle, 1887), Dr. Who as a television show (BBC TV, 1963), Pokemon as a game (Game Freak, 1996) - and have a single creative individual at the core. But they also facilitate the telling of many stories: “Successful trans-media worlds are never based around a single plot line. They have a solidity and interconnectedness that goes far beyond that. They leave room for future stories and for guests to imagine their own stories” (Schell, 2012, p. 342).

In our two games worlds, the various and diverse creations of game designers around the world (and of the players who participate in that world) are so embedded.

Integration With a Virtual Library

The most important feature in Lexica, our ELA game world, is its extensive real-time integration with a virtual library (Amplify, 2015) that provides access to more than 600 books. Characters from the books appear in the games, and characters from the games provide comprehension supports as students read books in the library’s the e-reader. Characters in the game world also play roles similar to those of an attentive school librarian, helping students find books they love to read, and providing opportunities to discuss books (or parts of books) that they’ve already read.

The library offers students a wide range of books, both classics and modern works that have established appeal with today’s upper elementary and middle school kids. In keeping with the idea of a trans-media world, game mechanics also encourage students to think about and discuss what they have read elsewhere (e.g., using non-digital books). At every stage of game play, students have choices as to what they want to read – and whatever they chose to read can be relevant and useful in some way in the game world.

The data so far about the amount of additional voluntary student reading in the context is preliminary but highly promising. We have been especially surprised by the popularity of some authors now in the public domain, including Charles Dickens. We suspect that the particular popularity of A Christmas Carol (Dickens, 1843) has something to so with the story’s similarities to tales from another trans-media world, that of Harry Potter (Rowling J.K., 1999).

Social Features to Support Engagement and Learning

Social features are more difficult to implement in a school context given the need to protect student information and privacy, and given the potential for bullying and other misbehavior. But given the importance of social features for both engagement and learning, we have invested in platform tools which enable those features within, across and around games.

For instance, we provide secure threaded message boards where students can connect with one another or with game designers on topics such as tech support, games feedback, and book discussion. The idea is to enable safe and supportive communities where it’s cool and encouraged to be smart, thoughtful, and creative in ways that are not necessarily valued by peers at school. The community provides a platform for kids to showcase their smarts and talents by generating and sharing content (fan fiction, art, video, etc.) — boosting their confidence and helping them hone their creative skills. We work with the schools to model and support of appropriate social behavior, but ultimately the students themselves are encouraged to take ownership over the social experience.

Within Lexica, students can create their own custom interactive stories. They can do this by writing character dialogue and clicking and dragging different furniture and building architecture options to create 3D settings for their stories. Students can play each other’s stories as they would play other levels in the game world. Students can leave comments with feedback on one another’s stories.
Similarly, within $C0D3BR34K3RS$ ($Codebreakers$), a math game from Strange Loop Games that Amplify will publish later this summer, students are given the tools to build their own custom game levels. They can do this by writing character dialogue and clicking and dragging different furniture and building architecture options to create aerial views of a room, as well as designing 3D trophies for peers to win. Students can play each other’s levels.

Many of our games have multiplayer options, so that students will be able to play real-time matches against other students.

**Treat Play-Testers as Active Contributors to Game Development**

One of the most exciting things about working with the current generation of middle school students is their high level of enthusiasm to participate in game design and development. Rather than always treat these students as lab rats, we have also worked to nurture a cadre of play-testers who work with us in a more active and collaborative way, and mostly on an ongoing basis.

Efficacy testing is of course essential, and rigorous data collection, with data from sufficiently large numbers of “normal” users, is essential to efficacy testing. But we feel that traditional user testing, especially with kids, is too often reduced to nothing more than checking on what works and what doesn’t. Defining the roles and relationships in this way – like a clinical trial for a new pharmaceutical - tends to limit the range of feedback. But with our alternative approach, students are often thrilled to be part of an ongoing product development process, where we make them feel like co-creators; and they often give us a much wider range of really terrific (and often very specific) feedback. In particular, they are more likely to be honest in telling us what they don’t like and why.

Implementing this approach required us to think differently about how recruit play-testers, about the design of the physical spaces where we work with them, use of our own staff time, etc. Many of our play-testing methods are based on those developed at the New Mexico State University Learning Games Lab (Chamberlin, 2015). On an almost daily basis, we have small groups of students (in our office or in after-school programs) who provide us with quick face-to-face qualitative feedback. We generally do not quantify this feedback, except in the cases where it is nearly unanimous (there are a surprisingly large number of cases where we can use the words “all” or “none”). We ask the students participating in these groups to commit to come for a reasonably large number of sessions (e.g. once a week for a semester), so that they truly feel like “emerging game developers.”

“Games Are Never Finished; They’re Only Published”

In the 1970’s, when tabletop wargame designer and publisher James F. Dunnigan made the point that “games are never finished; they’re only published,” it was taken by his peers as a reality check: “there comes a time in every game’s life where it is ripped from the bosom that’s nurtured it and shoved out the door” (Emrich, 2001).

With today’s digital games, Dunnigan’s observation can be interpreted in the opposite sense, as a reminder that games can continue to be revised and improved even after they are published. We continue to work on all of the games in our portfolio. As is standard practice these days, we use aggregated (and anonymized) player data from the production (“live”) version of the game to inform ongoing improvements.

But recently Russell King added a follow-on to Dunnigan’s quip (King 2015) that is especially relevant in the context of today’s educational games: “Absolutely correct. It’s the players that finish them!” Now that our games are live, we are using a combination of social media tools and face-to-face sessions in schools so that students who are playing our games will also have the opportunity to contribute, individually and collectively, to the ongoing development of those games. We regard such ongoing feedback loops as an important part of the design of the product itself, not just because it helps improve game development, but also because we see that it leads students to have a different relationship with the game: they become “our games”, not just “the games we got in school.” Along with that different relationship comes a higher level of engagement.

**Two things we’ve learned so far**

**If You Make The Games Good Enough, Teachers (and Parents) Will Play Them Too**

One of the most important results we got from the initial pilots of our games was the extent to which both teachers and parents wanted to play them. Their initial interest was often curiosity about what their kids were doing, but in many cases these adults kept playing because they found the games engaging in their own right. Many parents reported how much they enjoyed having educational games that they and their kids could enjoy playing together.
It seems to us that this insight has important implications for how schools should distribute educational games. For instance, providing access to parents (and perhaps siblings) could expand the community of learners in key domains including math and science.

**Many Schools Want Help Implementing Social Features**

Schools using our games do always have the option of turning off social features. Inasmuch as any set of social interactions create additional opportunities for misbehavior, this is, at least initially, an attractive option especially for schools wary about educational gaming more generally. But given the importance of social aspects of gaming to the learning experiences (e.g. Gee & Morgridge, 2005), we hope very few schools will actually do this, and so have begun offering coaching and other forms of support for implementing such features.

For instance, students may consider community moderators more abstract because they interact with these authority figures only virtually. Therefore, we advise schools that a known authority school figure should distribute a Student Code of Conduct prior to rolling out the games and related student forums. That way, students know what is expected of them; know that there are real-world consequences for their behavior in the community; and understand that what they do in the online game community may be communicated back to the school.

**References**


Abstract: Games can contribute to student learning in diverse settings. Social constructivism, situated learning, and social-historical theories support this; but what about students who lack a feeling of competence to learn through failing, who quietly drop out from school, or simply extinguish their desire to learn? The card game ProblemUp! derives its substance from the Cognitive Enrichment Advantage (CEA) approach, which provides the means for creating a community of practice where students adapt 22 specific strategies to meet personal needs in overcoming school, home, work, and interdependent learning problems. ProblemUp! focuses on helping underachieving students in high school and college settings by providing unusual, and often bizarre, game-generated problems that require creative solutions, strategic resourcefulness, and lateral thinking. Such “outside of the box” reasoning exercises supported by the CEA approach and enacted in a social and playful environment can help students develop metacognitive strategies that can be applied in real life.

Games can contribute greatly to student learning (Gee, 2007; Shaffer, 2006; Shaffer & Gee, 2005; Shaffer et al.; 2009, Squire, 2011). Social constructivism, social-historical, and situated learning theories help explain this phenomenon (Driscoll, 2005; Schunk, 2012); but what about students who lack a feeling of competence and are unaware of the many aspects of strategic thinking that could help them overcome personal challenges and envision future achievements? What kinds of games can help counteract resistance to learning, especially resistance to finding solutions to problems? How can we teach problem solving if we don’t know what problems the future holds for the new generations? We formed a research design team to create a game that addresses the issues raised by these questions. The game is built on a growing body of work that demonstrates effective approaches to teaching strategic thinking and reasoning—or, in other words, teaching how to learn (Greenberg, 2014). The card game ProblemUp! (www.problemup.com) derives its substance from the Cognitive Enrichment Advantage (CEA) approach (Greenberg, 2014), which provides a framework for creating a community of practice where students adapt 22 specifically taught strategies to meet personal needs in overcoming school, home, work, and interdependent learning problems that force underachievers to quietly abandon school—and learning—due to their own and educators’ lowered expectations (Greenberg, 2014). With ProblemUp! we focus on helping students in high school and college settings enter the world of challenges by using inventive strategies supported by the CEA approach. The game generates surreal problems in which students can explore strategic solutions and develop the ability to communicate rationales while learning from peers and more knowledgeable others in a social and playful environment.

The Need for Strategic Thinking

Most discussions of competencies required for success in career and life in the 21st century focus on mastery of basic academic knowledge and skills —communication, mathematics, science, technology, etc. Educators pay little if any attention to underlying competencies, particularly those of strategic thinking and metacognitive problem solving. Texts discussing research on effective learning tend to report what good learners do, and discuss how to teach students expert-developed strategies that apply to specific academic areas (Schunk, 2012). Few experts focus on underlying, micro-level ingredients of strategies that can be selected by individual learners based on personal strengths and weaknesses, and then adapted to overcome problems in situated contexts (Greenberg, 2014). Most educators and even fewer students engage in cognitive education approaches (Haywood, 1997). Hence, when students come up against challenges, they find ways to avoid them, letting others solve the problem for them, reinforcing their own and others’ low expectations for success. For good reason, such students avoid confronting directly the reasons for poor performance (not wanting to focus on their perceived limited ability) and seldom if ever have the opportunity to learn the underlying metastrategic knowledge that could help them find solutions to their challenges. The focus remains on the product rather than on the process of learning.

Public media as well as scholarly journals are full of reasons why students need to be good strategic thinkers in K-12 and university settings—indeed, throughout life. The controversial Common Core curriculum emphasizes the need to engage students in gaining a deep level of understanding of curriculum (Rothman, 2011). At the same time, large scale studies of retention in college and university settings indicate that only about half of American students who enter postsecondary institutions graduate (Burkum, Habley, McClanahan, and Valiga, 2010). The
other half, take the backdoor as a way out. Even with the increase in the use of well-known approaches to improving retention and graduation, research does not support their overall effectiveness. This may be due, at least in part, to the use of one-size-fits-most interventions, whether focused on academic or nonacademic activities or a combination of the two (Lassibille, 2011). We contend that these approaches ignore a key need: the development of effective prerequisite strategic thinking skills and habits (of which students may be unaware) that can be applied in different contexts to overcome specific challenges.

When students do not know how to develop and adapt strategies, these challenges can become barriers to success as students run for the way out—by dropping out physically, intellectually, or emotionally. Strategic thinking has been successfully taught to students, but infrequently. Why? Most teachers are unaware of approaches to teaching students how to learn, especially when the focus is on the micro-level of strategic thinking through personalized strategies (Greenberg, 2014). Those who do, especially educators of older students in high school and post-secondary settings, find such students are resistant. We argue that what is needed is an alternative way in to strategic thinking development—something games can do by providing structure through rules and freedom of exploration through open-ended problems in an informal and non-judgmental environment.

**Developing Strategic Thinking Through Games**

Games meet conditions that enhance effective learning (Salen, Torres, Wolozin, Rufo-Tepper, and Shapiro, 2011). They potentially engage learners in nonthreatening (initially nonacademic) playful roles that allow them to practice strategic thinking and reflect on the outcomes of multiple attempts (their own and those of peers) while receiving and offering feedback. Games can provide a powerful learning environment. But underachievers may not succeed unless they become aware of and expand their knowledge about strategies that can help them—and the need to adapt such strategies to meet specific conditions within a given problem scenario (Greenberg, 2014).

How does one become successful in most games? Experts discuss the importance of learning from failure by players—the many private trials that lead to eventual success. In the late sixties, Reuven Feuerstein began to discuss the issue of trial and error learning for underachievers. He stated one can only improve through learning from errors if one develops effective strategies for identifying problems and determining new approaches to improved performance. Some learners need assistance to learn how to develop effective strategies in order for trial and error to become a positive learning experience. But how many learners understand—at an explicit level—how these strategies can be modified to meet very specific needs (based on game or personal requirements)? And how many students actually give up without meeting success—those who don’t have the skills to seek assistance from more knowledgeable others or who are not able to adapt strategies to meet personal needs?

Evidence supports the use of the comprehensive CEA approach underlying the *ProblemUp!* game in a variety of settings with various ages of learners (Greenberg, 2014). Observations over time, however, highlighted several issues that led to limited dissemination of the approach. Our goal is to develop a game that will find a way to students who may otherwise exit educational settings, find a way to educators who understand the need to teach strategic thinking and do not have institutional support to develop their own approach, at least initially, and find, eventually, a way to assist any learner to overcome barriers in their personal learning goals. At this point, we see the potential of our game furthered by two approaches. First, teachers and others working in schools and universities can facilitate play in and out of the classroom. Second, our game is designed to meet needs discussed by Gee (2007) and others whereby learners are actively engaged in critical thinking, meaning making, and problem solving—but in the case of *ProblemUp!,* underachieving learners are engaged in surreal problem scenarios that take the sting out of daily failures and allow them to tinker with creative solutions by applying strategies (developed in the CEA method) they can then draw on to solve personal problems. As we seek this goal, we need to address specific design issues.
Developing ProblemUp!

Over the past few years we have focused on stages 1 and 2 (see Table 1, Figure 1, and Figure 2):

1. Design and develop a card version of the game based on game-design principles (Salen & Zimmerman, 2004) and the CEA approach.

2. Develop a multi-player digital version of the game that will enable a group of players to interact through an application/software that would allow them to communicate with each other while playing.

3. Field test the card and the multi-player digital game and make iterative changes.

4. Establish a website and appropriate methods for communicating with schools, universities, and individual users.

5. Design, develop, and field test a single-player digital/online version of the game (with or without interaction with other players).

6. Develop and field test a blog where players of any age in any setting could talk with each other and a facilitator/mediator. The blog would also allow users to contribute to novel rule-sets and scenarios to be integrated in the game.

We began by planning development of a prototype game. We played different iterations of the game in our research group with the support and informal feedback of students and friends. We compiled lists of strategies and categories of meta-strategic knowledge that are part of the CEA approach, as well as scenarios for problem cards based on academic and nonacademic needs of fictitious university students. A prototype-version of the cards was designed. Throughout the process strategies have been reworded in order to make the game more accessible to high school and undergraduate students. The game was then tested in informal game sessions. Players often times selected winners based on the creativity in the stories they told, rather than based on the degree to which the proposed strategy was well developed to meet the needs in the given scenario. This led to refinement of rules, emphasizing more explicitly the need to adapt specific metastrategic knowledge to solve situated problems.

On several occasions, K-12 and university teachers provided further informal feedback as they “messed about” with the card game. Those new to the approach quickly became engaged when an expert facilitated gameplay and also when they could observe others playing initially. They reported that the game could easily be adapted to learners of younger ages. In some of these situations, those playing the game began to help each other develop strategies. With an online prototype, we were able to let players interact and easily select new strategies. Overall,
these informal experiences and observations led us to refine the game in several ways.

First, we changed the content of the Problem Cards from “preset” scenarios presenting real-life dilemmas faced by students, to surreal and open-ended scenarios (see Figure 2) that can be freely interpreted by players and enriched with details not shown on the cards. Further, we developed a system that can generate virtually millions of different problem scenarios by combining and recombining the Problem Cards.

The prototype of the game includes five decks of 54 Problem Cards (for a total of 270 cards) that represent five categories (1: adjective, 2: protagonist, 3: problem, 4: descriptor and 5: object). Each card features a word/phrase. A player draws one card from each deck positioning them sequentially on the table (12345). This combination of cards determines a unique problem scenario. Cards 1 and 4, as well as cards 2 and 5 can be interchangeably used to create even more absurd scenarios, which allows for millions of combinations (see Table 1). This contributes to a high level of variety and increases the re-playability value of the game. Moreover, we predict this version will establish a safer climate for play where humor can further a sense of shared engagement with other players and lead to deeper critical and lateral thinking related to the problem scenarios and strategies.

Second, we revised the rules of the game. Instead of one judge determining the winner of a round, all players must decide which player they think provided the best response. Further, the rules emphasize the need to base votes on two factors: the most creative story based on the Problem Cards as well as the best solution that matches qualities of the strategy selected by each player. We believe this change will encourage all players to pay close attention to each player’s response and think carefully about the criteria to use in determining their vote. In this manner, the game can better highlight its purpose of helping players develop flexible, yet detailed, strategies for overcoming situated challenges.
<table>
<thead>
<tr>
<th>How to Play ProblemUp!</th>
<th>Player Cards</th>
<th>Strategy Cards</th>
<th>Problem Cards</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SETUP</strong></td>
<td>Each player selects a different Player Card to represent him or her and places it face up in front of him/her.</td>
<td>One player shuffles the Strategy Cards face down and passes three Strategy Cards to each player.</td>
<td>One player shuffles the Problem Cards for each category separately and places them face down in five piles.</td>
</tr>
<tr>
<td>Notes: Players may play alone, with a partner, or in teams. Individuals or teams receive one set of Strategy Cards to share.</td>
<td>Each player gives all other players a copy of his/her Player Cards.</td>
<td>Each player holds the Strategy Cards in his/her hands.</td>
<td>One player turns over a Problem Card from the top of each of the five piles to begin a round.</td>
</tr>
<tr>
<td>Players decide before the game begins the victory conditions (how a player wins the game): how many rounds, amount time to play, or number of Problem Cards to be collected.</td>
<td>Each player places these cards in a stack, face down, beside their own Player Card.</td>
<td></td>
<td>Note: The prototype of the game consists of 270 cards, i.e., 54 words/phrases for each of five categories (adjective, protagonist, problem, descriptor, and object), resulting in millions of combinations for problem scenarios.</td>
</tr>
<tr>
<td>GAMEPLAY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. One player reads the problem scenario generated by the five Problem Cards.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Each player creates a story in which the characters use one of the three Strategy Cards to solve the problem. Stories should include as many details as possible that elaborate on the characters, problem, and strategies.</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>3. Each player reads his or her chosen Strategy Card, including the label for the strategy, and lays it face up on the table. Then, the player shares his/her story and proposed solution.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Other players listen to the stories and solutions in preparation to vote for the best one.</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>5. After every player has shared his/her story, players vote for the person they believe told the best story (most closely connected details of the problem and the solution to the problem scenario). Players vote by placing the Player Card of choice (face down) in the middle of the table.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. The winner of the round is the player with the most votes for his/her story/solution.</td>
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<td></td>
</tr>
<tr>
<td>7. The winner receives the five Problem Cards used for that round.</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>8. All Strategy Cards played that round go on the bottom of the Strategy Card pile.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. All players receive one new Strategy Card.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. If no clear winner, the Problem Cards remain on the table.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Five new Problem Cards are placed face up to begin another round. The next clear winner receives all Problem Cards face up on the table.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. The winner of the game is the player with the most Problem Cards when the game stops.</td>
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<td></td>
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</tr>
</tbody>
</table>

Table 1: Set up and gameplay for the card version of ProblemUp!.

Future Steps

Based on feedback received at the GLS Conference, we intend to make further iterative changes and then seek IRB approval to field test the card game as played both face-to-face and online. Results will be used to further refine the game and determine how best to incorporate a game facilitator/mediator to facilitate transfer of strategies to real-life scenarios. Eventually, we intend to research the efficacy of the game in improving academic performance of underachieving students in K-12 and higher education settings. We believe it also has potential for a broader
audience of adult learners willing to exercise their creative thinking and gain awareness of how different strategies can be successfully applied in different contexts. Informal interactions and observations, field testing, and iterative changes of the card game will continue, based on reports of use in various settings. The development of an online game will require resources for programming, design, testing, etc. Ultimately, we want to establish a blog with the dual goal of providing a forum for players to share interesting stories and perspectives and to propose future cards to the deck, and ongoing facilitator/mediator support. In conclusion, with this game we want to offer opportunities for creative thinking, problem solving, and social interaction to better meet the needs of those seeking to develop strategic thinking skills, essential to succeed and overcome the challenges of today’s and tomorrow’s world.

References


Creating a Customizable Alternate Reality Game Toolkit for Academic Libraries

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Alexandra Heidler, Syracuse University
Sarah Bratt, Syracuse University

Abstract: This article documents the process of creating and testing a prototype of a customizable Alternate Reality Game (ARG) toolkit for academic libraries. The goal of the project was to create an information literacy game toolkit for academic libraries that was more engaging and relevant to users than a traditional fact-based scavenger hunt. The researchers started with a Delphi study with librarians to develop a set of functional and technical requirements and then developed a story and prototype to meet those requirements. They then performed limited testing of the prototype and documented lessons learned about making games for libraries.

Introduction

Academic libraries are challenged to provide services to users who do not always perceive the value of library resources (Kolowich, 2011). The growth of open-source journals and online repositories enables increased access to a growing subset of quality peer-reviewed academic articles without the need for a library. The “that’s good enough” mindset many users harbor toward academic research reduces the desire to go to a physical library or access resources through an academic library portal. One way the library can address this concern is by providing stronger information literacy education available on demand to bolster user appreciation of the value of library resources not available on the free web.

A recurrent problem with information literacy education is that it is often presented without context or connection to immediate student needs. Therefore, most students are not engaged in this just-in-case educational approach to library services. For library games to be successful they must be relevant to the students’ needs (Markey, Leeder, and Rieh, 2014). Their approach was to create a game that helped a student analyze sources; in order to make the game meaningful, the student played the game while working on a classroom assignment.

We envisioned creating a game relevant to students by encouraging librarians to customize the game around a locally relevant controversial issue such as fracking. This focus would preserve relevancy to the students’ needs without the requirement to be tied to a classroom assignment schedules. The librarian customizing the game would also use resources and services specific to that library to address the challenge of helping users realize the value of local resources that can be found through the library’s physical space or authenticated gateway. We conceptualized this project as a toolkit for librarians to create a customizable game.

A grant proposal to the Institute of Museum and Library Services (IMLS) in partnership with the Education Arcade at MIT was funded to develop a prototype based upon technical and functional requirements set by academic libraries. We were then to develop the narrative and create a functional prototype. This article talks about the processes of gathering requirements, developing a game concept and narrative, creating and testing the prototype, and delivering the toolkit to a group of librarians.

Gathering Requirements

In fall 2012, we led a Delphi study with ten academic librarians who had previous experience in using games for library activities. The Delphi study method is an iterative surveying method that allows the asynchronous building of consensus with experts through a series of surveys. The goal was to develop a prioritized list of technical and functional requirements for an alternate reality game toolkit in an academic library. The resulting list of technical and functional requirements, which follows, was drafted by the library panel, ranked by priority, and revised over several rounds by the panel. The following list was shared with the librarians and then used to guide the design and development processes.
Technical Requirements

High Priority
- Multiple users can access the game at the same time.
- The ARG needs to run in different browsers.
- There must not be non-standard plugins requiring administrative privileges.
- The ARG meets ADA compliance through 508 Web accessibility guidelines for vision and hearing impaired participants.
- The ARG needs to be accessible via the open Web and not installed locally.
- If there is important audio, there is a transcript or subtitles available.
- The interface is intuitive and easy to work with.
- The ARG can be run on a mobile device.

Medium Priority
- There are troubleshooting tools for library staff.
- There need to be no cookies or downloads required.
- The game can be played with a keyboard or a mouse.

Low Priority
- The ARG needs to be accessible with limited Internet speed.
- There is a text-only version of the ARG

Functional Requirements

High Priority
- Users get some proof of completion.
- There are tools available for a staff member to use to keep the ARG running.
- One failure should not end the experience; users should be able to continue when stuck.
- There needs to be a way to track user participation and statistics to help instructors wanting to integrate the ARG into a course.
- Users can get a clue before skipping a question.
- The library can use multimedia instead of words for game elements.
- There is a robust help system for library developers and end users.
- Reporting will allow library staff to see how patrons are performing on challenges.
- Users can save their game and continue later.
- There can be links to other Web-based resources within the ARG, both library-based and external.
Medium Priority

- There is a passcode to allow staff members to get past any challenge to help patrons.
- There is an automated report for broken external links.
- There is a map of the library integrated throughout the tool.
- There is a way for library staff to see what other libraries have created.
- There should be a way to print the ARG to make a paper-based version.
- Users can be part of groups or teams.
- Each library can create multiple experiences for different difficulty levels and different topic areas.

Low Priority

- Participants can go back and change answers.
- There is embedded access to the library’s catalog, databases, and digital collections.
- Users can get help from a staff member even when not in the library through IM or chat reference, or have easy-access to a telephone number.
- There is a way for users to share experiences.

Developing the Game Concept and Narrative

In April 2013, we met consultants at MIT’s The Education Arcade (TEA) to develop the story for the ARG. The core concern was “How can we create an information literacy game that is more than a traditional fact-based scavenger hunt?” within the constraints created by the Delphi study. The major decisions from these meetings were to theme the challenges in the game around a controversial issue relevant to the student, and to raise awareness that library resources can deepen understanding about an issue. The basic storyline was developed, namely: the user must choose between assisting an artificial intelligence (AI) who infiltrated the library system and is trying to put the world on a sustainable path or assisting an unknown voice from the future rebelling against computer overlords.

This dystopian-themed narrative was presented over five story beats exploring the story between the user, the protagonist AI, and Sarah (the rebel from the future). As users proceeded through the game, they were presented with the narrative through two interfaces:

1. An educational game with retro-style pixelated graphics represented the method that AI used to reach out to the user. This included all of the trappings of reward-based gamification, i.e., points, levels, and achievements, as well as the look and feel of a poorly-designed question-based educational game.

2. A simulated instant messaging (IM) window appeared with mysterious messages while the user was answering the first question. This IM window was the interface to rebel from the future, Sarah. (See figure 1.)
The first two beats of the story were universal for all users. The third was a decision point where the user must choose to align with the protagonist, Al, or Sarah, the rebel from the future. Neither was “the correct” choice; each choice led to a different ending. Users engaged with the story by answering questions (users answered correctly if they chose to ally with Al or incorrectly if they were working with Sarah, to fool Al) and learning about the consequences of their choices.

This story was created around a series of five challenges. The challenges, which consisted of questions, clues, answers, and responses designed to explore different sides of a controversial issue selected as potentially relevant to the users, were the input created by the librarian and entered through an administrative back-end module. The challenges were intended to educate the user about a type of resource, ask the user to locate and read a specific item, and then encourage the user to reflect upon and answer a question about that resource which related to the controversial issue. After engaging with the challenge and clues, the user should have learned about a new type of resource and one aspect of a controversial issue.

We suggested librarians avoid factual questions where a user simply scans the resource to locate an answer, but instead design challenges that require that the user read and analyze the resource to answer questions correctly. We also suggested that some challenges require the user to contrast different resources to answer a question. The goal was to create questions that required more engagement than “scan the text for a specific fact”.

In order to create an opportunity for reflection, users were asked for their views on the controversial topic at the start of the game. At the end of the game, the users were first shown their own opinion, then shown post-game reflections by other users and finally asked to provide their own reflection once again to share with others. The goal of this progression was to replicate a group debriefing process, a practice intended to increase participants’ understanding of an issue.

**Developing and Testing the Prototype**

The game was designed and constructed around the top priority functional and technical items listed in the Delphi study. For example, the game’s low-resolution graphics and largely text-based interface fulfilled the technical requirements of a game that could be run on older library computers, different browsers, and mobile devices. There was no audio unless the library chose to integrate links to multimedia. Aggressive testing was done to ensure ADA compliance using screen reading software to ensure that Section 508 web accessibility guidelines were met.

It was also important to include reflection as an element of the game, as learning requires both doing and reflection. Users were asked for their views about the issue before and after gameplay, and were able to view reflections shared by others. The sharing of information was meant to help users consider and become exposed to other forms of thought and conclusions generated within their own community.

Stress-testing was done through the Syracuse Game Designer’s Guild, a community group of game designers, developers, and players. Fifteen playtesters suggested modifications to the narrative and addressed typos, use of animation, and increasing the text prominence for the correct responses to questions. Some users expressed uncertainty as to whether they chose correctly between the two main game characters. Modifications to the code,
corrections of typos, and subtle changes to the interface were done based on the feedback obtained from Game Designer’s Guild play testers.

After updates were implemented, the prototype was tested with 20 librarians and library assistants. A number of game testers were confused with the ARG layer on top of the traditional educational game and did not understand why the basic game was interrupted. Some testers thought that the program was experiencing errors and contained typos, as fake error messages and “leet speak” appeared on the screen as Al grew weak and lost control. Testers who did not engage with the narrative found these elements bothersome, perceiving that the ARG components hindered the Library Adventure educational game.

Some users found the narrative decisions required in the game to be frustrating, as neither choice is entirely good or bad; users wanted more information as to which was the “right” choice to make to win the game. Another narrative challenge was providing users with a definitive confirmation of correct answers because in the backstory, Al did not know the information that he was asking for. Al would confirm any answer as correct, while Sarah continued to encourage the player to lie to Al.

These plot-based concerns highlighted the key difference between an ARG and a traditional educational game. The design concept of an ARG is that the user is immersed in a different reality; the disorientation was intentional and in line with ARG design goals. Theoretically, it is this disorientation that makes an ARG engaging, as it taps into users’ intrinsic motivation fueled by curiosity to explore the narrative mystery instead of relying upon extrinsic motivators like points and levels.

However, we learned from interviews that some librarians were uncomfortable with the idea of releasing a game for students that was intentionally designed to disorient users at first; librarians were afraid users might choose to simply quit the game when confused. To help mediate this confusion, a game entry screen was developed to provide the user with the option to either read the backstory prior to playing or play in a fully immersive ARG manner, where the story unfolded as the game progressed.

In the original design, the choice to support Al or Sarah came through the actions of the users: if the users gave Al the right answers, then they supported Al; if they gave Al the wrong answers, then they supported Sarah. Many users looked for a correct choice between the two game characters in order to win the game, when the narrative did not support a correct choice—just two possible paths. To help reconcile this concern and give users a “win state”, the game was modified so that users were given a more blatant option to choose which character they would support, and post-choice narratives were changed such that the player’s choices led to a successful ending. If the user sided with Al, then he turned out to be benevolent and supported the user’s choice. Alternatively, if the user sided with Sarah, then Al became threatening and evil, supporting user’s choice.

**Delivering the Toolkit**

After internal testing, the toolkit was delivered out to the librarians who participated in the Delphi study. Guidance in developing content to engage users was delivered to librarians through emails and a video. The two sample games were also shared with librarians. During fall 2013, few libraries had rolled out or implemented games; it seemed that librarians were intimidated or could not find the time to create their own challenges. While we waited for the librarians to develop games, we worked on an administrative reporting feature so that librarians could view basic reports about their users. In December 2013, we offered individualized assistance for librarians to help create their challenges. In January of 2014, we added another ten librarians to the testing pool. We stopped gathering data about the played games at the end of February 2014 to allot ourselves time to interview librarians and analyze the gameplay data.

There were nine different games created by the librarians, and the games were played fifty-five times. Three of the games garnered the majority of the plays; other games were created but not released to patrons. We were disappointed that more librarians did not create and release games. That said, as the main goals of this grant were to collect requirements, explore ideas, and create and test a prototype, we reached those goals and learned many lessons useful for audiences interested in designing games for librarians.

About two-thirds of the users who started a created game worked through the initial reflections and answered the first question created by librarians. About half of the users made it to the third question, and about one-third of users completed all five questions. There was an optional survey at the end of the game, but only nine users completed that survey and three completed a follow-up survey.
Librarian Interviews

Fifteen librarians were interviewed and shared their experiences. Librarians who created games shared their cre-
ations with colleagues for feedback about integrating the game into instructional programs. Interviewed confirmed
our suspicions that only a few librarians shared the game with students; in many cases the gameplay was limited
to just library staff for testing. Many librarians reported that the story-based approach was not what they were
seeking; they were seeking a generic platform to ask questions and have the system track users and answers that
could be used for a self-guided tour.

Many librarians did not test the game with students because they believed they knew what students would want to
play. One stated “if it was confusing for the staff, we knew it would be too confusing for the students.” Other librar-
ians believed the pixel-based graphics would turn students away as the graphics were old-fashioned.

Librarians who were more familiar with gaming narratives and pixel-based games like Minecraft understood the
design principles that drove the game, but others refused to even playtest the game with their students.

There were some inconsistencies between the results of the Delphi study and the desires of the librarians once
they saw the implications of their technical and functional requirements. Several wanted animations, audio, and
more graphical “flash” in the game, features which would make it difficult to create a game accessible to screen
readers and functional on older computers in quiet public spaces. Because some libraries were at schools with
game degree programs, they were accustomed to games with a heavier emphasis on graphics, and so they were
disappointed in the choice to use retro graphics.

All librarians expressed interest in incorporating more gaming activities into their libraries. However, allocating time
and funds for gaming was problematic. Indeed, many librarians had to work on game-based activities outside of
their formal working hours. The opportunity to test and/or create a game using the toolkit allowed many librarians
to consider what kind of game would be attractive, or engage their audience(s). The time it took to create five
challenges proved to be a barrier to customizing and using the game. Had the toolkit been easier to implement
by providing pre-developed challenges that a library could choose from, we anticipate that more librarians would
have been able to implement the tool.

Some librarians struggled with the task of creating an engaging challenge. Few librarians are trained game and
puzzle designers. Create an engaging game using this toolkit tasks the librarian to create interesting challenges.
When we realized the librarians were struggling, we made available a puzzle design consultant. However, this help
came too late; many had already given up.

Lessons for Game Design in Libraries

One of the valuable outcomes of this project is lessons learned for successful game design for libraries. These les-
sions, along with the requirements presented earlier, can serve as a guide for both librarians and game designers
creating games in library settings.

Lesson 1: Many Players Don’t Read Text Because the technical and functional requirements desired by librarians
guided game design, we saw no design option other than a text-based game, as the requirements of ADA-com-
pliancy, screen reader usable, and functional on older computers and different browsers pointed to a text-based
game as the best choice. We advise challenging these requirements to explore the balance stipulated require-
ments and creating an engaging game. If this is truly a requirement, then we suggest building two games—a text-
based game for low-bandwidth and ADA needs and a multimedia-based game to attract a wider audience.

Lesson 2: Librarians should be Customizers instead of Co-Creators While the concept of a customizable
game was attractive, we overestimated the level of design experience required. While we developed the story and
the interface to enable librarians to create engaging challenges, we expected librarians to be co-designers of the
game. Rather, a customizable toolkit where librarians select menu options and add small amounts of customiza-
tion would most likely be much more successful.

Lesson 3: Encourage Librarians to Test Games with End Users instead of only Staff We were surprised how
many librarians only tested their games with other librarians or staff members instead of end users and did not
offer games for end user testing. One common complaint was the retro videogame style and reportedly outdated
graphics. Many librarians were unaware retro-style graphics are a common modern design model. The same is
true for the heavy story layer in this game. Librarians typically do not use story-based games, so some librarians
did not feel the story-based game was appropriate and did not reach out to end users.
Conclusions

This study underscores an ongoing challenge between researchers and librarians; as a research project, it is acceptable (and desirable) to pursue a project that explores new areas and thus may fail, but librarians who view this project as a service and representation of their library may not be willing to take that risk. Our own testing with students did not bear out the librarians’ concerns, but as the librarians are the gatekeepers to their users, we needed librarian participation for testing the games in academic library settings.

References


Acknowledgments

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**Using Spatial Game Analytics to Analyze Player Paths Through Games**

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**Abstract:** By combining pre-test and post-test measures with spatial gaming analytics, we will investigate how different player types move through a level, and how those differences can inform the design of educational games like *Fair Play*. Of particular interest were the differences between participants who had a high final bias compared to a low final bias, and participants who play games more than an hour a week, and those that do not. Initial analysis revealed differences in the way these groups played *Fair Play*.

**Introduction**

By connecting outcome variables with specific gameplay actions, we can make better educational games while improving the learning supports embedded in those games. By analyzing specific decisions that players make and connecting them with learning events, learning outcomes, and interpretable visualizations, we can better understand both learners and games. In this paper, we present a new approach for understanding how different sets of learners in *Fair Play* (GLS Studios, 2013) moved through the space and how that movement relates to various measures and outcomes.

Most contemporary educational games rely on pre-test/post-test differences to determine if players successfully achieved content goals. Unfortunately, this approach doesn’t tell a game designer much about the value of specific design decisions (such as whether a boss is too difficult or if an Non Player Character, NPC, is positioned correctly). As we design educational games, we would also like to build upon and improve existing design principles (Barab & Squire, 2004), which we cannot do without considering data collected from gameplay. By correlating in-game positional data with outcome variable data, we believe we can identify gameplay patterns within the game that may influence, or predict outcome measures. In this paper, we will illustrate such a technique using the educational game *Fair Play*. We hope this analysis will also be helpful in other games that record positional data.

**Spatial Game Analytics: heatmaps**

A common problem when developing tools to analyze game data is that a successful approach in one game may not be useful in another. For example, the way players interact changes drastically between a first-person shooter like *Halo* (Bungie, 2001) and turn-based strategy games like *Fire Emblem: Awakening* (Intelligent Systems, 2012). When developing game analytics, there needs to be a balance between general structures used across games and those better suited to a certain game genre. Heatmaps, as an analytic visualization, tend to map to a wide range of games – most games display something that can be transformed into a heatmap (such as the UI), and most games have a representation of a player in the game itself. As such, the contribution of this paper is to present a modality of heatmap helpful for understanding learning through gameplay and to give an example of analysis performed with the heatmap. This type of analysis, referred to as Spatial Game Analytics, “serves as a strong explanatory power for deciphering and understanding player behavior” (El-Nasr, M. S., Drachen, A., & Canossa, A., 2013).

Often used by commercial game companies (Ambinder, 2009; Pruett, 2010; Niwinski & Randall, 2010), heatmaps are a visual representation of a player’s movement inside of a game. A player’s positional data is recorded and superimposed onto the game map, or UI. The resulting image is then color-coded for frequency (for example, highly traveled spots might be represented by warm colors, while low-activity areas might be rendered in cool colors). Applied to learning games like *Fair Play* (Figure 1), heatmaps can reveal patterns such as points of interest, points of attrition, unused resources, and popularity of NPCs.
Learning Game Telemetry: ADAGE

With current technology, researchers can collect gameplay data with an unprecedented level of resolution. Every mouse click and player action can be recorded, stored, and analyzed. Working with these big data sets poses some problems, such as “how to determine which data are useful, and how to make use of this data in ways that will ultimately inform and improve student learning?” (Behrens, Mislevy, DiCerbo, & Levy, 2012) Effective game-based assessment must accommodate variations in the length, frequency, or content encountered, in order to measure changes in learning attributable to the game experience.

ADAGE is a system that allows users to collect data from games that implement the ADAGE API (Owen, Ramirez, Salmon & Halverson, 2014). An important feature of the ADAGE API is its flexibility to collect data from any player interaction we wish to study. This includes simple things like mouse clicks, and more complex things like changes to the game’s internal state. While the ability to log data is helpful, it is by no means revolutionary. Researchers, and industry, have been collecting player data for years. What is helpful, however, is a standardized data framework that is open and available to all developers and researchers. By being open-source, the ADAGE API is more likely to be adopted across games and across institutions. This common language will allow for analysis that does not rely on a specific implementation, or game type, as long as it adheres to the common format. This in turn will allow the sharing of analysis methods that can be critiqued or refined resulting in a deeper understanding of a player’s interaction with a system. In this study, ADAGE was used to collect information from players in real-time.

Method

Participants

The study included 58 people (26 female, 32 male, with 50% of the respondents age 18-25 and 37% 26-35) The participants self-selected from invitations sent to a large list of faculty, staff, and students from a large Midwestern university. All 58 of the participants included in this study completed the game, the demographic questionnaire, and the post-test. The participants were uncompensated.

Materials: Fair Play

Fair Play is a game created by the Games+Learning+Society Center at the University of Wisconsin-Madison that attempts to address implicit bias, or unconscious assumptions based on group stereotypes, in academia (Gutierrez, et al., 2013). The goals of Fair Play were twofold: The first was to explore the possibilities of using videogames as a vehicle for intervention of implicit bias; the second was to educate the general population on issues of implicit bias in academia. While the original project goal was to address gender bias in academia, the focus shifted to implicit racial bias in academia due to the wealth of recorded incidents/analysis indicating that the majority of individuals in the U.S. unconsciously prefer White individuals to Black individuals (Nosek et al., 2007; Nosek, Banaji & Greenwald, 2002). In this study, data was collected from players while they played the first level of Fair Play.

Assessment Instrument: Implicit Association Test

The Implicit Association Test (IAT) measures an individual’s implicit bias by noting how long it takes the user to correctly associate a given word with a category given a prompt. The most common IAT is the Black/White, and Good/Bad IAT. During a standard IAT, the user is given an association (like black = good) and is then shown a series of words with good or bad intonations that the user must associate with the black or white photo shown. The test measures the delay between first showing the word and a successful classification. Generally, the longer it takes the user to correctly classify the prompt the more entrenched the opposite bias (Greenwald et al 2009). A
measure of the user's implicit bias is calculated based on the deltas. A bias score of zero is generally considered to be unbiased, other scores indicate a preference towards one association over another, which is determined by a positive or negative magnitude. For this study, players took the IAT upon completion of *Fair Play*’s first level and the resulting score was used to measure the effectiveness of *Fair Play*.

**Procedure**

Participants played the first level of *Fair Play*, took the IAT upon completion, and finished with a general demographic questionnaire. During gameplay, information about the player’s actions were recorded using ADAGE. After selecting variables of interest (how long a participant played games per week, and their final bias as reported by the IAT), the positional data collected was segmented to create various heatmaps. This visualization can help us to make sense of how players interact with the game allowing us build help systems, or refine the game itself.

![Figure 2: The process of converting heatmap data to a direct graph \((A, B, C, D)\).](image)

Using heatmaps as a basis, we can also represent player movement as a directed graph. By clustering the heatmap data gathered we can identify areas within a game that players transition in and out of (Figure 2b). By reviewing player movement logs we can then determine if a player moves from one area to another and at what frequency (Figure 2c). By combining this information, we are left with a model of player transitions over time that we can use to make inferences about the player. By converting heatmap data into a directed graph we are also free to run graph analysis over the model to find structures of interest like cycles and most/least visited nodes. For example, in figure 3d we notice that the lower left area B can be completely avoided by visiting nodes A, C, and D. If we have an important event that occurs in B we might consider moving it to A, C, or D. We might also notice that most players quit the game if they are in area D which may prompt us to conduct follow-up interviews with participants to see why they quit in area D (perhaps there was a bug there). Of course, creating a graph to represent transitions does not need to be limited to player movement. We can also use this same method to analyze other state transitions like paths taken during an NPC conversation, or common actions performed by players that could indicate a common strategy. Like heatmaps, these types of analysis are applicable to most games, though the resulting models will be game dependent. By identifying patterns of play that correlate to preferred outcome variables, researchers can then modify their games to elicit that type of behaviour.

**Experimental Design: Measures & Data Collection**

Data collected includes information about the player’s current position, conversation choices, the successful completion of game objectives, and general demographic information. Once gathered, the data is cleaned so that it’s usable for our purposes. Specifically, we paid attention to any pre/post measures, and any positional data. Because we use the ADAGE API the time spent cleaning the data was minimized. The most important data to preserve for this purpose is x, y data simply because the resulting visualizations will be 2d, and because elevation isn’t really important for Fair Play meaning the z dimension could be ignored safely. 3d data can be used with minor modifications, and It’s also possible to collapse multiple dimensions to two dimensions through various dimension reduction techniques such as PCA.

A visualization of all player movement in the first level of Fair Play was produced by running a clustering algorithm over all positional data. In this study, we used a modified version of scikit-learn’s K-means clustering (Pedregosa et al 2011). For the representations used in this study, the next step is to segment the 2d representation using the clusters identified. For this study, we used a modified version of SciKit’s K-Means visual representation of handwritten digit data which segments a 2d projection by cluster (http://scikit-learn.org/stable/auto_examples/cluster/
We created additional visualizations by segmenting the data along outcome measures and demographic information in order to compare and contrast the resulting groups. The two factors we focused on for this paper were the player’s final IAT bias, and the number of hours the participant played games.

**Results**

We found differences in movement for players who would receive a low final bias (near zero, signifying little bias) when compared with players who had higher final bias. Players who self reported as having played more games also differed from players who reported playing little or no games.

When all participant data was entered into the heatmap algorithm, we received the visualization in Figure 3.

![Figure 3: Heatmaps and clusters generated from all positional data (left) and a bird's eye view of the first level of Fair Play (right).](image)

This representation outlined the first level of Fair Play and generally displays predefined areas of interest such as the location of NPCs.

The heatmap data was segmented based on the player’s final IAT score. Figure 4a represents 29 players with the lowest final IAT score while Figure 4b represents the 29 players with a high final bias. The resulting visualizations show that players with low bias produced clusters similar to the aggregate while high bias players produced very different clusters. This shows that the distribution of positional data differed upper left and center of the map indicating a difference in the way players with a high final bias moved through the map.

![Figure 4: Heatmaps created by segmenting participant data based on final bias. Left represents participants with a low final bias, while the right represents users with a high final bias.](image)

Directed graphs (Figure 5) produced from individual's positional data also support the claim that participants who displayed high bias during the IAT played the game differently than those who exhibited low bias.
Another visualization (Figure 6) was generated based on how often the participant played games. 30 participants reported playing 1 hour of games or less, while 28 participants reported that they played more than an hour a week. While the clustering was more consistent than the visualizations produced by Low Bias / High Bias there were differences in the way the two groups move across the map. Specifically, participants who played more than an hour per week explored areas of the map that were not required while participants who played less than an hour per week did not.

Figure 6: Heatmaps created by segmenting participant data based on hours of gameplay per week. Left, participants who reported playing <1 hour. Right, participants who played >1 hour.

Discussion
In this preliminary study, we used spatial analytics in conjunction with post-test measures and demographic data to analyze gameplay patterns in Fair Play. With this approach, we were able to identify areas of player interest and differences in the ways players moved through the first level.

Identifying Areas of Interest
The aggregate heatmaps successfully displayed the parts of the map that players gravitated towards. As expected, several of these points lined up with NPCs and other critical parts of the game. When the data was segmented by hours of games played per week, we found that participants who reported playing >1 hour per week were much more likely to explore parts of the map that weren’t necessary to complete the first level. In our study, the area behind a building (Figure 7) was explored mostly by people who play more than an hour of games per week. This makes sense because there were no obvious indicators suggesting that part of the level was accessible. Further more, this part of the map wasn’t necessary to complete the game and could safely be ignored. For the purposes of game design, placing an easter egg, or another NPC, in this area would be a good way to take advantage of the player’s interest in a part of the map that isn’t being used.

Figure 7: A close up of the upper left corners of the game hours per week condition indicating that participants who played >1 hour per week explored more of the map (left).
Differences in Player Types
The heatmaps generated from low bias and high bias participants differed in the distribution of points and the resulting clusters created. While data from the low bias players yielded heatmap with clusters similar to the aggregate, the high bias participants generated different clusters. Though the analysis was preliminary, by using heatmaps in conjunction with post-test data we were able to find slight differences between players who would have a high final bias and those that would have a low final bias.

The differences between players who played more than one hour a week of games is particularly interesting. Although most educational games target a wide audience, familiarity with the medium influences the way participants interact with the game (where they went, etc). Understanding these differences is important because it suggests that the way the game is presented (and the curriculum and structure necessary) may have to change depending on the participants.

Although the directed graphs generated support the hypothesis that gameplay can highlight differences between participants with high bias compared to participants with low bias, more work is needed to identify cycles and structures within these graphs. Future work will include researching how the resulting cycles and structures relate to, or influence, performance on post-test assessments.

Conclusion
Although there have been studies about the effectiveness of Fair Play as an intervention, this study represents the first steps towards evaluating the game with in-game data. This process not only gives us more insight into the relationship between actions made in the game and outcome measures, but also lets us evaluate the design decisions made during development. Because educational games have, built into them, biases that the designer holds about what is important to learn, and the best way to learn them (Squire 2011), being able to evaluate those design decisions is particularly important.

References


Playing with Gender: Examining How Learning Games Can Adapt to User Characteristics to Maximize Positive Outcomes

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Abstract: This study explores the role of gender—treated as a construct that includes multiple potential identities—within interactions between media users and game characters in digital learning games. Using a museum-based science-learning game with scientist characters designed to serve as experimental stimuli, we examined how the relationship between character gender, player gender and player age influenced motivation in the game. Analyses suggest that the scientist characters’ masculinity or femininity influenced male and female players’ motivation differently, but that the specific manifestation of such influence appears to vary for different age groups. These results suggest that the characters in science-learning games could be designed to adapt to the players’ characteristics in order increase their science content learning or interest in STEM fields. More generally, this study highlights the importance of considering player characteristics in game design and the potential of adapting to such characteristics in order to maximize meaningful outcomes.

The depiction of scientists in media is a widely researched topic, with a variety of studies showing that the ways in which scientists are depicted influences people’s attitudes about science fields and their own potential role in them (e.g., Brossard & Dudo, 2012; Gerbner, 1987; Shanahan, 2004). Scientists are often portrayed in popular media as white males (Dudo et al., 2011), or when females, in roles that emphasize their femininity (Steinke, 2005). Exposure to such depictions may contribute to some children’s narrow views of scientists (Losh, Wilke, & Pop, 2008), potentially reducing the likelihood that such children will identify personally with science and thus pursue STEM fields (Adams & Gupta, 2013). While increased public awareness of this issue over the past decade may have contributed to increased diversity in scientist depictions, such disparities are still evident (e.g., Perryman & Theiss, 2014; McIntosh, 2014). However, much of the research on scientist depictions focuses on traditional, one-way media, not interactive media, such as digital learning games, within which scientist depictions are less constrained than in traditional media. The present research addresses this issue by focusing on scientist depictions within digital learning games.

This issue of scientist depictions in digital learning games is important because such games are becoming increasingly incorporated into informal education worldwide (including museums, science centers, enrichment activities in K-12 classrooms, and home use) and thus the populations of people using such information technologies are becoming increasingly diverse. This creates the need for games to appropriately adapt to the diverse user bases in ways that maximize learning potential for all users, which is challenging to accomplish for traditional media platforms. However, the flexible nature of such software offers a potential solution for this challenge. Namely, digital learning games can be designed to adapt to the user’s characteristics in ways that are likely to increase the users’ engagement in the learning process. But in order to do so, the design of such technologies must incorporate a sufficient understanding of how different types of users connect with different types of content.

Additionally, the present project examines how users’ identity characteristics may impact whether and how they identify with scientist characters in learning games. Identifying with the characters may motivate users to engage more deeply with content. STEM-oriented games and programs that involve players personally have been found to increase players’ self-efficacy in STEM fields (Dietrele, 2009) as well as increase STEM interests (Giarratani et al., 2011) and identification with science for underrepresented populations (McCreedy & Dierking, 2013). Through such development of identities that are associated with science, young people become more likely to pursue STEM fields (Adams & Gupta, 2013). Thus, by focusing on the relationship between users’ and scientist characters’ identity characteristics in digital learning games, the present research aims to contribute to the broadening of participation in STEM fields.
The particular identity characteristic on which we focus in this project is the construct of gender, which is one of the most powerful identity characteristics in human beings, with many biological, cognitive, and social influences on its development and expression over the lifetime (Connell, 1987). Further, we consider gender as more than a binary male/female construct. Instead, we consider the potential for multiple gender identities, drawing from the conceptualization of gender on a continuum, with masculinity and femininity as neither mutually exclusive nor always derivative of biological sex (Bem, 1981).

Game character gender plays an important role in users’ motivation. Hypersexualized game characters have been found to reduce female players’ motivation (Behm-Morawitz & Mastro, 2009). However, user motivation has been found to increase through identification with characters (Bailenson, Beall, Blascovich, Raimundo, & Weisbuch, 2001; Fox & Bailenson, 2009). This suggests that scientist character gender in a learning game should be designed to increase user identification as much as possible without exaggerating gender characteristics.

Identification with media characters can shape users’ identity and behaviors. Through the act of game play, users adopt a character’s viewpoint and thus develop an “understanding of his or her plight and motivations” (Cohen, 2013, p. 194). This process may create a shift in self-perception, in which the media user’s perception of herself is modified to incorporate elements of the character’s identity (Klimmt, et al., 2010). Identification with characters has been found to promote social learning and affect the sense of self (Cohen, 2001; 2013; van Reijmersdal, et al., 2013). As it relates to gender, identification with media characters influences the construction of gender roles (Jose, 1989), including gendered representations of scientists (Steinke, Applegate, Lapinski, Ryan, & Long, 2012). Specifically, Steinke and colleagues found that children’s identification with scientists was explained by homophily (boys identified more with males, girls more with females) in some but not all cases (e.g., depending on characters’ dominance).

In the present context, when considering multiple potential gender identities, this suggests that a science learning game may increase player identification—and thus motivation—by matching the scientist character’s gender to the player’s gender in some but not all cases. For example, it is not clear whether masculine males should be matched with masculine male scientists, feminine females with feminine female scientist characters, and so forth.

Such homophilous matching may be detrimental because it reinforces male-dominant stereotypes. These stereotypes may be demotivating to users—especially women or girls—because of the ways in which they influence the users’ self-efficacy. This is explained by Stereotype Threat Theory (Steele, 1997; Steele & Aronson, 1995), which suggests that people subconsciously conform to negative stereotypes about demographic groups to which they belong when they are reminded of such stereotypes. In this context, scientist characters in which their gender is exaggerated (highly masculine or highly feminine) may serve as reminders of negative stereotypes about female performance in science, thereby demotivating some players, depending on their own gender identity.

In contrast, when stereotype threat is not potentially triggered by exaggerated gender in a homophilous match, the positive effects of identification with a homophilous scientist character may increase motivation. Further, recognizing that the conception of gender identity and attitudes about gender change throughout childhood, we would expect the effects on motivation caused by scientist character gender to differ between age groups.

Given this uncertainty, we examine these relationships between scientist character gender, player gender, and player age within the context of an open-ended research question:

**Research Question:** Does the relationship between scientist character gender, player gender, and player age influence user motivation in a science-learning game, such that more masculine and/or feminine characters lead to more motivation for male or female users?

**Method**

In order to examine this research question, we helped design a digital STEM learning game to use as stimulus material in a field experiment. The game, called *Hungry Birds*, was developed by the Ohio-based educational games design company Digital Glass (http://digitalglass.biz) to teach natural selection concepts. Through a partnership with the game’s producer, we helped design the scientist characters in the game—who serve as guides to the game and learning content—to reflect four gender categories: high/low masculine male and high/low feminine female (see Figure 1). Given limitations on the project scope and thus number of scientist characters included in the game, we chose these four categories to provide both a stereotypical “high gender” role for each sex as well as a simple, contrasting “low gender” option we expected would be familiar and identifiable for younger participants.
The design of these characters’ appearance and voices went through multiple iterations, including informal surveys in which we attempted to identify the characters’ identity characteristics that represented gender while not being confounded with other elements of identity. For example, we found that eye glasses signaled a reduction in perceived masculinity but also an increase in perceived intelligence, so we chose to not put eye glasses on any of the characters.

The game is designed to be played by museum visitors on a large touchscreen monitor. In the game, the user plays as a bird flying through trees, eating black or white peppered moths by touching them on the touchscreen monitor (see Figure 2).

Black moths are initially easier to eat because the trees are light in color, but partway through the game, the trees get darker (because of pollution), and thus it becomes easier to eat white moths. This actually happened during the Industrial Revolution in England, leading to significant changes in the peppered moth population. This example teaches and reinforces understanding of the biological concept of natural selection in a fun and accessible way. Visitors may play the game alone or with a partner, encouraging dynamic group learning.

From October through December 2014, we conducted an IRB-approved pilot research study at the university’s museum, a Smithsonian Institution Affiliate which holds collections related to the natural sciences, anthropology, history and culture. The game was placed on a touchscreen within a larger exhibit on evolution and natural selection and was available for all museum visitors to play.

We used the players’ score for each session as the measure of motivation to perform well in the game. We reason that performance motivation in a learning game task would translate into motivation to engage in the STEM learning involved in the game, drawing from Cognitive Dissonance Theory (Festinger, 1957) and Balance Theory (Heider, 1946; Petty & Cacioppo, 1996). These theories suggest that people strive to maintain consistency (i.e., balance) between related cognitive elements in order to reduce discomfort with inconsistency (i.e., dissonance). Specifically, using the triangle in Figure 3 as a template, the relationship between cognitive elements A, B and C (with x, y, and z representing the valence of connection between the elements) is in balance if 1) x, y, and z are all positive or 2) if one of the connections is negative and the other two are positive.
Figure 3. Template triangle illustrating Balance Theory, with $x$, $y$ and $z$ representing valence connections between cognitive elements A, B, and C.

In the current case, if the player (A) is positively oriented ($x$) toward game task performance (B; as reflected by performance motivation) and the player recognizes that the game task (B) positively relates ($z$) to STEM learning (C), then the player should feel positively oriented ($z$) toward STEM learning (C). Another possible interpretation is that if the player (A) is positively oriented ($x$) toward the scientist character (B; as reflected by following the character’s instruction to perform on the game task) and the player recognizes that the scientist character (B) positively relates ($z$) to STEM learning (C), then the player should feel positively oriented ($z$) toward STEM learning (C). More simply put, if the player identifies with the game and/or scientist character, as reflected by game task performance, then the player should also identify with STEM learning. While this reasoning requires additional empirical testing, it was sufficient to justify our use of the measure of game score as a proxy for motivation in this study.

Results

In our analysis, we included the randomly assigned scientist character’s gender, which we classified into a 2 (male or female scientist) by 2 (high or low gender) design, as our main independent variables, as well as the players’ biological sex as inputted into the game (only a binary male/female classification) and age as inputted into the game (i.e., seven categories of age ranges from “9-10” to “23 and above”).

Results from a series of Analysis of Variance (ANOVA) tests suggested that the relationships between these constructs influenced motivation, but the specific manifestations of such influence appears varied for different age groups. Due to space constraints, we only report some of the models here. Namely, for 19-22 year-olds, across both male and female players, there was a significant interaction effect between the two scientist gender measures, with players who had the masculine male scientist scoring highest ($M = 31.46$) relative to those with the low-masculine male ($M = 21.38$), the feminine female ($M = 23.41$), and the low-feminine female ($M = 25.87$), $F(2, 66) = 5.15$, $p < .05$, $h^2 = .07$. For 17-18 year-olds, across high- and low-gendered scientists, there was a significant interaction effect between player gender (male/female) and scientist gender (male/female), with male players scoring higher with a male ($M = 34.17$) than a female scientist ($M = 25.16$), but female players scoring higher with a female ($M = 35.91$) than a male scientist ($M = 26.50$), $F(2, 30) = 4.53$, $p < .05$, $h^2 = .13$. Lastly, but perhaps most interestingly, for 13-14 year-olds, across male and female scientists, there was a significant interaction effect between player gender (male/female) and scientist gender (high/low), with male players scoring higher with a high-gender ($M = 26.83$) than a low-gender scientist ($M = 22.38$), but female players scoring higher with a low-gender ($M = 30.83$) than high-gender scientist ($M = 21.25$), $F(2, 42) = 6.31$, $p < .05$, $h^2 = .13$.

Discussion

The present research explored how characters in digital learning games can be designed to adapt to players’ characteristics in ways that maximize positive learning outcomes. The results suggest that the relationships between character gender and player gender influences performance motivation, but the specific manifestation of such influence appears to vary for different age groups. Specifically, for 19-22 year-olds, a masculine male scientist appeared to be most motivating across all participants. For 17-18 year-olds, male users were more motivated by male scientists, while female users were more motivated by female scientist (i.e., homophily). And for 13-14 year-olds, male users were more motivated by high-gender scientists (i.e., high-masculine male or high-feminine female) while female users were more motivated by low-gender scientists (i.e., low-masculine male or low-feminine female).

We do not have a strong basis for reasoning about the differences between the three age ranges, but we would like to highlight that the results for the 13-14 year-olds are most interesting because they illustrate the importance of considering the continua of gender when designing learning technologies. The theory of stereotype threat (Steele & Aronson, 1995) may help explain why the females in this age range (early teen years) were less motivated by the high-gender scientists. According to this theory, people conform to negative stereotypes about a demographic to which they belong when they are reminded of such stereotypes. In this case, the high-gender scientists may have...
served as reminders of negative stereotypes about female performance in science and/or video games, thereby demotivating the female players. This suggests that digital learning technologies should aim to do the opposite, namely, to avoid cues that would serve as reminders gender differences (e.g., high-gender characters) for female users.

Overall, these results suggest that there is a potential for matching user and scientist character gender in ways that increase motivation. By considering how gender, as a continuous construct, and age influence users’ connections to science content, games could be designed to offer characters that maximize such outcomes. The present study was limited in its ability to assess gender along a full continuum, i.e., there were only four scientist characters and gender was still treated as a binary construct for players. Future research and games could address this limitation by increasing the number of gender identities considered along the continuum and developing ways to better assess the user’s identity characteristics. In the case of biological sex, this is relatively easy: The game can simply prompt the user to input his or her sex on a two-point scale. However, it is more difficult to assess more-complicated facets of identity that may have similar effects, such as gender on a continuum, race, cultural background, or sexual orientation. Future games and studies are necessary to find ways to incorporate more complex aspects of identity to help facilitate appropriate adaptation to users.

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References


Second Life Ghost Towns: Questioning Discourses of Learning Artifacts in Higher Education Islands

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Abstract: Second Life presented new opportunities for curriculum innovation in higher education. At its peak, over 171 colleges and universities from around the world were using this online virtual world as a cost-effective way to create customizable, media-rich environments for distance and online education. However, the use of Second Life by colleges and universities in the United States began to drop significantly, particularly as initial studies and evaluations of learning outcomes and experiences produced mixed results (Inman, Wright & Hartman, 2010). Steep learning curves, connection issues, social disruptions, and other barriers emerged that began to temper the initial enthusiasm for the learning platform. This paper uses the frameworks of Dwayne Huebner (2000) and Karen Ferneding (2004) to further theorize the possibilities and limitations of the space. By limiting themselves to technical and political language frameworks, educational users of Second Life often missed out on the rich possibilities of this virtual world.

Introduction

The use of digital technologies in higher education has increased in recent decades. The proliferation of online virtual worlds offers new possibilities for curriculum design and the delivery of course material. Linden Labs’ Second Life is a space where players (or “residents”) create digital avatars and interact with others. Second Life allows players to lease “islands” or tracts of virtual land for numerous purposes including selling virtual and real products, conducting classes and conferences, doing research, and hosting social and community events (Linden Labs, 2007). Proponents have argued that the use of this new technology as a course delivery method, particularly in the context of distance learning, may provide a way to create a more substantial feeling of “community” among distance learners. This lack of community is often cited by distance education program evaluators and researchers as a major contributor to high incompletion and dropout rates in distance learning courses (Coffman & Klinger, 2007). Many supporters position virtual worlds as a superior, more immersive method of content delivery because of more visual interactions. Second Life offers text and voice chat functions in a virtual world combined with scripting and building capabilities that together, have the potential to enhance educational interaction. Many universities and colleges across the US took the leap into Second Life, with over 171 virtual campuses in existence by the end of the first decade of the new millennium (Jennings & Collins, 2008). However, if you visit these campuses today, many have become virtual ghost towns.

The utilization of online virtual worlds in educational contexts has not been without its problems. Educators and researchers cite steep learning curves in negotiating the new interfaces for both faculty and students, lack of broad access to the adequate technological hardware needed to access this medium (especially for students and school districts in low income areas), as well as ethical and legal concerns about exposing faculty and students to potential harassment and assault known as “griefing” in online communities (Rufener-Bach, 2009). In addition, critical concerns have been raised as to the effectiveness of course delivery in these venues and their potential to increase the impersonal character of interactions in the classroom mediated by technology (Foley, 2007). When these barriers arise, educators will often default back to familiar methods to teach concepts.

Slota, Young and Travis explored many of the barriers that have posed challenges for educators in virtual worlds (2013). When comparing Second Life to their examinations of four technologies, which consisted of Logo, The Adventures of Jasper Woodbury, HyperCard, and Operation BIOME, similarities around barriers arise. Despite the opportunities presented for student-driven computational learning in Logo (an artificial intelligence-like program where students were able to learn about programming through interaction with an AI turtle), educators returned to familiar methods, using worksheets to drill programming concepts first, then allowing students to practice programming on Logo. The Adventures of Jasper Woodbury, the second initiative discussed, was based on anchored instruction and situated cognition. Involving a series of videos where students would be given a baseline of mutual understanding to work with before delving into the learning, the series was soon used improperly. The videos turned into a supplemental resource, completely mitigating their purpose and leading to their eventual demise (Slota, Young, & Travis, 2013). Analysis of the Operation BIOME program revealed time barriers experienced by educators. Despite researchers’ attempts to provide opportunities for connection and mentoring of educators by scheduling meetings to talk through issues they may have using the program, Operation BIOME usage by educators declined. Many of the research participants admitted that they simply did not have the time necessary to
flesh out the program, having to cut out certain aspects of the program and preferring to stick to the comfortable methods of teaching that they had used throughout their careers.

Understanding these misuses by teachers is paramount in the discussion of why Second Life is no longer at the forefront of learning-based technologies. While Second Life allows for an interactive education mixed with new aesthetics, many of the campuses explored did not take advantage of the tools offered to them. Instead, Second Life higher education islands are littered with doll house aesthetics, mimicking real world classrooms without incorporating the new technology whatsoever.

Karen Ferneding (2004) provides an additional point of critique that can help provide a deeper understanding of why some of these initiatives fail. She argues that technology is often used as evidence of learning and educational progress in and of itself. Instead, she interrogates the role of technology in delivering a message that simultaneously limits the possibilities of the learning process.

Consideration of some of these issues leads to several important questions. How does the language used to discuss educational promises of virtual worlds both structure and possibly limit critical analysis of how they could deliver educational opportunities? How does this language structure values and learning in virtual worlds? How might there be a discourse of inevitability (Ferneding, 2004) driving the conversations about the promise of these environments in higher education, one that may “effectively close down the spaces for alternative perspectives, voices, and interpretations regarding the naming of the nature of public education’s general condition and the imagining of its future?” (Reynolds & Webber, 2004, p. 13). Are higher education institutions utilizing these virtual worlds able to deliver on the promise of educational innovation and change?

To explore these questions, we first searched the list of universities and community colleges that have a presence on Second Life, listed publicly on the Second Life Education Directory, accessed through the Second Life Wiki, which is run by Linden Labs (Second Life Education Directory). Despite being updated as of 2013, only 44 of the 106 universities and one of the 17 community colleges listed in the directory still had Second Life virtual locations or, “Islands”. Of those campuses that were still accessible, none showed evidence of recent or ongoing use. Instead, most were ghost towns where no users were present.

Though part of an overall trend in the declining popularity of Second Life, to understand why educational users in particular moved away from the platform requires specific theoretical lenses. Huebner’s (2000) frameworks are useful for exploring specific messages embedded in the language of curricular design. These frameworks sensitize us to value orientations within curriculum regardless of educational setting and apply equally well to educational endeavors in virtual spaces and face-to-face contexts.

As a case study illustrating many of the missed opportunities, we will analyze an advertising video created by Ohio University to promote their virtual campus environment within Second Life. In doing so, we use Huebner’s (2000) frameworks to examine the advertisement’s discourse about the promise of online virtual worlds for educational practices and illustrate how institutions of higher education often approached virtual worlds with significant limitations in how they understood their potential uses.

Huebner’s Analysis of Language Systems

Dwayne Huebner provides a compelling critique of the role of language in structuring and directing inquiry in the field of curriculum studies. Based primarily on conventional wisdom that serves to trap curricular workers into prescribed, often uncritical modes of thinking, curricular language creates and sustains myths which become dangerous “because they remain nonrecognized and unchallenged” (Huebner, 2000, p. 218).

In particular, Huebner calls for curricular workers to attend to their language in order to prevent it from predetermined what should be considered and defined as educational activity and what then, is to be valued in these activities. He identifies five value frameworks that curricular workers may be able to consider when evaluating language and curricular work. These include the technical, political, scientific, esthetic, and ethical value frameworks (Huebner, 2000, p. 223). Huebner makes the case that much of current curricular work and design centers primarily on the technical value framework with some emphasis on the scientific and, though less overtly, political frameworks. He argues that esthetic and ethical value frameworks are seen far less widely than other frameworks. Huebner suggests that while these categories are not meant to be prescriptive or fixed, they provide a starting point from which to interrogate current uses of language around curricular projects to further critical inquiry into how learning may be taking place in various areas. Huebner’s frameworks may be a useful starting point from which to interrogate the use of technology in higher education.
Historical Promises of Educational Innovation: Examining Ohio University’s Second Life (OUSL)

The virtual world Second Life is designed and maintained by San Francisco-based company Linden Labs. The virtual world allows users to create avatars (a digital stand-in character on screen) and build virtual spaces by utilizing simple programming functions in order to create their own online communities. This virtual world features its own in-game economy with a direct relationship to real world economies, as players can exchange real dollars for virtual dollars called Lindens and vice versa. While anyone with an Internet connection may sign up and create an avatar for free, much emphasis is placed on participation in the in-game economy and many of the advanced scripting features for creating objects, particularly in a leased land space, are available only by earning or buying Linden currency.

Ohio University began its exploration into virtual world instruction in February 2007 with the purchase of a virtual island within Second Life. The university’s development team began to structure the space, designing the campus and virtual buildings in which to hold classes (VIRTUAL LAB, 2006). Spearheading the effort were two organizations, Ohio University Without Boundaries and University Outreach, led by Director Merle Graybill. In addition to providing new learning opportunities and expanding the campus, Ohio University planned to utilize the virtual campus as a way to market its “real life” campus to prospective students. Additionally, Ohio University planned to use its virtual campus as a way to reach out to business partners to provide training and learning opportunities in the hopes of creating long term relationships. Part of the strategy for outreach involved the creation of an advertisement for Ohio University’s virtual campus.

Second Life Promotional Video (Ohio University)

The commercial is featured both on Ohio University’s VIRTUAL LAB website and the popular video media site, Youtube. Running approximately two and half minutes, the advertisement features narration by a young, white, male avatar who demonstrates various elements of interaction in Second Life such as flying and the ability to manipulate and change the environment, as well as providing a tour of the virtual campus.

The commercial begins with the avatar flying through the air across what appears to be an ocean. A song plays in the background of the commercial, beginning with the lyrics, “We can be more than other people.” Throughout the piece, the avatar provides commentary on the potential of the campus to offer learning opportunities never before available to students. From flying over an ocean, the shot focuses on the avatar manipulating a silver ball while standing in a green campus quad next to a large, red brick university building with a large glass wall. The next shot features an angular zoom away from a large cable bridge upon which the avatar is walking. Next, we see the avatar piloting a fighter jet and then the scene immediately cuts to an empty lecture hall where the avatar is standing at the podium. The rest of the scenes feature images of student avatars interacting and watching large screens displaying PowerPoint presentations, podcasts, and videos. Next, the conference center is featured, where the avatar host is seen in a business suit standing behind a conference table in front of large video screens. The voiceover describes potential opportunities for businesses to save money by using the OUSL conference space to showcase their products and services. The commercial concludes with a message that reads “See you in world” followed by a web address where viewers can access more information about Ohio University Second Life campus.

Second Life Promotional Video: Mythinformation, Technical and Political Value Language Frameworks

A major theme within the commercial is that of innovation and the freedom of possibilities that appear to be inherent Second Life. The avatar voiceover explains:

Most of us have dreamed of flying. Dreamt of a world with endless possibilities where reality falls away to be replaced by imagination, creativity, and endless opportunities for discovery. Discovery, so central to learning, has now broken free of the boundaries of the classroom. Learners now thrive in an environment unbridled by space, time, or even the laws of physics. Welcome to the Ohio University Second Life Campus. An engaging new universe of learning opportunities for intellectual and professional growth, an immersive atmosphere where the classroom has not just been recreated, but rather reinvented. (VIRTUAL LABS, 2006)

There are several particularly interesting messages we can read in the above piece. First is the valuation of the virtual world over the real world, an example of what Ferneding calls techno-utopianism as a form of “mythinformation.” The term mythinformation was coined by political theorist Langdon Winner referring to the “almost religious
conviction that a widespread adoption of computers and communication systems along with easy access to electronic information will automatically produce a better world for human beings” (quoted in Ferneding, 2004, p. 50). The idea that the virtual campus breaks boundaries implies that the real classroom has boundaries while the virtual world does not, and additionally, that these are impediments to learning. In particular, the traits of the real world classroom considered to be boundaries are phenomena such as “space, time, or even the laws of physics.” This suggests that temporal boundaries and spatial limitations are hindrances to the learning process and emphasizes characteristics associated with freedom and experimentation. The move towards de-contextualization presented in this advertisement suggests that learning can and should be separated from time, space, and other social and physical contexts. There are practical applications such as asynchronous learning experiences that allow students to engage with class activities or materials in non-traditional ways, opening higher education experiences for non-traditional students. However, over-emphasis on solely technologically based learning environments can be highly problematic given the increasing compartmentalizing of learning activities. This can create ahistorical, non-contextualized understandings which perpetuate unrealistic relationships and may actually serve to alienate students from the learning process and the course content.

A second issue is the idea of the reinvention of the classroom through the introduction of new technology. The assumption of innovation taking place within the virtual world becomes more problematic when we contextualize the piece within the visual elements of the advertisement showcasing the new technology. A majority of the features illustrated in the commercial re-create existing symbolic or visual markers of the university experience. For example, in one of the scenes, we see the host avatar in an empty lecture hall complete with rows of chairs facing a large screen where the avatar is standing at the podium. Shots of the virtual campus show a series of red brick university buildings clustered around a central grassy quadrangle, an arrangement that mimics the architecture of the real life Ohio University campus in Athens, Ohio. In addition, the learning experiences described by the commercial are very similar to existing methods of education:

Learning experiences can range from entire college courses to one hour learning modules. Learning comes in many forms. Learning kiosks are scalable systems for housing course content for blended or stand alone delivery. Each kiosk houses applicable course content in a variety of possible media forms from text to video podcast and more. (VIRTUALLABS, 2006)

Much of the learning material featured in the commercial is text-based, ranging from PowerPoints to typed notes and documents to text-based quizzes. While there are a few video podcasts and lectures, these are simply traditional documentary-style videos in which the talking heads of professors speak directly to the learner from a kiosk or from screens at the front of a virtual lecture hall. While the innovation appears to be in the way the information is accessed (through an avatar standing in a virtual world at a kiosk or sitting in a virtual classroom space), the mode of information delivery itself is not innovative. The role of student as listener and consumer of information is replicated from the real world of university classrooms where passive listening and learning are traditionally encouraged.

The structure and message in the commercial suggests the primacy of Huebner’s (2000) the technical language value framework. This framework refers to concerns about mobilizing human resources and materials to achieve predetermined ends or objectives that have been identified by a “sociological analysis of the individual in the present or future social order” (Huebner, 2000, p. 223). In the commercial, the central focus is on the descriptive mechanisms for course delivery and how they work together. The goal of the commercial appears to center more on changing interfaces of education and curriculum than the content or structure. The end projected by the commercial is a full integration of technology into the virtual space; however, success here appears to be a measure of how like traditional curriculum this particular environment can become. There are no indications of any markers by which to assess that learning has taken place or that what is being learned is “good.”

The coupling of this language with evocative phrases, such as “Discovery, so central to learning, has now broken free of the boundaries of the classroom,” serves a dual purpose. While this language may suggest innovation and boundlessness, it simultaneously serves to discount the importance of embodied learning as well as devalue the need for contextualization. In this way, the virtual world is constructed as superior to the real world where things like laws of physics somehow get in the way of learning. This compartmentalization is reflective of a technical language that values the importance of how to make something work rather than scientific value frameworks concerned with the attainment of knowledge and the empirical testing and exploration necessary to produce this knowledge (Huebner, 2000). Additionally, aesthetic and ethical language frameworks do not appear to be present in the commercial. However, one can detect the presence of an underlying political value framework as evidenced by references to an agenda driven by corporate and business interests.
Another element of the commercial is the repeated references to industry partners and opportunities for the business community to utilize the space provided by the OUSL for marketing. The voiceover explains, “The campus also contains substantial space for virtual trade shows and conferences. Second Life conference exhibits are a highly cost-effective method for ongoing contact with your customers” (VIRTUAL LABS, 2006). Put into the context of the visual elements of the commercial, we see that these features are coupled with markers of business practices, some of the student avatars wearing brand name shirts and the large logo of a company at the conference center, complete with a business-suited representative.

The particular references to industry partners and businesses seem to indicate a political language framework within the commercial. This framework values the manipulation of resources in order to make them available to maximize effectiveness of the educational endeavor. This is often accomplished through the use of power, control and prestige on the part of the curricular worker (Huebner, 2000). Ohio University’s message appears to include references to the industry partners and funding sources used to further the Second Life campus project. The commercial reiterates that, “At the heart of Ohio University in Second Life is the same mission that drives Ohio University in real life; a complete dedication to the learning outcomes of our students and our industry partners” (VIRTUAL LABS, 2006). While attempting to situate the dedication to student learning as primary, the inclusion of the business and industry partner concerns can be read as an example of the phenomena of the increasing corporatization of public universities.

While the focus of the university is initially towards students and educational endeavors, the needs of business partners become more and more primary, especially in terms of emerging technology and its marketing with schools. While generally considered more cost-effective for teaching, Second Life is a very explicitly economic space where profit is a concern. The sustainability of new educational projects such as these require financial backing which, for many public universities, increasingly comes from business and industry sources (Reynolds, 2004). The speech in the commercial serves political interests by making explicit the value of business partners and a desire to cater to their needs to continue receiving funding. This becomes a priority for public universities in the wake of decreased funding due to state budget cuts. However, significant criticisms of the issue of corporatization, particularly its intertwining with mythinformation have been raised.

Ferneding (2004) explains that many critics have pointed to the characteristics of current educational reform discourse as being “narrow in scope, reflecting instrumental rationalist and functionalist perspectives...[and] aggressive political efforts to privatize or marketize public educational systems, policies that often reflect fundamental shifts toward market-based systems of national governance” (Ferneding, 2004, p. 48). However, Ferneding also points out that few critics have been particularly alarmed by the concurrent extensive and aggressive efforts to implement technologies into schools. She points to several elements in the construction of technology; as a tool and “neutral” artifact, therefore an apolitical entity, as a part of a larger grand narrative of progress, as a form of commonsense social story, and through its embeddedness within popular culture (Ferneding, 2004, p. 49).

The OUSL commercial exhibits these characterizations of technology as the panacea to educational failings and problems. By casting technology as liberating and as a superior mode of educational delivery to in-person educational interactions, the OUSL commercial also engages in the discourse of inevitability. The privileged position of technology serves to obscure the increased role of privatization and business interests in the decisions of educational institutions. Most critically perhaps, the limited frameworks of discourse serve as a way to shut down critical inquiry into this new technology and cover up the realities of technology as it falls short of stated goals of improving educational interaction. In particular, Fenerding (2004) makes the argument that the promise of technology as liberatory, as a way of deconstructing existing hierarchical systems that limit access to information and as a means of regenerating the possibility for participatory democracy, come into question as studies provide data that indicate the contrary. She explains, “Indeed the popularized utopian vision that such technologies will automatically create a participatory democracy relies on an ahistorical perspective that ignored the fact that technological progress has been a mixed blessing” (Ferneding, 2004, p. 51). The problem arises when curricular workers come to rely solely on the mere presence of technology to produced desired educational ends. This reliance serves to mute discourse articulating and interrogating the specific structures and aims of technology.

**Dominant and Missing Language Frameworks: The Discourse of Inevitability and its Limitations on the Learning Project.**

Much of the language in the OUSL commercial appears to focus on a primarily technical language value framework along with elements of a political language value framework. According to Huebner (2000), the danger in concentrating on only a few of these frameworks is limitations they impose on inquiry into the educational project. In particular,
The proposition may be put forth that educational activity in classrooms will be richer and more meaningful if all five categories are brought to bear. Indeed, the insignificance and inferior quality of much teaching today may be the result of attempts to maximize only the technical and political and perhaps scientific values without adequate attention to the esthetic and ethical ones. (Huebner, 2000, p. 228)

In keeping with Huebner’s assessment, the most conspicuously absent language frameworks in the OUSL commercial are the scientific, esthetic and ethical. Huebner’s (2000) esthetic framework values symbolic and esthetic meaning, involving an element of physical distance, without a functional or instrumental significance, yet containing a wholeness and totality in and of itself that can capture spontaneity often lost in the world. He outlines how the ethical value framework views educational activity as valuable for its own sake as opposed to a specified end, an activity that values the encounter of person to person, as an expression of an essence and meaning of life where, the educator meets the student, not as an embodied role, as a lesser category, but as a fellow human being…no thing, no conceptual barrier, no purpose intrudes between educator and student when educational activity is valued ethically…the educational activity is life—and life’s meanings are witnessed and lived in the classroom. (Huebner, 2000, p. 228)

While there is language present that might suggest an ethical value framework in the reiteration of a public education mission and commitment to students, these serve a more underlying political function. They are driven by rhetoric rather than a true concern for student development of a moral and ethical self in relation to a larger world. Similarly, one may perceive an esthetic value framework in the commercial. However, it cannot stand apart from the functional aims present in its creation. It represents reality very much tied to non-spontaneous aims. It represents human interactions not through a lens of higher meanings but instead through a lens of ideological structures that privilege the acquisition of capital and a reliance on technological progress to solve educational failings. Caution is necessary, perhaps now more than ever in the light of a discourse of inevitability that places technology at the forefront of human potential for solving social problems. While the OUSL claims to provide a new form of educational innovation and opportunity for students, the project they attempt falls short by limitations imposed through the value systems inherent in the language and discourse used to talk about this new educational format. In addition, innovation as it is presented in the commercial refers more to the novelty of its delivery rather than the actual content itself.

Despite the lack of innovation displayed by various universities within Second Life, there were a few institutions which used the tools given to them to transform their virtual campuses into interactive areas. The University of Denver was one of the most interactive campuses explored, allowing avatars to take a ride on a rocket ship or tour their virtual nuclear power plant via a flying bus. However, as observed with many of the other virtual islands, technological glitches were present in the space, with camera movement becoming jumpy and almost frantic as the camera attempts to focus on an avatar. Despite these issues, the space was innovative and demonstrated an example of a space incorporating attention to Huebner’s (2000) scientific and esthetic language frameworks: allowing students to learn about a nuclear power plant by controlling it. A telescope allows visitors to examine renderings of planets, and an interactive 3D periodic table of the elements demonstrates comparisons among the sizes of nuclei of various elements.

The best uses of Second Life all involved simulations that spoke to almost all of the language frameworks, providing students with an opportunity to work through situations within the game that may very well happen in real life. The University of the West of England runs multiple simulations on their Second Life campus, most notably a workplace incident simulator. The workplace incident, as Liz Falconer (2009) describes it, is made up of a set, engine, and scenario. In groups of two and with a tutor present, students walk through a warehouse where a forklift is loading and unloading boxes. Students interview witnesses and read through company policies, assessing an accident (Falconer, 2009). Through this simulation, students are given hands-on experience without the consequences that may be encountered in a real world event. The ability to replay simulations allows students to learn from their mistakes in a small group, under the facilitation of a trained tutor to understand how to handle various iterations of a given accident in an ethical manner. Providing this sort of room for critical inquiry and critique that disrupts the discourse of inevitability is needed if the potential for new technologies to become tools and not masters is to be realized.

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Stories, Games, & Learning Through Play: An Analysis of Narrative Affordances in Game-Based Instruction

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Abstract: Stories are the mechanism through which humans construct reality and make sense of the world around them. Yet, research on the positive effects of narrative in game-based and other learning environments is quite variable, and the relevance of narrative to the learning sciences is not well understood. Identifying precisely how narrative intertwines with human experience of the lived-in world requires the application of a situated cognition framework to understand recipient-content-context interactions as dynamic and co-determined. To begin unpacking this issue, a narrative-structured, game-based learning program, Project TECHNOLOGIA, was used to target in-context, on-the-fly dialogic interactions between narrative “producers” (i.e., instructors) and “recipients” (i.e., participating students). Results indicate that there may be value in pursuing narrative as an instructional game mechanic for complex social, cultural, and intellectual issues as well as the induction of real-world goal adoption. Recommendations for further research are provided.

Introduction

For millennia, stories have been used to frame human existence, learning, and culture. Yet, research aimed at reviewing and analyzing the positive influence of narrative in game-based and other learning environments is quite variable, and despite thousands of years of oral storytelling tradition, the relevance of narrative to theories of learning is not well understood or researched.

In response, this study was developed to reconcile what is assumed with what is known about the psychological underpinning of narrative. By highlighting the results of a narrative-structured, game-based learning program, Project TECHNOLOGIA, it addressed two specific questions regarding narrative as a tool and game mechanic for instruction:

1. How can narrative be optimally characterized with regard to impact on game-based learning?
2. What are the specific affordances of storytelling and narrative structure for supporting game-based learning?

If humans share knowledge, encourage investigation, and promote creative acts through narrative, identifying the connection between story “producers” (i.e., writers, designers) and “recipients” (i.e., readers, audience members) would likely facilitate pedagogical design writ large. As established below, taking a situated view may restructure the framework through which narrative is currently utilized and define its potential for shaping human understanding, goal adoption, and transfer.

Understanding Narrative

Storytelling and gaming are two areas where adopting an ecological perspective (i.e., situated cognition; see Barab and Roth, 2006; Young, 2004) might be especially helpful for delineating how and why learning occurs in particular formal and informal educational contexts. Much of the extant literature concerning stories and games is rooted in information processing and schema theory, and while this has been helpful for the purposes of deconstructing relationships between varying narrative elements (e.g., Burke’s [1945] pentad of story elements, Bruner’s [1991] 10 defining characteristics of narrative), it has also been limited in addressing the complex nature of producer-recipient-environment interaction.

Consider that stories, games, and other forms of narrative are rendered insignificant if the audience lacks the worldly experience to understand their underlying meaning in-context (e.g., a young child attempting to play and comprehend Irrational Games’ [2007] BioShock). Narrative and environmental circumstance are connected by the relationships formed not just between the narrative’s producer and recipient but also the producer’s life-world, the recipient’s life-world, and the medium in which the narrative is embedded. Even if the producer has written something with a specific instructional goal in mind, as with TaptoLearn’s (2013) Math vs Zombies, the recipient’s prior experiences fundamentally inform—or confound—the producer’s intended interpretation. For example, a student playing Math vs Zombies might have a goal to see how close she could let the zombie get before transforming it,
thwarting the designer’s goal to enhance math response speed. This suggests that stories must be approached as dynamic and context-driven to if we are to establish whether and to what extent narrative holds value as an effective instructional game mechanic.

Three Levels of Narrative

Narratives are traditionally organized around properties thought to be unique within specific categories—these might include genre (e.g., horror, comedy), tone (e.g., melancholy, hopeful), message (e.g., morals, lessons), or presentation type (e.g., book, stage production, film, video game). However, this organizational process generally ignores the situated and personal nature of producer-narrative and recipient-narrative interactions explained above, assuming a single narrative can only be understood through the producer’s original life-world lens.

To counteract this problem, it would be prudent to refine and standardize narrative cataloguing across all media research. Yet, knowing that the organization process as currently utilized is ineffective, generalization based on perceived “unique” narrative properties would be unduly limiting. It would benefit researchers to focus instead on the nature of narrative interactions—that is, how narrative is perceived and acted upon by individuals—rather than emphasizing superficial differences between individual stories, genres, or story structures. The following section: (a) describes one way this can be accomplished by dividing narrative (game-based or otherwise) into three distinct levels of analysis that are fundamentally consistent across all genres, formats, and more; and (b) addresses the question: “How can narrative be optimally characterized with regard to impact on game-based learning?”

Level 1: Narrative-as-Designed

When an author or game designer begins producing content, they are guided by their intentions and experiences as part of the lived-in world. Their respective life-worlds inform a particular production goal and guide the conveyance of a particular message, theme, or idea by way of story structuring, diction choices, game mechanics, and formatting decisions. This can be accomplished directly, as with contemporary social media games and apps that ask story recipients if they would like to share their progress or discuss story content via social media websites (e.g., Goodreads, FarmVille), or indirectly, as with stories built to unfold as part of the recipient’s interactive experience (e.g., Star Wars: KOTOR, Mass Effect, and Telltale Games’ The Walking Dead). These two approaches define the primary purpose of the narrative-as-designed: to convey the producer’s intentions to a particular audience and encourage receipt of an intended message.

Level 2: Narrative-as-Perceived

Even if the narrative-as-designed is well-produced, Narrative: Level 1 holds little or no weight if members of the receiving audience re-shape the story based on their own situated goals and experiences, including unintentional misinterpretation, willful misdirection when describing the story to others, or modifying the story in subsequent editions or cross-media (e.g., book-to-film, game-to-book adaptations). A misanthropic teen might pick up a producer’s work and read/play it under the assumption that the narrative-as-designed is a commentary on the triteness and unrealism of fairy tales. Perhaps he has recently suffered through a relationship break-up and believes that idealistic views of heroism and romance are overrated. Being inseparable from his experiencing of the story, his life-world will inevitably shape the lens through which he interprets the producer’s work and influence the way he describes any underlying moral or thematic value.

Given the frequency with which narrative has been used for educational purposes, it is surprising that existing cognitive science literature does not address the divide between the producer’s narrative-as-designed and recipient’s narrative-as-perceived. In order for desired instruction to occur, a producer would need his audience to understand and interpret the narrative-as-designed as planned. Otherwise, recipients may transfer the narrative-as-perceived in such a way that they distort the producer’s meaning, or worse, perpetuate misapplication among others. Understanding this relationship as bidirectional may help researchers and game designers develop an optimal generator set for conveying underlying morals, values, and ideas, something that could dramatically shape the development of game-based experiences for education.

Level 3: Narrative-as-Social Organizer

Narrative-as-perceived (i.e., Narrative: Level 2) has the potential to reinforce or mutate a producer’s desired message. Both outcomes can be intensified as a function of social amplification—that is, the more recipients who interact with and around a given narrative, the greater the distortion (e.g., crowd sourcing, playing “telephone”). Importantly, though, the social organization that occurs in and around stories can foster the creation of entirely new, co-constructed narratives that exist exclusive of the original body of content. This can be referred to as Narrative: Level 3, or narrative-as-social organizer.
Even the most mundane stories have the potential to spawn peripheral social groups with shared goals and intentions. For example, a game designer could produce a roleplaying game in which the player is only able to direct their avatar to eat an apple. The narrative, by itself, could be presented by the producer to a group of recipients for further consideration. Emergent questions could drive discussion about the event being described (e.g., “Why did the avatar eat the apple?” “Why did it only eat one apple?”). This puts recipients in the position to write and share analyses of the game, build on the original (e.g., fan fiction, mods), and create clubs, online communities, and other organizations where they can chat, debate, and evaluate one another’s contributions to the man-apple game.

**Project TECHNOLOGIA: A Study of Narrative as Game Mechanic**

In service of fostering cross-context critical thinking and researching the relevance of narrative in game-based learning environments, the staff of a large, public university Educational Technology graduate program developed a 24-week, dual alternate reality game (ARG)-roleplaying game (RPG) titled *Project TECHNOLOGIA*. Its plot follows the goings-on of a fictional space vessel, the Remmlar Array, helmed by a team of three administrators. Over the course of six three-part episodes, students are tasked with envisioning, designing, and stabilizing a new educational system through the wise integration of learning technologies as defined by the International Society for Technology in Education [ISTE] 2014 standards. This makes the target objective—based on balancing the needs and desires of a K-12 school district—the same from both narrative and instructional perspectives.

The program uses a combination of familiar game mechanics (e.g., roleplaying) and the Blackboard™ learning management system to guide players toward learning objectives and perspectives favorable for telling a story about learning as it unfolds. Its organization takes advantage of narrative in two distinct ways: first, players perform as “operatives” on a mission to save the world by fulfilling program-level learning objectives (e.g., visioning and implementing district-wide technology initiatives), and second, they perform as characters (e.g., school district technology coordinators) on a mission to save the game world, also by fulfilling program-level learning objectives (see also Slota, Ballestrini, and Pearsall, 2013). Additionally, they are encouraged to step out of the game to “tell” about their performances in the form of self-evaluation and group discussion—an intersection of *Narrative: Levels 1, 2, and 3*. This multi-performance tiering attempts to capture the potential benefits of game-based instruction by encouraging metagame activities like the discussion of game mechanics and successful strategies for dealing with particular problems (i.e., *Narrative: Level 3*), ideally feeding back into reflection behaviors, academic achievement, and transfer.

**Investigative Methodology**

Between February and July 2014, 14 Educational Technology Master’s students were invited and agreed to participate in *Project TECHNOLOGIA*, promoted as a story-driven game designed to help them more deeply engage with program content (12 female, 2 male; 12 Caucasian, 2 Asian-American, 1 Hispanic; aged 22 to 65 years). All of the participants were concurrently employed as practicing educators during the game’s 24-week duration, and their collective career backgrounds included elementary, secondary, and post-secondary positions in rural, urban, and suburban districts.

At the game’s outset, the players were randomly sorted into three teams—two groups of five and one of four. All teams were guided by separate instructional leaders whose responsibilities included posting new episodes based on a pre-established schedule, responding with non-player character actions and dialogue as needed, and maintaining a focus on the ISTE standards. Each *Project TECHNOLOGIA* participant was assigned a particular avatar/character that could speak, “think” (i.e., give third-person descriptions of avatar thoughts), and act within the story space (i.e., Blackboard™ discussion forums). Additionally, the participants were given login credentials for individual GoogleDoc-based Operative Thought Journals that could be used as repositories of personal perceptions and feelings about the game, outside influences on participation, and in- or out-of-game goals.

Player assessment was based on a combination of in-game dialogue, player-player and player-instructor interactions, and the Operative Thought Journals. After viewing an objective-based prompt posted by their instructional leader, players were expected to collaborate and act within the gameplay. This allowed the instructional leaders to evaluate skills (e.g., visioning) with emphasis on the complex challenges facing educational technology specialists. It also maintained focus on real world application by placing learners in complex, problem-rich contexts that required intellectual risk-taking and self-evaluation of learning (i.e., anchored instruction).

Throughout implementation, the instructional leaders used in-game player activities to guide story progression (e.g., non-player character dialogue, activities). The Operative Thought Journals, by contrast, were withheld from the instructional leaders to prevent player opinions from unduly influencing the story’s structure and/or content.
before it had been experienced in its entirety. Though the in-game learning objectives were identical across participant groups, story details (e.g., non-player character comments, behaviors) varied slightly based on the decisions made by each team (e.g., attacking a non-player character vs. assisting a non-player character) and/or the instructional leader’s discretion (i.e., instructional approach, posting frequency). This was controlled through the use of pre-written “minus,” “neutral,” and “plus” versions of each in-game prompt, designed to anticipate particular types of player activity (e.g., helping vs. hurting a non-player character). Differences between the “minus,” “neutral,” and “plus” variants were primarily superficial (e.g., characters responding with different facial features, slightly different phrasing of ideas) and used to scaffold the participants closer to the program’s ISTE standards. “Minus” variants were posted in response to anything the instructional leader considered a negative behavior, distraction, or clear lapse in activity; “neutral” variants were posted in response to adequate group progress toward the current learning objective; and “plus” variants were posted in response to exceptional progress toward both the current learning objective and overarching mission (i.e., Project TECHNOLOGIA as a whole). This highlighted how player actions (or lack thereof) had consequences as a function of storytelling but did not distract from the game’s chief purpose.

Data Analysis

In order to explore how and to what extent particular narrative elements contribute to particular thoughts and responses among story recipients (Young et al., 2012; Young, Slota, & Lai, 2012), the investigator utilized grounded theory analysis (Glaser, 1998; Young et al., 2012). Analysis unfolded as a nine-step process beginning with the import of all 274 Blackboard™ discussion posts and 14 Operative Thought Journals into QSR NVivo 10 (approximately 44,400 words excluding the pre-written, episodic narrative prompts). Given the contextual differences between the two (i.e., co-constructed in-game vs. individual/internal, respectively), the investigator initially chose to treat them as mutually exclusive resources in order to identify common word, phrase, and concept usages unique to each (e.g., “collaboration,” “goal,” “I would like to…”). Due to the sheer volume of player-generated content embedded in both discussion board posts and Operative Thoughts Journals, the data was further parsed into composite idea units comprised of individual comments, statements, and/or questions. These idea units were occasionally shorter than a full sentence but never more than three sentences in length. Importantly, they were analyzed in the presence of the preceding and following idea units to minimize the loss of vital, context-dependent information (e.g., author tone, intention).

The investigator tracked commonalities between idea units throughout the reading process via open coding. Refinement with QSR NVivo 10’s coding toolkit resulted in 11 unique nodes across the 14 Operative Thought Journals and 11 across the Blackboard™ discussion posts. These nodes were re-applied to axially code all collected data and identify any categorical themes emergent across both sources (i.e., Operative Thought Journals examined alongside corresponding in-game dialogue). This laid a foundation for unpacking how and why particular individuals interacted with the narrative in particular ways, feeding back into the investigator’s goal to determine how narrative could be defined with respect to its specific affordances for supporting game-based learning.

A second researcher reviewed approximately 20% of the total data using the coding scheme generated through the primary investigator’s open and axial coding. This independent evaluation of code consistency, utility, and overall trustworthiness (i.e., peer debrief) yielded roughly 74% overlap with the primary investigator’s original code assignments. Inconsistencies between the two were used to review the primary investigator’s findings and identify how code clarity, precision, and specificity could be improved. The process resulted in minor modifications to a small number of code definitions, but no codes were judged in need of elimination or replacement.

Results: Categorizing the Affordances of Narrative for Game-Based Instruction

1. Conveying Context, Chronology, & Content

Participant interactions throughout Project TECHNOLOGIA suggest that instructional utilization of the Context, Chronology, & Content affordance of narrative might be especially valuable for establishing perceptible cross-context invariance that can facilitate transfer. In the case of instantiating a new school district technology initiative, event sequencing and interaction—including visioning, explaining technology goals to others, determining which tools optimally fulfill the original vision, and dealing with issues associated with rollout—is critical to success (Slota, Young, & Travis, 2013). However, several players entered the program with overly simplistic views on the relationship between visioning, tool selection, and communication among peers. Some began their participation already having specific technologies and other preconceived notions of what should happen in mind. This led them to somewhat naively work backward to identify philosophical foundations that would retroactively support their tool choices and/or rush to action without offering an underpinning philosophy whatsoever. Others openly acknowledged their misunderstandings and confusion with how technology coordinators form and execute district initiatives.
Given that all participants were in-service educators who had experienced at least a small amount of ineffectual initiative enactment in their own districts, misunderstanding and confusion would normally worry a program administrator. Yet, as the game progressed, interactions within the narrative environment provoked the identification of overlap between the game and their real world experiences. Many times, this came in the form of guidance from non-player character actions or statements. The game’s story organization and context clues seem to have provided at least some of the information needed for learners to identify how and to what extent their particular attitudes, approaches, and behaviors would result in particular outcomes. The evolution of responses, too, highlighted how participant thinking may have become better-rounded as a result of exposure to multiple non-player character perspectives (e.g., economic equalization, democratization, social competency). Altogether, this lends credence to the notion that narrative has the potential to provide important information about Context, Chronology, & Content that puts program learning objectives at the forefront of player thinking and discourse.

2. Engaging & Motivating

Story producers often make specific linguistic choices they anticipate will resonate with as much of their target audience as possible. This can be broadly referred to as narrative relatability, or the level at which a particular audience member will detect invariance between the given narrative and his or her experiences with the lived-in world. The effect is commonly observable in situations where the story recipient demonstrates parasocial interaction with a particular character (i.e., social surrogacy) but that character is unexpectedly and dramatically changed or killed as part of the plot—for example, Ned Stark’s execution in Martin’s (1996) *A Game of Thrones* or the death of Professor Dumbledore in Rowling’s (2005) *Harry Potter and the Half-Blood Prince* (see Cohen, 2004; Derrick, Gabriel, and Hugenberg, 2009).

Throughout *Project TECHNOLOGIA*, several participants commented on how non-player character dialogue shaped their on-going perceptions of right, wrong, and indifference within the game’s context, engagement with the story, and motivations for action. This included placation for the sake of avoiding conflict, frustration, testing boundaries, considering future action, amusement, intrigue, and changes to personal philosophy. Though none of the characters in *Project TECHNOLOGIA*’s story experience the surprising or emotionally taxing outcomes of Dumbledore or Ned Stark, these narrative-specific responses suggest that even relatively minor story elements are capable of triggering emotional connections between text and reader (e.g., characters, settings). This, in turn, can encourage reader investment and receptiveness to particular thoughts, messages, or ideas. Instructors who use narrative this way may be able to capitalize on emotional investment for the purpose of heightening engagement and motivation to interact with particular ideas or themes embedded within the game narrative.

3. Educating Intention & Attention

Whatever the benefits of engagement and motivation, emotional attachment alone is not enough to induce transfer. However, if applied toward tuning perception, it may be possible to shape intention and attention such that recipients will be able to recognize invariance between contexts, adopt new goals, and take action to achieve them (i.e., an intentional spring; see Shaw, Kadar, Sim, and Repperger, 1992). This effect may be amplified via narrative formats that provide insight into how or why a favored character has adopted particular goals, attended to particular environmental elements, and made particular choices (i.e., first-person perspective). If an emotional bond is laid as a foundation for “telling,” a more knowledgeable other (e.g., classroom teacher) could discuss the nature of the beloved character’s thoughts, opinions, and actions such that the learners will be more likely to perceive similar opportunities for action across contexts.

This occurred at various points throughout *Project TECHNOLOGIA*, with some goal adoption events unfolding within the context of the story and others within the real world. Interestingly, both within- and outside-narrative intentions emerged in response to particular non-player character statements or actions, often to counteract what a non-player character was attempting to do. Players would occasionally assert majority agreement to convince others to adopt similar intentions, though many goals emerged with a highly self-oriented rationale. If, as suggested here, the narrative can help learners perceive invariance between in-game and external experiences, it may be possible to seed up-to-date technological, pedagogical, and theoretical information into live classrooms by way of story-driven games—something viewed as quite difficult within professional development and pre-service teacher education circles. This will require more extensive empirical study but has promise for being an alternative approach to more traditional pre- and in-service teacher workshops and coursework.
4. Creating Opportunities for Co-Action

Participants in Project TECHNOLOGIA frequently commented that emergent opportunities for narrative co-action were crucial to participation, growth, and success throughout the program. These statements emphasize the perceived importance of collaborative action within the narrative for memorability and the creation of additional learning opportunities. They also serve as a foundation for facilitating reflection on how and why particular actions unfolded in response to story elements as well as which technology coordinator actions are most closely associated with success and failure in real world K-12 environments. While the instructional leaders may have posted a particular prompt with a specific goal in mind, the players clearly co-acted to attribute meaning, define emergent properties of the story, and interpret how to act on those properties given varying understandings about foundational narrative elements (e.g., characters, plot, theme, tone). Producer-driven storytelling is one way to encourage abstract critical thinking (i.e., Narrative: Level 1), but, as demonstrated in Project TECHNOLOGIA, it can also manifest as alternative visioning (e.g., providing new insights into the original narrative) or the presentation of alternative points of view among players (i.e., Narrative: Levels 2 and 3).

Peer-to-peer modeling likely fits under the same umbrella. While non-player characters seldom had an obvious impact on Project TECHNOLOGIA participants—save for a few outbursts of frustration over stubbornness—responses by some players appeared to affect the way in which others understood, interpreted, and interacted with the narrative. Those with minimal in-game participation were still capable of reading what others were doing (i.e., lurking) and provided an authentic audience outside of each team’s instructional leader. Additionally, the most active students could highlight their thought processes knowing that others might identify and adopt similar attitudes along the way. Given that roleplaying can convey information about what may or may not happen as a result of particular actions in particular contexts (e.g., parables, fables), lurking could provide even non-active learners with information about the narrative environment or real world that they could not or chose not to experience first-hand. Though this relies on a number of factors, including recipient attention, ability to reproduce the behavior, and motivation, the interaction between narrative, context, and recipient could have fostered vicarious reinforcement and the development of a legitimate peripheral learning environment (e.g., Lave and Wenger, 1991).

5. Nurturing Creativity

Creativity literature frequently describes two major components of creativity: novelty and task appropriateness (Guilford, 1950). The Four-C Model, in particular, explains how and why these components intersect to produce what are commonly considered “creative acts” (see Beghetto and Kaufman, 2007). Narrative production organizes thinking and behavior for—at the very least—mini-c and little-c creative acts and may be why narrative has persisted so long across evolutionary history. It has enabled humans to elaborate on particular thoughts and ideas such that others can understand complex and abstract concepts (i.e., teaching). In Project TECHNOLOGIA, mini-c and little-c creative acts regularly emerged as part of the co-active writing process. This included the introduction of novel, external goals as well as references to external, trans-media narratives. Furthermore, some participants actively sought opportunities to discuss how they could spur change in a deeply resistant educational system.

Imaginative, cross-context thinking could play a major role in limiting the perpetuation of test-oriented traditional direct instruction and lecture. As highlighted above, Project TECHNOLOGIA participants demonstrated content mastery by identifying and associating orthogonal concepts (e.g., film, personal stories) with what they experienced in-game. Utilized in conjunction with well-devised instructional guidance, this could lead to whole-group analysis of discrete social and cultural barriers associated with the planning of new educational technology initiatives. Direct instruction from a skilled teacher educator or administrator could theoretically draw attention to the same basic concepts, but co-action surrounding a shared, co-developed narrative appears to lay a fertile ground for student exploration, debate, and creativity over and above content—an extension of improved student agency and ownership over their learning. This is a very different framework from the “gamification” approach of implementing simplified behavioral approaches to learning as games in the classroom. As a result, it seems feasible that the development of better and more effective stories may significantly move learning scientists toward a deeper understanding of how particular types of narratives interact with particular students and instructional settings to yield optimal learning outcomes.

Conclusions

This study is a first step toward resolving the two questions posed at the beginning of this piece as well as Young et al.’s (2012) goal of identifying how and why particular players interact with particular games in particular ways under particular conditions. Further investigations should target the ways in which varied narrative formats (e.g., script, novel, game) influence motivation and achievement in addition to how particular storytelling mechanics (e.g., tone, character development) individually and collectively convey content, improve engagement, and pro-
mote goal adoption. Like a certain heroic plumber, we must act promptly but with enough caution to ensure we do not dismiss the castle of our betrothed in favor of another that merely plays host to a hostile turtle. That is the only path to conquering the field of game-based learning and, of course, living happily ever after.

References


Abstract: Foundational literacy skills are highly important to future academic success, as language skill gaps tend to increase with time. Affordances of table games for literacy in early childhood classrooms have not yet been adequately studied. The purpose of this study is to seek insights from early childhood educators about experiences with games in the classroom. Interviews were conducted with preschool through first grade teachers. This lead to the themes: Builds Good Social Skills, They Keep Repeating It and Its Not Boring, Intentional Teaching, They Think—Oh! It's Fun!, We Don't Get to Use Games Like We Used To, and All They Know of a Game is a Handheld Video Game. This study demonstrates importance of games in early child education and concerns to monitor. Exploratory qualitative research also provides feedback for developing and evaluating table game interventions with benefits for early childhood educators, curriculum developers, and table game enthusiasts.

Purpose and Research Question

There is a substantial existing body of research on games and education, however the majority of this research has been primarily focused on affordances of video games, especially in math or science, and targeted toward middle or high school students. These research findings may or may not extend to the unique needs and challenges of table games as literacy instruction tools for younger children. The purpose and central qualitative research question guiding this qualitative research is to explore affordances of table games as perceived by early childhood educators. The central qualitative research question guiding the qualitative exploratory phases is: "What are the perceptions about affordances of table games for early literacy education?" Specific issues that I planned to address included:

- What are attitudes and practices about games in early education classrooms?
- What are perceived benefits or challenges regarding games in the classroom?
- For what purposes are instructors using games (educational, social, recreational)?

Literature Review

Play

Play facilitates learning, stimulates imagination, provides opportunity for social interaction, and increases motivation through power or praise (Blanchard & Cheska, 1985; Csikszentmihalyi, 1990; Pellegrini, 1995). However, seductive details in games have potential to be distracting to learning if content and game mechanics are not closely integrated or players focus on doing well, rather than on educational content (Mayer et. al., 2001; Sweller, 1994).

Motivation

Motivated students are more likely to engage and persist at tasks and improve with increased effort and practice. Activities perceived as appropriately challenging and meaningful can lead to increased motivation, however activities viewed as boring or irrelevant lead to decreased motivation for elementary and college students (Pajares & Valiante, 2006). Research on competition is varied, some researchers stress negative impacts of academic competition (Deci et. al., 1999; Vallerand et. al., 1986) while other researchers view it in a more positive light (Burguillo, 2010). Specific implications of this research for preschool age children may need to be considered more fully.

Development

Children in preschool and early grade school, when awareness of written language begins to develop, often learn best by experiencing, playing, and actively engaging in tasks. They may have difficulty understanding complex logical rules or distinguishing other people’s symbolic viewpoints, concepts requiring abstract thought (Müller et. al., 2009). Social interaction and cooperation are also essential to development of cognition (Vygotsky, 1986). Clear and simple rules may help children in preschool or early grade school who are still developing social skills to understand acceptable social interaction (AAP, 2004).
Literacy Skills

People need to learn essential early literacy skills such as print awareness, alphabetic principle, grapheme relationships, phonics, blending, segmentation, rhyming, and vocabulary in order to read, comprehend text, and write successfully. Practice decoding words phonetically and increased vocabulary knowledge both increase word recognition and improve reading fluency (ALA, 2004). Word games allowing children to manipulate letters and sounds in words, or games focusing on rhyming and word families could teach or give children opportunity to practice decoding, spelling, and phonetic skills and learn new vocabulary words especially if targeted to the specific student abilities.

Qualitative Data Collection and Analysis Methods

My overall philosophical worldview is pragmatic, however I view qualitative research through a social constructivist paradigm (Denzin & Lincoln, 2011). Methodology for conducting this case study was influenced by the work of Creswell (2013) and Stake (1995). Participants were selected using an opportunistic, typical case, purposeful sampling approach, primarily due to convenience and gatekeeper access. To increase variation, participants from multiple institutions were approached. Participants included three preschool instructors, two child development administrators, four kindergarten teachers, four first grade instructors, and one public elementary school administrator. Participants were asked:

- What is your general opinion about games in elementary classrooms?
- Are there benefits you’ve experienced or anticipate with games in the classroom?
- Are there concerns you’ve experienced or anticipate with games in the classroom?
- What are your thoughts about games to teach or promote early literacy skills?
- What are your thoughts specifically about board or table games in elementary classrooms?
- Have games impacted your work or teaching?

There is a wide selection of literature that details qualitative research in general. I have found Creswell’s text on the subject to be particularly useful in thinking about how to qualitative research in an overall sense (Creswell, 2013). Researcher positioning and interpretations are critical, but a richer and more genuine picture can often be found when high priority is placed on framing the views, experience, and story as much as possible from the words or of the participants themselves. With this philosophy in mind I tried to use in vivo codes and themes, taken from participant quotes where applicable. Interviews were recorded, transcribed, coded with lean codes at the paragraph or sentence level, and then refined into cluster themes using in-vivo language. Validation strategies included peer review of codes to establish inter-rater reliability, member checking of themes and subthemes, and planned triangulation of data through planned future research including interviews, observations, and game play testing.

Vignettes

Location One

Soft music played in the background as young child-care staff encouraged children to nap, or at least play quietly. Classrooms in the facility were separated into cubicle rooms based upon age ranges. Most children were sleeping, but several infants and toddlers were awake and fussy. Although the facility had been in its new current location for a few months, it seemed that staff and administration were still in a process of getting settled into new settings and routines. Children in the facility were from diverse ethnic backgrounds, many of the children in the facility came from lower to middle SES families.

Location Two

This research was focused on the older classroom at the development center with children ages three to five years. The center also has a younger classroom with children a year-and-a-half to three years. Children’s drawing lined the walls under painted slogans including “we are artists and scientists” and “we value learning”. The central lobby and hallway included a puppet theater and nook with blocks, puzzles and toys. Laughter could be heard from children playing outside. Children in the facility come from diverse ethnic backgrounds, many of the children in
the facility are from middle to lower-upper SES background, where parents and families tend to be highly involved with the facility.

**Location Three**

Each grade in this public school is arranged into a pod or cluster of individual classrooms with a shared central space with tables and resources. Kindergarten and first grade teachers met at tables in the shared cluster space during their brief planning period while their students were involved in specials activities. Although the teachers were friendly and seemed glad to participate, there was an underlying sense of stress from too much to be done and too little precious planning and regrouping time. Some participants joined and left the group conversation as they needed to address other pressing class preparation concerns. Children from the school came from diverse ethnic backgrounds, many from lower to middle SES families.

There is a wide range of variability in the ages and rates for childhood social and literacy development. A few bright and gifted children are early fluent readers in preschool, while some children still struggle with early literacy concepts in first grade or beyond. Even looking at individual children, there is often rapid growth and changes in these areas during the age span from preschool to first grade. For future quantitative research it would likely be better to look at the impact of table games in a more tightly defined and narrowed context in terms of social context and age range. For the purposes of this qualitative study I wanted to look more broadly in terms of age and educational settings in order to gain a wider picture encompassing a larger spectrum of potential early literacy development emergence. Three substantially different locations, three different grade levels. What insights can be gained about uses, benefits, and concerns for games, or ways that games can be better tailored to support curriculum needs and schedules?

**Themes and Subthemes**

**Builds Good Social Skills**

Subthemes included “You Can Be a Good Sport”, “It Turns into a Game of Calvin Ball”, and “Fun Way to Connect With Families”. Participants viewed games as a way to teach and reinforce good social skills including following rules, sharing, taking turns, cooperating and interacting as part of a learning community, being a good winner and loser, and viewing losses and mistakes as opportunities for learning and improving. Without teacher intervention children have trouble taking turns and following rules, which can lead to bossiness, controlling, or fighting. Several teachers expressed concern with hurt feelings in competitive games and preferred to emphasize cooperation. Other participants were more positive toward competition. Most expressed strong nostalgia for board games with their families, and saw benefits in families playing table games together and for getting to know others.

“If they know they rules of the game then it works okay. Sometimes you do find with little kindergartners if you’re trying to have them play games individually in a group with no teachers there they have a tendency to try to make up their own rules. It turns into a game of Calvin Ball.”

“I think there’s also power in even if you don’t win you can be a good sport. I think that’s another lesson that is really powerful. Letting somebody else win... how are you going to win? How are you going to lose? How are you going to handle it? So I think games can be a nice learning experience for social behaviors.”

“If we could have a game night for families for family engagement. I think would be a fun way to connect with families. My grandparents played cards. Played bridge and pitch. It’s kind of a lost activity. You don’t see it that much anymore.”

**They Keep Repeating It and its Not Boring**

Subthemes included “Exposure and Practice to Literacy Skills” and “Act It Out”. Participants viewed games as a way to give multiple opportunities for review, repetition, and practice to build recognition for letters and words. Active involvement in games and hands-on activities was viewed as beneficial for increasing motivation and engagement. Some participants expressed a high degree of physical activity with games and activities, and mentioned that games can increase gross and fine motor skills, though some preschool teachers expressed concerns with losing small pieces or choking hazard.
“We know that children learn best through repetition and so that board game of handing different kinds of pieces, whether it be cards or manipulatives, that they handle several throughout game gives them multiple opportunities to practice their understanding. So whether it be I drew an A card now I have to find the A on the board so there’s two times that they’re connecting to the letter A so that gives the repetition of practice over a short time to kind of build that schematic way of letter recognition.”

“I think it gets the kids reasonably excited to play and that helps them learn. Sitting down as reading books sometimes they don’t seem as interested...as they would by playing a game especially board games where they can actually interact with it.”

“We do matching games, flip letters over two at a time...jump on the letters, make letters out of the kids.”

Intentional Teaching

Subthemes included “You Are Going to Need to Individualize”, “It is Facilitated by the Teacher”, “Geared Toward Educational Merit”, and “Thinking is Definitely a Part of Games”. Participants focused on developmentally appropriate practice and suggested games are more effective when targeted toward the skill levels of individual children. Problems can arise when playing games with children with high differences in skill level. Many of the participants spoke about modifying commercially available games to meet educational needs or to work to tie in games with curriculum. Young children may struggle with game rules and interaction and the teacher facilitation is important for the games to go smoothly. Facilitation can also occur with peer learning groups. Participants viewed games as beneficial as long as they support and reinforce learning objectives. Especially in first grade, the teachers expressed that there is not a time or place for games in the classroom unless they align to the curriculum. A few of the participants mentioned that games cause players to think more deeply and solve problems and saw a major benefit of games that they can stimulate creative thinking and deductive reasoning.

“Every single child you are going to need to individualize for that child. I think today’s classroom, especially with integration of inclusion strategies in that now you have an inclusive classroom and so you have children at all different levels or abilities and you want to include children with disabilities in these social playtimes and so you’re going to have to think about how do I include...”

“Sometimes you need to watch when you have board games if they’re really going to be learning from them...You have to watch the ones that you purchase that have been made as to whether or not they’re really going to engage the kids and help them learn anything. I wouldn’t really want to put games in here that are just busy time”.

“Maybe a strategy, maybe deductive reasoning, even a math skill. I think if the games are aligned to objectives they can be very powerful and its just strategically thinking about how to use those games.”

They Think—Oh! It’s Fun!

Subthemes included “Positive Outlook of a Game”, “Not a ‘Game Game’”, and “They Don’t Realize How Much Learning”. Although several of the teachers mentioned modifying existing commercial games, at all levels teachers spoke more about playing game-like or hands-on activities than longer or more formal board games or games with a winner or loser. Several participants discussed the notion that with games children are having fun and learning without it seeming like a learning activity, allowing teachers to sneak learning in undetected under the children’s radar. Children were described as being more engaged when they perceived activities to be games rather than work.

“I think too that positive outlook of a game. We’re going to play game! You see every child smile once you say that. So if you can connect that social emotional feeling of we’re going to play a game with literacy I can see how much positive attitudes would change with literacy.”

“The games that I would use would be phonics games, maybe compound words those kinds of things and they’re maybe more puzzlish or a set of sequence cards and they put them together and tell me the story using words certain like first, then, next, and finally.”

“I use them as much as I can because just because kids like games. Anything you can turn
into a game is fun. Sometimes it can be a worksheet and you can turn it into a game. Sometimes it’s just their perception and they think it’s a game. They’re like “we’re going to play a game!” and...here’s a worksheet.

We Don’t Get to Use Games Like We Used To

Subthemes included “We Get So Busy” and “I Can Put it in the Workstations”. Teachers have a lot of demands and expectations. Sometimes trying to meet curriculum, administrative, and schedule constraints leaves little time for playing games. This seemed to be especially true for the first grade teachers. Preschool teachers reported playing games frequently, as did kindergarten teachers, though in a more structured way. Although they were generally positive toward benefits of games, many of the first grade teachers expressed that there was not much time and support for playing games as they were perceived to take away from time for lessons and instruction. Although time for playing games was limited in some cases, especially in first grade, teachers specifically emphasized incorporating games into workstations and learning centers.

“I play games too more at beginning at the year. When I was a kindergarten teacher we played games all year but...we don’t get to use games like we used to. Especially in math... We used to be able to do a lot of games more in math but we just don’t anymore..."

“Other than at their workstations there is really not a time. We don’t ever have a time that we can just play a game. There’s just a lot that we have to do. So we make it our own way to make games with workstations.”

“I think that would be fine as long as the focus is on literacy and during workstations. If you wanted to come during workstations and play with them I would be fine with that! That’s really the only time. Its an hour and 20 minutes of the day. If they’re not in reading groups they’re in workstations. If you hung out at one station and taught the game and people rotated to you that would be so great! They would love that!”

All They Know of a Game is a Handheld Video Game

Some of the teachers did not think kids were playing table games at home, but many mentioned children playing games on electronic devices both at home and school. Several teachers mentioned good apps and learning programs available and many of the teachers were currently incorporating computer games into learning in addition to other forms of games and fun activities.

“I think it is easier for parent to just say go sit at the video game rather than get out the Monopoly game. Now if you’re going to play a game we’re going to get out the computer or iPad and we’re going to play a game on there. It’s not like they’re not playing games, but I don’t even think they own a board game.”

“There games that are on the computers that the kids do... technology wise...

Everyday at least one kid goes on the computer to the Wonders website which goes along with our new curriculum and they have all kinds of phonics games. They have to sort, grammar, they are fixing sentences by themselves.”

Discussion

Games have the potential for many valuable experiences and benefits, including but not limited to tools for academic skills. Teacher participants, especially for preschool age, used games to teach and reinforce social skills and learning objectives. Often games used in classrooms could be classified more as activities than formal games, but teachers viewed the hands-on nature of games as a factor for increasing engagement and motivation. Children enjoy activities when they perceive they are playing a game and find the activity to be fun, and repetition of key concepts aids learning. However, since children have dramatically varied social and academic skills, the role of teacher as facilitator of games and to make sure that games reinforce learning objectives is critical. Participants viewed games as a good way for individuals and families to connect, but many participants did not think families were currently playing board games much at home, though they are often playing video games or apps. Participants saw benefits for both board games and electronic games to reinforce learning. Especially in first grade, however, constraints of time and curriculum do not allow much room for playing games. Instructors often tried to
include game-like activities as part of their workstations.

Findings from interviews fit closely with both existing research on literacy and play, as well as matching predictions based on personal experiences and observations. As expected, participants’ views on competition was mixed. Interestingly, participants in administrative roles seemed more supportive overall of competition than participants with classroom instructor roles. Also as expected taking turns, and following directions were listed as potential problems, but games were seen as a way to improve and reinforce these social skills. Although unsurprising, I found it discouraging that as children entered first grade games and play were modes of instruction that were supported less in schedules by schools. I suspect that this view of games and play in classrooms, unfortunately, continues to trend increasingly less open toward games in older grade classrooms.

**Limitations**

One limitation to the study involved variation in interview methods. Most participants were interviewed in a one-on-one setting, however in order to accommodate the schedules of some participants, it was necessary for some interviews to take place in a focus group setting. Another limitation to the study involved the interview population. All participants in this study were Caucasian and female. It would be useful in future work to include interviews from more participants, especially to include observations from teachers who are male or from different ethnic backgrounds.

**Future Research Plans**

The next phase of qualitative research involves additional qualitative case study interviewing members of the game community who are involved with table games for classroom, library, or home learning purposes about experiences and views on affordances of board games for literacy instruction. I also plan field observation research in preschool through first grade classrooms involved with pilot play-testing existing literacy games. Observations will focus on qualitative themes and codes, motivation, competition, luck, social or emotional factors, and issues of seductive details or cognitive load involved in game play. These will be used as part of an exploratory sequential mixed methods framework to design a board game intervention (see figure 1). Instruments and interventions developed based on qualitative findings will be pilot tested on a small scale to evaluate instrument and intervention reliability and validity before conducting quantitative experiment on a larger scale with more participants. This study gives the benefits of allowing the voices and experiences of teachers of preschool, kindergarten, and first grade students regarding games and literacy to be heard, and is one step toward looking at games as a tool to support early literacy instruction.

**Figure 1: Exploratory Sequential Mixed Methods Framework**

**References**


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Walking and Talking as a Group: Interactional Practices for Playing an Augmented Reality game on a Mobile Digital Device

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Abstract: To better understand the use of mobile digital technology for place-based language learning, and more generally as a factor in human interaction, this paper describes the methods used by small groups to accomplish quest-type tasks in an augmented reality (AR) game. The ARIS game (arisgames.org) was available on mobile devices (iPhones) and played outside the classroom. Video-recordings of each group were made using two head-mounted cameras and one hand-held camera. Analysis focused on the groups’ orientation to the device as they accomplished game activity. Results show that the device and the holder of the device were frequently oriented to for instruction and leadership via verbal and non-verbal communication. We outline communicative practices used by the groups, how participants made information from the game publicly available to one another, and how they interfaced cartographic resources and the physical environment in way finding activity.

Introduction

This paper describes the design and pedagogical implementation of an augmented reality (AR) language learning game designed in ARIS (arisgames.org). AR games leverage GPS-enabled mobile media (e.g., Apple iPhone) to engage players in spatially enacted narratives and informational and interpretive quests that are arrayed across physical places, with the goal of interfacing language learning affordances with embodied experience in the world. Such use of mobile technologies has made relevant research on talk-in-interaction while moving (Haddington, Mondada, & Nevile, 2013; McIlvenny, P., Broth, M., & Haddington, 2014) and the orientation to mobile devices in such interactions (Brown, McGregor, & Laurier, 2013). Our primary interest is to better understand how players of an AR game manage the interface of the virtual and the physical through talk-in-interaction. Focusing particularly on serial quests as a design element of the AR game in question, this research investigates how participants engage vocally, visually, and haptically in order to coordinate spatial movement.

Since the advent of the iPhone in 2007, way finding with smartphones has become a high frequency life activity that includes visual perception of the physical and built environment, digital cartographic resources, and communication with co-present parties. In the research reported here, we focus on way finding activities by small groups of English language learners playing an AR game that involves a series of game-like quests. The student-players are asked to find five designated locations in which green technology is used. Participants file a video report of each example they see (Thorne, 2013). This setting allows us to analyze and uncover participants’ sense-making practices as they situate, and enact through talk-in-interaction, the mobile device’s two-dimensional map representation in the broader context of the multi-dimensional, sensory-rich physical world.

Review of research

Although researchers of social interaction have studied the situated relevancy of objects during interaction (Knorr Cetina, 1997; Goodwin, 1994; Nevile et al 2014), there are few studies of the organization of people’s talk-in-interaction around mobile devices as they walk, a common practice for groups using smart phones (hereafter ‘device’ or ‘mobile device’) for information gathering or way finding. De Stefani and Mondada (2007) studied how movement influences the organization of talk. Movement was seen as relevant in that the immediate physical context for talk changes because of the co-participants’ mobility, and talk being sequential, participants must orient its sequentiality to changes in physical surroundings. In a recent edited volume (Haddington, Mondada, & Nevile, 2013), De Stefani addressed moving while interacting in supermarkets and illustrated that co-participants often come to a stop in order to introduce next actions. Broth & Lindström (2013) describe how walking results in a changing contextualization for talk: “places materialize as meaningful ‘places in sequence’ in and through the embodied mobile interaction of a group” (p. 91).

Research on interaction around the use of mobile phones includes a number of studies focused on the sequential structure of talk as well as on how the portability of these devices influences the interactions of those in the vicinity of the device (Arminen & Leinonen, 2006; Arminen & Weilenmann, 2009; Licoppe, 2009). Of these studies, only
Licoppe focused on the way participants connected virtual location on the device to the physical location of the device holder. Most closely related to the focus of our current study is the research by Brown and colleagues (Brown & Laurier, 2005; Brown, McGregor, & Laurier, 2013). These are a series of empirical studies of meditational tools for way finding used by small groups. In Brown et al 2013, video recordings were made and screen captures were collected of participants visiting various places in a city (Stockholm) on a ‘typical day’. Their analysis showed that participants used the devices in order to be informed about locations and for way finding.

For the research reported here, we had similar questions to those posed in Haddington et al 2013: “how does mobility impact social interaction…how do people interact as they attend and respond to the passing environment” (pp. 3-4). Although there are numerous meditational affordances available for our participants who are exploring green technology and sustainability projects on a university campus, for this paper we focus on the interactional practices used by participants to orient to the device and device holder in order to facilitate the movement of the group toward the accomplishment of their activity.

‘Serious games’ and mobile devices

Developments in contemporary digital learning have recently come to include ‘serious’ games, which involve the use of computer and mobile devices for game-like activities with an explicit educational focus.

The particular focus of this research is the empirical examination of English language learners engaged in playing an augmented reality (AR) place-based mobile game which presents scenarios and prompts that encourage participants to expand beyond the traditional subject positions associated with that of ‘student’ or ‘learner’ (Firth & Wagner, 1997). AR games are a more recent entry into the arena of educationally oriented game development, but similar to commercial recreational games that have been studied as learning environments (Gee, 2007; Thorne, 2012; Thorne & Fischer, 2012; Thorne, Fischer, & Lu, 2012), AR games represent a shift away from models of learning based on information delivery and toward theories of human development rooted in experiential and situated problem solving. As Squire describes:

> Although mobile media learning has mostly been framed as “anytime, anywhere” their more profound impact may be in the experience of place. Mobile media enables a multiplicity and hybridity of place that causes opportunities and challenges to learning and education. (2009, p.70)

Designing AR games to highlight and more fully understand and appreciate specific places is a growing phenomenon, with numerous projects that include scientific themes (e.g., metallurgy), urban studies, architecture, and history (for examples, see http://arisgames.org/). AR games are rapidly appearing in museums, community-based education projects, and in formal educational settings. Existing AR games (e.g., Holden & Sykes, 2011; Squire, 2009; Thorne, 2013) and accompanying mobile resources for learning share certain objectives, such as to increase engagement in the language learning process by moving students and language learning experiences out of the classroom and into the world and to provide in situ, contextually-relevant prompts for communication and language use for the topical activity at hand.

A prosocial AR game recently developed at Portland State University by an on-campus group (The 503 Design Collective: a team of students and faculty), which takes the university’s emphasis on green technology and sustainability as its core focus, is called ChronoOps (standing for ‘chronological operations’). The conceit of the game is that students play the role of an agent from the future (the year 2070). The game narrative is that in the year 2070, the planet has suffered massive environmental degradation and the player-agent has been sent back in time to the year 2015 (as of this writing) in order to learn from the “simultaneous dawn and dusk of green technology” that is in evidence on and around the university campus located in Portland, Oregon. When players enter certain physical locations, they receive video, audio, or text information and/or directions in one of numerous languages (currently English for ESL students, French, Japanese, Russian, or Spanish). Players are given tasks that result in visits to the electric avenue (a location where electric cars can be recharged), a large solar array producing electricity for the city, local public community gardens, recycling projects, and environmentally designed “green structures” on campus. En route, players are prompted, in their role as agents tasked with investigating sustainability projects that could yet save the future of the planet, to record verbal narratives of what they observe using the target language. At various points, they are also asked to make text notes, shoot video, and take photographs, all of which are later used in language-learning assignments such as the production of written reports and oral presentations. Participants are asked to play in small teams of three and group interaction while playing the game involves various types of task- and way finding-related communication.
This research analyzes the interactions of two small groups as they play the *ChronoOps* AR game. A distinctive feature of the context for our study is that only one participant in a group of three was carrying a mobile device. This created a dynamic in which the group would orient toward a single device, prompting the need to communicate information to one another.

**Data collection**

Participants were eight groups intermediate-level students of English as a second language (twenty-four students total) at the university where the research took place. At the start of the data collection, students downloaded the app to access the game. The teachers had the students work in groups of three (one phone per group) to find examples of green technology in the area.

Intensive video recording (approximately twelve hours of video total) was made of the interactions and the recordings were transcribed. Two members of each group wore head mounted cameras that captured an approximately 170 degree visual field in the direction they faced (Figure 1).

**Figure 1: Three views from a head-mounted camera**

These cameras captured audio of the camera wearer and the group. A third member of the group wore a wireless microphone that fed audio to a third, hand-held camera operated by a member of the research team (figure 2).

**Figure 2: Hand-held camera view**

(The head-mounted cameras can be seen in the students on the right and left)

Additionally, the students used their group’s mobile device to record video reports from each of the green technology sites, which were uploaded and available to the teacher and students after the class.

**Analysis methods**

For this paper, data analysis procedures were influenced by conversation analysis (CA) (Goodwin & Heritage, 1990) and linguistic anthropology (Goodwin, 1994, 2000). The authors were camera operators during the data collection and participant observers. The instructors of the classes in which our participants are enrolled are part of our research team and we are familiar with the curricula and other contexts of the courses in which the AR game was used.

Although our analysis used close CA transcriptions of the talk-in-interaction, the visual record of the interaction available via multiple camera views was imperative for understanding the role of the physical environment and interaction via mobile devices. Group data analysis sessions were conducted and the transcriptions include embedded images of the participants’ gaze, gesture, direction of movement, interaction with objects, and the digital and physical environments to illustrate how these resources interact with the talk-in-interaction (Goodwin, 2000; Mondada, 2008). Although we conducted sequential analysis of the talk, the use of multiple video recordings and our research questions required multimodal analysis allowing us to foreground and describe sequences of actions as much as turns of talk (Ford et al 2013), where actions are designed as “complex multimodal gestalts” (Mondada, 2014, p. 139).

The availability of one phone per group required that small groups work together to accomplish the game activities. They moved around the university campus as a coherent group of ‘mobile withs’ (Jensen, 2010, based on Goffman, 1971). As was expected, the investigation showed that the mobile device played an important role in the way the groups managed their interaction (Brown et al 2013) and progressed toward completion of the game, with two
primary orientations in evidence: 1) explicit orientation to and staying near the device holder, and 2) group members physically orienting to the device itself (a richer description of this interactional work is given in Hellermann, Thorne, & Jones, in preparation).

Situating work: explicit orientation to staying near the device-holder

The first excerpt illustrates the importance of the device-holder in organizing the physical location of the members. The participants of this group are Max, Prius, and Trek. As they move toward their first destination, Max is holding the device as the three participants walk three abreast down a sidewalk in a park. At the start of the excerpt, Max slowly comes to a stop (line 11). Trek observes something to her right and points to it. Prius mimics the gesture and utters a change of state token (balloon caption) in overlap with a try marked proposal for a place or direction from Trek (balloon caption). The gestures become indicative of a next place or direction and Trek and Prius walk in that direction until Prius turns his head (image just before line 19) to see that Max, the holder of the phone, had stopped. Prius shifts the direction he was walking to move back to Max. Trek notices and follows suit. It is then that Max notices the two had moved away from him and utters a reprimand in the form of a question (lines 19 and 22).

The orientation to maintaining physical proximity to the device is seen in (1). When two group members move away from the one group member who has stopped walking (the holder of the device), it is one of the two strays (Prius), not the device holder, who first orients to the device holder’s lack of movement and his separation and begins moving back to the device holder (Max). The device holder orients to this separation and makes a joking reprimand. Here, a provisional direction to the next destination had been selected (nonverbally) by two members who moved in that direction. That destination, however, appeared to be subject to verification by the device holder.
as Prius and Trek changed their course and re-configured around Max as Trek suggested that the direction she initiated was not a correct one (line 23).

The excerpt shows group members’ accountability for straying from the device holder. Although we have seen examples in which it is the device holder who makes a directive to the group (‘hey, come back here’), in the excerpt we present it is the observation of one of the strays that redirects the two straying members back toward the device holder. The reprimand by the device holder and a negative assessment by one of the strays as to their chosen direction show straying to be an accountable action.

**Participants looking at, doing looking at, or directing others to look at the phone**

Other than orienting closely to the physical location and instructions from the phone holders for purposes of finding their next location, participants also display an orientation to the device itself, even when they are not holding the phone. This orientation involves one or more of the group members standing in close proximity and directing their gaze towards the device. This is seen most often in the group members' persistent orientation to attending closely to the device as a guide for the group's movement. The following excerpts show how the device serves to create a focal point for their coordinated attention (Goffman, 1981; Goodwin, 1981) to the collective task as a ‘team’ (Goffman, 1959). The group members display this orientation non verbally and verbally.

Excerpt 2 (below) shows that members of a collectivity may not be visually attending to the degree expected but do attending nevertheless as part of maintaining the public sense of a group. The members of this group are Rec (device holder), Red, and Reu. As Rec reads from the phone (line 1) and self-initiates repair (line 2), Red’s gaze is toward the phone. However, given the difficulty of seeing even very sharp images on a mobile phone screen in daylight, it is unlikely that he can see the text on the screen well enough to read it. Upon hearing the information-seeking first pair part in line 2, Red initiates repair (line 3, asking for a repeat of what was said) and then repositions himself in order to be able to read the screen and provide an informed response to Rec’s information-seeking first pair part.

```
[ESL131006SGT1G2RC1 25:34-25:44]
01 Rec: “rain water can be used.”
02 what is    >the rain< water?
03 Red: I’m sorry?
04 Red: “the toilets in the: ‘academic’-“
```

Excerpt 2 shows that before the device holder (Rec) displays trouble in the interpretation of the instructions on the device, Red displays a posture that indicates his alignment with the group and engagement with the device. Positioned facing Rec, Red also bends his head so that his gaze is toward the device. When text is read from the device that makes repair relevant, we see Red shift his posture and gaze to be able to use the device to help with the repair.
Discussion and Conclusion

As a first step to understanding this particular AR game context for language pedagogy, our analysis focused on the ways in which participants orient to mobile devices to accomplish their activity. In this paper, we have illustrated how walking, pointing, gesture, and gaze are used by participants to display and maintain an orientation to the device holder. These practices occurred when two participants strayed from the device holder and when the device holder was reading text from the device.

It is not surprising that the participants oriented to the mobile device as an important focal point and mediating tool for the activity. However, we found the interaction around the device to be even richer than we expected. From the perspective of language pedagogy, this investigation shows how an object can become a mediating and catalyzing device for language use and learning; in essence, that a quotidian activity such as way finding can result in complex instances of interaction. Moving into and out of group configurations involved a continuing process of interpreting what was visible on the device with what they saw and knew to be around them. The process of moving from place to place provided the group with a situated context for communication in the service of collective problem solving and decision making. The excerpts from the analysis highlight how the device is a catalyst for situated, embodied, and co-constructed talk-in-interaction.

The pedagogically-motivated decision to have the activity be carried out by small groups using one device per group had the effect of getting all group members to share an orientation to the device and, thus, the device holder. Our ongoing analysis is showing that in using the device, the most common orientations of the group members were (a) to the groups' current location, (b) to the next destination on the google map, and (c) the text instructions displayed by the game interface on the device. The use of one device per group also meant that participants in each group periodically moved in and out of a clustered fforma (Kendon, 1990). This was initiated by the need to re-orient to the device's indication of their location on its map. This clustering was also reflexive in that when all participants looked at the device, re-orientation was made relevant due to each member's need to coordinate and affirm their physical and 2-D cartographic location. The relatively under-specified nature of the AR map feature, however, facilitated a more consistent outward focus for the groups. In this outward focus we saw how ‘objective’ physical objects (a building, a bicycle parking area, a streetcar) are contextually re-realized by the group. Via the tasks outlined by the AR activities and negotiated among the group, objects in the environment are talked about and semiotically remediated (e.g., Prior & Hengst, 2010) within the narrative frame of environmental stewardship. Visible processes and sequential alignments included the coordination involved in making public and locally-relevant the private logic of the AR game’s map. Through this process, problems in understanding as well as next actions are made public via talk-in-interaction, which served to coordinate the virtual-digital and sensory-visual information and which eventually led to successfully completing the way finding and green technology narration activities.

Although the device holder is clearly oriented to as a focal point more than other members of the group and may sometimes have special privileges (and responsibilities) by the fact that she/he is holding the device, the device was accessible to all group members. At various points, they looked at the device while the owner held it and they occasionally grabbed the device themselves for better access.

There is not space in this report to discuss the intricacies of the groups’ formation as they stopped and re-started movement (Hellermann, Thorne, & Jones, in preparation). However, it is important to mention the fact that the activity demanded that participants walk to a series of destinations which made movement an important contextual feature of the talk-in-interaction. While stopped, group members had more shared access to information on the device. The momentary suspension of the sequential presentation of the immediate physical environment also allowed time for group members to interpret, assess, and make suggestions about strategies for accomplishing the activity.

References


A Novel Interactive Paradigm for Teaching Quantum Mechanics

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Abstract: Quantum Mechanics (QM) is the foundation for science and engineering disciplines as diverse as physics, materials science, chemistry, and nanotechnology. However, educators face major challenges in teaching QM concepts to students given the abstract and non-experiential nature of QM. To address the above challenges we are creating and evaluating a virtual environment governed by the laws of quantum mechanics as a way to engage alternative ways of teaching and learning QM.

In our current prototype, students begin in a classical world that is governed by laws found in our everyday experiences. Here, they encounter potential and kinetic energies, the conservation of energy, the predictability of position, and the continuous nature of energies allowed. They later move into a nanoscale environment in which energies are quantized, electrons can tunnel through potential barriers, and only probabilities are known. The juxtaposition of these two worlds enables students to compare classical and quantum mechanics.

Introduction

Quantum Mechanics (QM) is the foundation of diverse science and engineering disciplines such as semiconductor physics, materials science, and nanotechnology. However, people almost unanimously agree that QM is extremely challenging to learn—especially for newcomers into the field. Students may spend several classes learning mathematical formulas that represent the behavior of particles in the QM world, but they may not form a clear intuitive understanding of these concepts. This is because, unlike classical mechanics, we do not have a first hand experience of QM phenomena. In fact, the laws of QM completely contradict our everyday experiences. As the famed physicist von Neumann declared, the only way to grasp the abstract concepts of QM is to “get used to them”.

Learning QM is very different from learning classical physics. In classical mechanics, students are able to make connections between the formulas they learn in class and the real-world phenomena they experience in their everyday lives. QM, on the other hand, directly contradicts students’ experiences in the real world and has no real world correlations. The only way to master QM concepts and become comfortable with them is to work in this area long enough to become accustomed to the counterintuitive behaviors of particles at the atomistic scales.

Can we foster experience-based learning of QM through interactive games and if so how? Can games be used along with a classroom environment to teach both theoretical and experiential aspects of QM? Research has confirmed the power of games as learning environments (Squire, 2011; Gee, 2007; Prensky, 2003) while cognitive science and other contemporary learning theories all highlight the importance of creating experiential and active learning opportunities to enhance students engagement and retention.

Over the past two years, our team consisting of faculty, graduate students, and undergraduate students from various disciplines such as Computer Science, Digital Media, Electrical Engineering, Human Computer Interaction, and Physics have collaborated to work on the design, development and evaluation of a game prototype. In this paper we outline the design and evaluation of an educational video game, Particle-in-a-Box, with the aim of providing students with a unique learning environment to facilitate experiential understanding of QM concepts. We describe the design of the game and discuss ongoing research methodologies for evaluating the effectiveness of the game both inside and outside of classroom.

Background

There have been several studies, which explore the effectiveness of games as teaching tools. Games constitute rich virtual worlds, which can provide multiple contexts for learners to understand abstract concepts of theoretical subjects and provide connections between these abstract ideas and their applications (Shaffer, 2005). Complex tasks can be presented as small core experiences in these game worlds, which can later be extended into longer, more complex sequences. This makes it easier to break down complex concepts and gradually increase their
complexity through concurrent chaining (Mayo, 2009). Theory and practical knowledge should provide feedback
to each other continually and as such, games and simulations help achieve the goal of reconciling theory, research
and practice (Rieber, 1996).

As a starting point, we studied existing video games and visualizations in and outside the field of QM to see wheth-
er and how they address the problems noted above. Several games exist which explore aspects of QM such as
Quantum Tic-Tac-Toe and Quantum Minigolf (Goff, 2006; Reinhard, 2007). These games have been designed to
show a single quantum phenomenon (superposition and propagation respectively). Moreover, these games are
designed on topics of QM that do not directly pertain to the basic concepts in undergraduate quantum physics.
Quantum Minecraft (qCraft) is a game mod that intends to introduce the concepts of QM through the world of Mine-
craft, a popular game that evokes creativity by breaking and placing blocks. However, the QM concepts introduced
in qCraft are the ones that are often referred to in science fiction (e.g. quantum entanglement and teleportation)
and are not relevant to STEM education except the narrow area of quantum computing (Google, 2013). We also
looked at a series of visualizations, called Visual Quantum Mechanics. This is a collection of Mathematica-gen-
erated online videos that show QM phenomena. These visualizations, however, are more similar to common
simulation tools used by experts and may not be quite effective in engaging newcomers in the field as they are
mathematically complex and do not utilize real-world metaphors.

Methodology

Game Design

We designed the game to focus on the particle-in-a-box problem, also known as the Infinite Potential Well Prob-
lem. The particle-in-a-box problem is commonly used as a thought experiment to simplify some of the concepts of
quantum mechanics such as the Schrödinger equation and for comparing concepts between classical and quan-
tum mechanics. It is typically shown as a standing wave within a one-dimensional box with infinitely high walls,
while in classical mechanics it is merely depicted as a physical ball inside the same box.

In our game, appropriately titled “Particle in a Box”, we portray both the classical and quantum modes in separate
virtual worlds, grounding the elements in the classical world in common, and identifiable objects such as a bowling
ball to represent the particle. In contrast, we use abstract shapes and representations in the quantum world -- a
plasma sphere to represent the electron for example. These representations are chosen to show a sense of scale
for the bowling ball and a sense of fantasy for the electron. We designed two very distinct environments that allow
students to contrast the properties in classical physics with those of quantum mechanics.

Classical World

We designed a level, which follows laws of classical physics to provide a comparison point for the quantum levels
succeeding it. The player guides a small avatar, nicknamed “The Dude”, by using the arrow keys along a linear
path in a 2D perspective. The overarching goal for each level is to collect all of the collectibles in the level and
bring them to a portal while avoiding a moving obstacle in the path. The obstacle in the classical world is a bowling
ball, and it can reach certain areas of the stage only when it reaches certain amounts of energy. The collectibles
are represented by heavy weights, which were chosen because the physical qualities of weights can represent
energy and the weights can have variations in length, which correspond to an increase in the player’s probability of
getting hit. We wanted a way for the player to manipulate the energy of the particle in the classical and QM worlds,
and picked a common video game mechanic of item collection to make it easy to understand. The act of picking
up a collectible increases the total energy of the bowling ball, making it move faster and making The Dude more
susceptible to getting hit by the ball.
Several design considerations went into the placement decisions for the energy graphs depicting the potential, kinetic, and total energy of the bowling ball. In early game mockups, we showed these energy graphs in a separate popup window, but later found it to be too obtrusive and not immediately relatable to the ball's movement. We soon incorporated the graphs into the world itself, having it span the length of the stage to match up with the ups and downs of the stage itself. During initial pilot tests, we observed that participants incorrectly assumed that The Dude could interact with the graphs because of the visual qualities of the graphs. Finally, we settled on making the graphs visually distinct from the game but still stretch the full length of the screen for clarity (see Figure 1).

**Quantum World**

The design of the Quantum world mirrors that of the classical world, but with key differences to highlight the contrast between the two worlds. The visual design transitions to a darker color scheme with a fantasy mood to indicate its departure from everyday reality. The obstacle is now a plasma sphere representing an electron, whose position is unknown to the game player until a 'measurement' is made. Depending on the energy state of the electron, the probability of the electron appearing anywhere on the flat, one-dimensional stage will vary. Every few seconds a measurement is taken, revealing the position that the electron takes on during that particular moment in time. This makes the gameplay unpredictable and random. The collectibles are now colored lights instead of weights, representing packets of visible light photons (see Figure 2).

This world has undergone several iterations as well. The electron originally stayed persistent until the next measurement was taken, but this was revealed to change the players' strategy as well as reflecting inaccurate principles. Now we have the particle disappearing immediately after it is revealed, increasing the sense of uncertainty. We also once included a probability density curve in the background in addition to the wave function, but this felt redundant, as the curve will be proportional to the amplitude of the wavefunction squared. Instead, we plan to represent the probability as a density heatmap on the floor of the game (see Figure 3).
Introducing Charges

After conducting our pilot study, we designed an additional level to show variations in potential energy profiles for the QM stage. We wanted to explain how a particle’s potential profile could be affected by charges. The game mechanics for this portion resembles a puzzle game where the user could drag positive and negative charges along a path to see how this affects the potential profile. The background of the stage shows a “target” potential energy that the player will aim to reach with the true potential by manipulating both position and magnitude of the positive and negative charges. Once the potential graph matches the target potential, the stage is unlocked and the player moves the Dude as they would with a regular QM level (see Figure 4).

Tutorial

Given the abstract nature of concepts and the educational aims of the game, we decided to include a set of tutorials to accompany the different levels of the game. We needed two kinds of tutorials, one for explaining the actual concepts of classical and quantum mechanics and the other to explain game controls. For the purpose of the educational aspect of the game, we focused on the scientific concepts tutorials in our designs. These tutorials went through several iterations as we worked to find the best way to incorporate the information seamlessly into the game without overwhelming the user or not presenting enough information to the user. In our very first set of pilot tests, the tutorials began as a series of presentation slides shown separately from the game itself; this helped us to assess the level of detail the tutorials should get into before implementing them within the game. As we progressed we moved on to still images incorporated within the game right before each level, explaining the physical phenomenon that would be demonstrated in the following level. In the next iteration we added animations to the tutorials to present information more dynamically and give a preview of the mechanics present within the level (see Figure 5).
Evaluation

For evaluating the game, we initially conducted a pilot study, to help us understand any issues with gameplay and to enhance the evaluation process. We are now conducting a series of in-class studies with undergraduate students of quantum mechanics who were our target users.

Pilot Study

We devised the pilot study to evaluate an early version of 'Particle in a Box' for improvements to the educational aspect as well as gameplay. The primary aim of this was to provide an initial probe into the effectiveness of the game in students’ understanding of the basic concepts of Quantum Mechanics. We did this by testing the effectiveness of the visual representation of the Classical and the Quantum environments and evaluating students’ understanding of the contrast between these two worlds and their underlying rules.

We conducted these pilot studies on 10 participants. Since these tests were conducted to help us enhance the design, the participants from this study had no formal training in the concepts of Quantum Mechanics. The research methodology for the pilot studies consisted of four distinct phases: pretest, gameplay, posttest, and semi-structured interview. We began by administering a pretest on the participants, consisting of some multiple-choice questions and some one-line answers about the basic concepts of quantum mechanics. The purpose of this pretest was to determine the level of initial knowledge the participants had about these concepts and to provide a baseline to measure their posttest results. After the pretest, we let the participants play through the game, consisting of a Classical Mechanics tutorial and level followed by a Quantum Mechanics tutorial and level. While the participants were playing through the game, we observed them and took notes on their progress and pain points. Afterwards, we administered a posttest consisting of all the questions from the pretest as well as some questions about the game mechanics and usability heuristics of the game. Finally, we conducted semi-structured interviews with the participants to determine what they liked, where they faced problems, which concepts they understood, which concepts they did not understand, and any suggestions they may have had.

Our results were positive: we found that while all the participants answered the questions about Classical Mechanics correctly, students also showed some improvement in their understanding of Quantum mechanics concepts presented in the game. For example, students were asked: “In Quantum Mechanics, if you had a particle inside of a 1-dimensional box, where would be the highest probability of finding it, assuming the particle is in the lowest energy level?” Three out of 10 participants were able to give the correct answer before the game; while 5 out of 10 participants were able to give the correct answer after the game. Furthermore, more students chose to answer questions about QM in the posttest as opposed to selecting ‘I don’t know’ as an option in the pretest.

When asked to describe the goal of the game, most participants correctly explained how it would help them compare and contrast Classical and Quantum Mechanics. One participant wrote a succinct response saying “the goal is to teach the player the difference between classical and quantum mechanics. I think the game does a good job describing the difference between the two genres of physics.” Students were able to understand the unpredictable nature of QM. “I don’t know how to predict the position of the particle in the quantum mechanics section”, “what I found most difficult was the unpredictability of where the particle will be”, were some of the comments about that level. Their comments reflect the difficulties associated with the probabilistic nature of Quantum mechanics itself.
Based on the analysis of the pilot tests, we concluded that the gameplay was easily understood but the tutorial for the quantum mechanics concepts needed to be concise and precisely worded. We used the qualitative results from the posttest questionnaire to determine areas of improvement for the future of the game. Meanwhile, we also added new levels to incorporate the concept of charges so that the participants could understand how these charges affect the potential profile.

**In-class Study**

We are currently conducting a series of in-class studies with undergraduate students studying quantum mechanics—our target audience for the game. As of now, we have evaluated 5 participants who were recruited through a Physics class at Georgia Tech teaching basic concepts of quantum mechanics. The 5 participants were evaluated at the same time and the study was structured into four parts: pretest, gameplay, posttest, and a focus group discussion.

The pretest and the posttest for this set of evaluations have been adapted for the participants. These tests consist of more direct and focused questions as appropriate for the participants who are already familiar with QM. The questions are designed to measure their inherent understanding of QM rather than gauge how well they can solve equations. The focus group includes discussions about what the participants like and dislike or what was confusing about the game, and also suggestions about how the game could be improved.

**Future Work**

We have developed a playable version of the game, which includes the basic introductions to the two environments of classical mechanics and of quantum mechanics. In the future, we will increase the number of levels with increasing difficulty in the game to include more concepts of Quantum Mechanics. For designing these levels, we have tried to incorporate the structure of basic QM courses. For example, the next level will also include the concept of charges and how these positive and negative charges affect the potential energy profile and the wave function. We will include a ‘level lock’ where the player cannot move forward unless the potential profile of the wave matches the desired profile. The player can manipulate the potential profile using the position and magnitude of the charges.

Our next goals are to increase the complexity of the quantum levels and simultaneously introduce more scientific concepts about quantum mechanics, while maintaining the scientific accuracy of the QM concepts. We also want to devise an overarching narrative to make the gameplay more compelling so players will be able to follow the progress of their onscreen avatar The Dude and understand the motivations behind his actions. Finally, we also want to make the tutorial fully interactive. While completing these goals, we plan on conducting further in-class studies to continue evaluating of Particle in a Box to ensure its effectiveness in teaching Quantum Mechanics.

**Conclusion**

We acknowledge that it is challenging for students to learn Quantum Mechanics if they are new to this field. To address this challenge, we have designed, developed, and evaluated a game as a novel approach to teaching QM to beginners by visualizing formal abstract concepts in interactive worlds. We chose a low-level QM concept (Particle in a Box) to base our game on, and incorporated established game mechanics that are relatively easy to pick up. The game is in the form of two virtual environments: one governed by classical mechanics and one governed by the laws of quantum mechanics to help students compare and contrast the two worlds so that they can learn Quantum Mechanics through experience and gameplay along with classical classroom methods.

**References**


Abstract: As famous game designer Sid Meier said, a game is a series of interesting choices (Rollings & Morris 2000, p. 38). Understanding the role and effect of choices, is critical to effective game design and, quite likely, to learning. With this in mind, the overarching question asked was: Do the effects of customization, defined as a series of choices, change players’ experiences over time? A mixed method study was designed with two conditions: customization (n=33) and no customization (n=33). Adult participants played Lord of the Rings Online (Lotro), a Massive-ly Multiplayer Online game (MMO), for about ten hours over four sessions. Data was collected through surveys, interviews and observations. Results showed that participants’ perceived choice changed over time and customization had a small effect on players’ perceived choice.

Background

Control is a basic human desire that is common in almost all aspects of life. It is related to many positive outcomes such as achievement, persistence, motivation and self-esteem (Skinner, 1996). Today, many technologies, from mobile phones to social networking sites and games allow users to control their interaction. Wise and Reeves (2007) succinctly state that control is “user influence, user activity, and power over discourse” (p. 4). Averill (1973) defined three types of control: decisional, behavioral, and cognitive. In this paper, we are interested in decisional control that is defined as the “…range of choice or number of options open to an individual” (p. 298). For example, increasing the number of features to customize in a game can increase decisional control.

Customization offers many choices and is common practice in videogames, especially in MMOs. It may impact player engagement with videogames (e.g. Bakkes, Tan, & Pisan, 2012). It may also increase players sense of autonomy which may result in increased motivational outcomes (Ryan, Rigby, & Przybylski, 2006). An increasing number of games allow players to customize their avatars’ look in great detail, create custom user interfaces (Adinolf, & Turkay, 2011). Customization of virtual spaces in games corresponds with the concept of territory marking. Sundar and Marathe (2010) emphasize the importance of research on customization “…as newer digital media offer more and more customization, it is important for scholars to understand how it transforms the process of communication” (Sundar & Marathe, 2010, p.299).

Opportunities for customization may give users decision-making authority over the technology enabling them to influence and create their own experiences, as well as providing ways to be a part of a group based on their needs and desires. We encounter the word “customization” almost every day. What customization means to users in various areas still needs to be studied. This study aims to shed more light on the effects of customization on player’s decisional of control and motivation. It poses the following research questions:

1. Does customization impact players’ perceived choice in an MMO?
2. What is the relationship between players’ perceived choice and their engagement with and motivation to play the game?

User Choice

A large body of findings suggests that giving individuals choices leads not only to better performance and more intrinsic motivation when performing tasks, but also to higher overall satisfaction. These findings relate self-efficacy and a sense of control to more motivation and more persistent efforts to succeed, which in turn lead to better performance in the task at hand (Cordova & Lepper, 1996).

The motivational aspect of choice has been a part of multiple motivational frameworks such as expectancy-value model of achievement motivation (Eccles & Wigfield, 1995), social cognitive theory (Bandura, 1997), and Self Determination Theory (SDT; Deci & Ryan, 1985).

SDT represents a broad framework for the study of human motivation and personality within social contexts. According to this theory, there are three basic psychological needs that, when satisfied, enhance intrinsic motivation and lead to autonomous internalization of behaviors of initial extrinsic origin (Ryan & Deci, 2000). These needs are the need for autonomy, relatedness, and competence. The need for autonomy refers to the need to feel a sense of full volition and “choicefulness” regarding one’s activities and goals, a feeling that emerges when one’s actions
and goals are experienced as emanating from one’s authentic self (Deci & Ryan, 1985). A central focus in SDT on autonomy contributes to adaptive motivation and has been interpreted by many as the practice of providing choice (Iyengar & Lepper, 1999). Therefore, one may predict that the need for autonomy is one of reasons that players customize in virtual worlds. The need for relatedness refers to the need to feel closely related to other people (Deci & Ryan, 2000). Especially in multiplayer games, the need for relatedness may be one of the main reasons to customize. Many MMO players start playing a game because their friends play this particular game (Nardi & Harris, 2006). It is quite a common practice to create game characters that will fulfill a need in a game community (i.e. making a healer character because there is not one in their playgroup) and this may satisfy a player’s need for relatedness in the game. The need for competence is the need to be effective in one’s interactions with the environment, and to feel that one is capable of mastering challenges (Deci & Ryan, 2000). Ryan and Deci (2000) emphasize that intrinsic motivation can emerge only if people feel all three needs are being satisfied.

Several researchers have examined the relationship between choice and learning. Zuckerman, Porac, Lathin, Smith, and Deci (1978) assigned 40 students each to a choice or no-choice puzzle-solving condition. Individuals in the choice condition reported a greater feeling of control, indicated that they would be more willing to return for another session of puzzle solving, and spent significantly more time solving similar puzzles in a free-choice period at the end of the experiment. Cordova & Lepper (1996) investigated the effects of choice on elementary school children’s learning within a computer game. Subjects made choices on features that are not relevant to the pedagogical aspect of the game. They had either the opportunity to make several choices about which icon would represent them in the game, what player name they would use, the name of their spaceship, their opponent’s name, and their starting point related to two shortcuts. Conversely, they played the game with the icon and names assigned by the experimenter. The results showed that minimal choices produced a significant increase, not only in the participant’s motivation, but also in the depth of their engagement in learning, as evidenced by a preference for more challenging versions of the game, the greater use of complex operations, and an emphasis on strategic play. Moreover, the amount they learned increased, as did their perceived competence and level of aspiration. It is possible that although the choices in this study appear trivial the opportunity to choose icons and names representing the player and her/his opponent made the game personally meaningful to the participants.

A more recent experimental study conducted by Kinzer et al. (2012) examined the impact of providing students (N = 171) with choices of a on-screen agent that would provide students with feedback in an educational game. Middle school students chose among six images of scientist characters before they started playing the game. Results showed that students not only displayed more affective engagement and motivation towards the game when they were given the choices, but they also showed increased learning outcomes as shown by significant differences from pre- to post-test.

Choice is equated with interactivity, yet only a small number of studies have investigated its psychological consequences in media use. Sundar (2007) notes that the fundamental goal of interactivity is to offer the user different choices, with the result of a highly personalized end product.

In a similar vein, Chen (2007) suggests that in order to design an interactive experience for a broader audience, the experience has to adapt to different users’ personal “Flow Zones” by offering them many choices (p.33). At the same time, he warns that simply increasing the number of choices can be costly as it may create choice overload. He predicts that one way for game designers to avoid such situations is “to embed the player’s choices into the core activities of the interactive experience.” (Ibid: p.33). Today, videogames offer more and more choices. They enable players to individualize their game experiences through allowing them to decide on various features. Recently, game designers and game researchers have been considering personalization and customization as paths to maximize player affective engagement with videogames (e.g. Bakkes, et al., 2012).

**Methods**

Adult participants were recruited through fliers for a lab study at a medium-sized East Coast University in the US, and were remunerated $50 ($5 per hour) for their time. The current study used a between-subjects design. Participants were randomly assigned to one of two groups by gender, Customization (CG) (n=33; f=17, m=16) and No Customization (NCG) (n=33; f=17, m=16).

MMOs are long-term games and a reliable study of player behavior in these games should take place over more than one experimental session. To approximate voluntary gameplay, this study’s procedure involved about 10 hours of game play, which was divided into 4 sessions over two weeks.
Player engagement was assessed with revised a twenty-two item, 5-point Likert scale questionnaire (O’Brien & Toms (2010). Game motivation was assessed with a single 7-point Likert scale item from the Intrinsic Motivation Inventory (Ryan, Mims, & Koestner, 1983): “I would be willing to play this game again.” Another 7-point Likert scale item was used to measure participants’ perceived choice/decisional control: “I think I had some choice in this gameplay session.” A repeated measures analysis of variance (RM ANOVA) was employed to reveal differences on outcome variables over time (sessions) and between CG versus NCG on engagement. Assumptions were met for the test. For qualitative data, semi-structured interviews were conducted after gameplay sessions.

Procedure

In the first session, CG created their game characters and customized their appearance. NCG were assigned well-made, pre-generated characters that matched each participant’s gender. Participants continued to play with that character throughout the study. For both groups, the first session ended upon completion of the LotRO tutorial (which takes about 2 to 2.5 hours). At the end of each game session, participants completed a survey on the computer. CG participants were introduced to various ways they could customize the game, whereas NCG participants’ choices were controlled. For example, NCG did not choose their mission rewards or professions; the researcher chose for them, binding keyboard shortcuts for that purpose. Participants had freedom to pick profession related quests. NCG participants were told that the computer would make the reward choices for them until they learned the game. The reason to limit mission rewards is that rewards provide ways for players to customize their characters by boosting their skills or changing the appearance of their character (e.g., picking a hat or weapon). We did not limit quest choice. NCG participants were able to choose quests, which gave them some autonomy on narrative. None of the participants explored auction houses, which would have got around the limits on mission rewards for NCG. During the study, participants had no line of sight to the researcher. This allowed smooth control of NCG’s choices. NCG’s characters’ appearance were set with the cosmetic outfit option in LotRO so that participants would see the same outfit no matter how their characters were equipped throughout the sessions. These differences aimed to control CG’s and NCG’s autonomy and decisional control by dictating their customization options.

Results

Perceived Choice/Decisional Control

An independent samples t-test showed that Perceived Choice/Decisional Control did not statistically significantly differ for CG and NCG except in the last session (see Table 1). A mixed ANOVA was conducted to assess whether there were group and session differences in participants’ reported perceived choice. The following assumptions were tested: (a) independence of observation, (b) normality, and (c) sphericity. Independence of observation and normality were met. The assumption of sphericity was violated. Thus, the Greenhouse-Geisser epsilon was used to correct degrees of freedom.

<table>
<thead>
<tr>
<th>Sessions</th>
<th>Ind. Samples t-test</th>
<th>CG</th>
<th>NCG</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t</td>
<td>p</td>
<td>η²</td>
</tr>
<tr>
<td>Session 1</td>
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<td>.143</td>
<td>.03</td>
</tr>
<tr>
<td>Session 2</td>
<td>-1.53</td>
<td>.130</td>
<td>.04</td>
</tr>
<tr>
<td>Session 3</td>
<td>-1.81</td>
<td>.075</td>
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</tr>
<tr>
<td>Session 4</td>
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<td>.008</td>
<td>.11</td>
</tr>
</tbody>
</table>

Table 1: Means and standard deviations of perceived choice/decisional control scores.

Results indicate a statistically significant but small main effect of time (number of play sessions), $F(2.26, 144.29) = 11.72, p < .001$ (Perceived Choice significantly change over time), $\eta^2_{partial} = .16$ of customization, $F(1, 64) = 9.30, p < .01, \eta^2_{partial} = .13$. There was no statistically significant interaction between groups and sessions, $F(2.26, 144.29) = 3.23, \eta^2_{partial} = .05$. Figure 1 represents the interaction between sessions and groups (CG and NCG).
Figure 1: Estimated marginal means of Decisional Control over four sessions.

A set of Pearson correlations for all four game sessions was conducted. There were significant correlations between sense of control and perceived choices for all the sessions (see Table 2).

<table>
<thead>
<tr>
<th></th>
<th>Session 1</th>
<th>Session 2</th>
<th>Session 3</th>
<th>Session 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sense of Control</td>
<td>0.47***</td>
<td>0.36***</td>
<td>0.57***</td>
<td>0.62***</td>
</tr>
<tr>
<td>Motivation</td>
<td>0.18</td>
<td>0.29*</td>
<td>0.31*</td>
<td>0.40***</td>
</tr>
<tr>
<td>Engagement</td>
<td>0.17</td>
<td>0.39**</td>
<td>0.47***</td>
<td>0.54***</td>
</tr>
</tbody>
</table>

*** p < 0.001, ** p < 0.01, * p < 0.05

Table 2. Pearson correlations for Perceived Choice and Motivation and Engagement

Qualitative Findings on Perceived Choice/Decisional Control

One of the interview questions was “Did you feel in control of your game experience today?” Several patterns emerged from the interviews related to players’ decisional control in the game.

Choosing vocation/crafting: Players talked about feeling in control because they decided on certain professions or performed crafting-related activities in the game. In this topic, [P60] remarked that “I think this time I had more control over what I did. Hmm… such as picking items especially when I got to take my craft.”

Customization: Players enjoyed the act of choosing rewards in the game as part of the continuous avatar customization. For example, during the last interview [P70] talked about such acts as the most enjoyable moments for her:

The most enjoyable moments were when I got some rewards and when I got to choose the best one among the ones that they gave me...And then when I customize my character with the weapons and armor that I earned...to make my character better and stronger... (P70, Interview 3, CG, Female)

In addition to choosing rewards, some players talked about discrete cosmetic avatar customization including the initial avatar appearance customization during the character creation and cosmetic outfits. For example, [P15] from CG talked about how he liked having a control over his characters’ outfit through the cosmetic outfit option in the game. “… I really like the cosmetic outfit options… I like to have my character look the way I want to look. … And that was fun... there were dyes, there was crafting.”

Some players talked about the possibility of experimentation with character skills, thanks to having options. For example, [P12] from CG talked about such experimentation, “Then with all the skill buttons… I thought that was also pretty interesting, because I could do different things as I advance in the game…”

Choosing quests: Thirty-eight percent of the participants talked about decisional control related to having options on what tasks they may accept or reject in the game. For example, [P37] from CG stated his reasons to reject side quests in the first session as, “Some of the side quests were like I can choose to do and I felt like it was not important to the critical mission... So, I ignored it because I’m interested in the main story. I chose to do so…” Participants also commented that the choices on tasks increased as they progressed in the game. For example, [P72] talked about this freedom:

… Compared to the first time that you needed to complete quests to finish the intro, there was a lot more
freedom as far as what quest to do and when I wanted to do. So, I enjoyed that I had large variety of quests that I can choose from and tackle them on my own leisure and explore at the same time. (P72, Interview 4, NCG, Male)

In the same line, players talked about their satisfaction with choices they had in different types of quests that would fit with their play styles. For example, [P25] disliked the fighting in the game and she talked about her content with having non-fight related quests in the game:

...yeah I would say that I was happy with the choices I had. In the beginning getting into the game I knew that I had to do some fighting because of the nature of the game and the nature of the Lord of the rings and I felt better about it later because it wasn’t in every quests. ...I can take a break. I can sell stuff or go to the pub... I don’t think that you were there at that time but it was really cool that you can get drunk [laughter] so those little details... (P25, Interview 4, CG, Female)

In summary, many participants talked about having different options on quests and the positive effect of these options on their game experiences. In fact, some players think that having choices makes the game environment more immersive. [P51] from CG reported “I feel like it [having choices] adds to the experience of being in a virtual world.” Players also talked about the possible relationship between why people, in general, play MMOs or even get addicted to MMOs, and the ways that these games foster players’ decisional control. For example, in a representative quote, [P27] talked about her reaction when I stopped her at the last session and why she did not get bored while playing:

I think it is very addicting. Even now ‘oh, I want to keep playing’ like when you came in I was sad... ‘Oh, really that’s it? I want to keep playing...’ hmmm... I think it is very addicting because there is so much going on. You really lost track of time and it is very distracting. I think that is it is so addicting that there’s so many things going on you don’t really get bored like in other games after certain point you get bored and you turn off but in the games you do have so many choices in so many things going on you just don’t feel like stopping. (P27, Interview 4, CG, Female)

Although players talked about such freedom in the game world, some people wished for more choices on specific aspects in the game. For example, [P7] from CG wanted an option to control day and night in the game. She said “if I could turn that in night to day. If I do too many tasks at night I get so tired. If I could change it to 20 minutes daytime and 20 minutes nighttime.” Another player [P73] wished for more options for the characters that they get to choose. “I wish that there were more options, being able to control more than one character or choosing between good or evil side...”

A quote from [P43] highlights the choices presented above:

I made choices about which rewards I would receive and which quests to take. Being able to decide made the experience feel more within my control; however, I still wish I had more different options for quests. (P43, Interview 1, CG, F)

Discussion and future studies

Decisional control refers to the range of choices or number of options available and involves choices prior to an event (Averill, 1973). In this study, participants’ decisional control was measured with a single 7-point Likert scale item, “I think I had some choice in this gameplay session.”

Results showed that both CG and NCG players’ decisional control increased over the first three sessions. Interestingly, players’ decisional control dropped during the 4th session even though the number of choices reported was the most of all four sessions. Perhaps the reason was participants knew that was the last session, and they knew that they would not be able to play with their characters after that session. So, this knowledge might have reduced their decisional control. They may also have felt decreased decisional control because the categories of choices they made did not increase in the fourth session. They were still making choices for quests, mission rewards etc. When CG and NCG were compared, there was no significant difference between groups except during the last session. Whatever the reason for this drop, it was more severe for NCG.

Participants’ perceived choice was significantly positively correlated with their sense of control in each session. An examination of the correlations between Perceived Choice, and engagement and willingness to play the game revealed that Perceived Choice had a positive relationship with both, though only in sessions subsequent to the first. In the first session, participants were introduced to a new environment and they were too busy learning how to play: getting familiar with game controls and interface to pay attention to the extent of choices available to them.
This may be explained by the positive psychological impact of making choices; the more players were engaged in making choices, the happier they were. However, there is still a question whether giving people fewer choices would have produced the same result, since some studies suggest that people’s happiness may depend on “having a choice, not having many choices” (Schwartz et al., 2002, p. 1194). To my knowledge, no such study exists and it is not possible to state at this time whether the number of choices available made players happy. Future studies should investigate this open question. For instance, board games provide many choices to players, ranging from aesthetics (e.g., color and shape of game pieces) and strategies to win. Are these choices enough to give people sense of decisional control? Would changing the number and the range of choices impact players’ motivation and engagement with those games?

While decisional control is directly related to availability of choices, it also depends on how a person perceives available choices, rather than on the objective range or number of choices. In other words, decisional control is perceived, so it is the degree to which people agree or identify with the choices available, no matter how limited. One of the main choices that CG had was on their mission rewards. However, if a player does not realize s/he has options when picking a weapon, we cannot expect that her/his decisional control to be affected by the number of choices. Another common practice in MMOs is that mission rewards are usually tailored to character class. In this case, the player does not really have a choice, but has to figure out what is best suited for his character. So, it becomes a puzzle rather than a choice. This is why it was important to investigate participants’ perceived choice and its relation to player engagement and motivation, as well as the actual choices made. Even though CG had more choices in the game, NCG did not feel significantly less decisional control, perhaps because of the high behavior control provided in MMOs. Another reason for this finding may be that having a choice to complete tasks given by quests was a great enough control for players. We could not limit all the choices artificially since we could not change mechanics of the game by programming different versions. Future studies should be conducted with custom games or in collaboration with game developers to manipulate the variables more consistently for robust results.

Although this study involved significant amounts of gameplay, it is likely that as players gain more expertise, the impact of certain types of customization (i.e., being able to choose items to change character skills or characters appearance) may become more salient and others may become weaker to impact participants’ perceived choice. Moreover, MMOs are long-term games. Ten hours of gameplay content is still very novel to players and there may be a relation between novelty and perceived choice. Future studies should investigate this possibility with even longer gameplay time, ideally in players’ regular play environments rather than in research labs or in combination of both.

This study was conducted with a single MMO. It is likely that participants’ decisional control may be impacted by available choices differently in different types of games. For example a shooting game might differ, as might a game of chance. As the perceived choice relates to motivation and engagement, future studies are needed to examine which types of choices impact decisional control and when they become irrelevant.

Participants in this study were novice players. It is likely that as players gain more expertise with the game, the number and type of choices available may impact their perceived decisional control and motivation differently. Future studies should investigate how expertise relate to decisional control.

Lastly, Wouters et al. (2013)’s meta-analysis showed that there is a gap on the literature on the investigation of user control in serious games. Future studies are needed to examine to what extent different types of control impacts players’ learning and motivation in educational games.

References


Learning for Doing: Designing Instructional Games for the Workplace

Ethan Valentine, University of Iowa

Abstract: While learning games have received a large amount of attention and research in the last few years, there is still a large gap with regard to workplace learning. Very little literature is available that aims to develop a set of design principles specific to a learning setting that differs significantly from traditional classrooms. Therefore, the goal of this work is to elicit discussion on the design of game-based learning for the workplace, as well to encourage research in this crucial, but often forgotten, learning setting. In this paper I first consider these differences and examine the joint media engagement (JME) framework as it applies to the workplace. I then examine existing literature on game design and use in the workplace. Based on this literature, I propose a set of design principles for workplace-based instructional games based on the joint media engagement (JME) framework.

Overview and purpose

Virtual worlds and digital games provide new opportunities for learning content in a wide variety of fields and experience levels. Although these tools provide great potential in classrooms and informal learning environments (such as museums), perhaps the greatest potential lies in workforce training. Simulation of workplace situations, regardless of level of fidelity, can provide suspension of disbelief for users, allowing them to be engaged in learning the skills necessary for their occupation (Bauman & Wolfenstein, 2012b). Despite the opportunities in workforce training, and some research on individual interventions, there is little in the research literature examining or seeking to develop a set of design principles for using digital games and virtual worlds as instruction in this type of setting. Therefore, this paper examines how to best design these tools for instruction in the workplace.

In this paper, I focus primarily on a review and synthesis of game/virtual world design literature, considering both principles developed in other learning environments and applications and needs within the workplace, with a particular focus on healthcare fields due to the amount of work already being done in clinical education. I first consider workplace learning as learning for doing within the situated cognition perspective before discussing the joint-media engagement model as it applies to workplace learning. The next two sections describe my review of the literature and the evidence gathered. I then argue for five instructional design principles for games in workplace learning based on the available literature and the JME perspective. These principles produce instruction that is: user-oriented, collaborative, easy-to-use, has specific goals and immediate feedback, and involves learning for doing. Finally, I discuss the importance of these principles, and future research needed.

Perspectives

Learning for doing in the workplace

In many ways, classroom and workplace learning are similar. Both include learning content that will be applied at some future point, often in relatively formal settings. However, there are distinct differences that necessitate a different focus for the workplace. First, the community involved in is often very different. Students in a school are engaged with typically equal-level peers also enrolled, while the workplace community has highly varied skill and experience levels. In a workplace environment, these highly varied community members are working toward a common goal, as opposed to the purely individual goals of each student in a classroom. Le Maistre and Paré (2004) further point out that work division is completely different. While schools may actively discourage collaboration as a form of cheating, collaboration in the workplace is absolutely necessary.

Perhaps more important, however, is the direct outcome or objective of the learning. In a school activity, students engage with texts and instructors to understand theories or methods, with the goal of learning being just that: learning. On the other hand, in a workplace environment, the focus of the learning is very different. The expectation is that learners already understand many of the theories and tools available to them (Le Maistre & Paré, 2004). Regardless of the field, the desired outcome of workplace learning is not knowledge of a theory, but the direct application of learning to that field, whether that means treating injuries or fixing a power line. As with classroom-based clinical education, workplace training aims to give learners “valuable experiences to build on” as they move forward (Bauman & Wolfenstein, 2012a, p. 7). Games and simulations in particular can provide this sort of lived experiences more effectively and consistently than existing tools (DeVane & Bauman, 2012). Further, although this type of learning is often a challenging to incorporate in schools (Collins & Halverson, 2010), learning in the workplace is inherently focused on learning skills, simplifying implementation.
Another aspect of workplace learning that particularly favors the use of digital games and other multimedia is
the ability for flexible delivery. There is no need for everything to be learned within the confines of a particular
classroom at a particular time of day. Instead, designers can, and should, take advantage of outside learning op-
portunities and methods of delivery that allow learners to engage with content when they are able (Smith, 2003).
Digital games and virtual worlds may be accessed from a variety of locations at any time, widening the range of
environments exposed to and potentially easing transfer.

Joint media engagement in the workplace

Thus far, three major ideas related to workplace learning considered have been collaboration, flexible delivery,
and learning for doing. Within the framework of situated cognition lies the goal of learning through joint media
engagement (JME). This viewpoint is particularly focused on learning through games and other multimedia tools,
and seeks to engage learners with others in solving real problems in a wide variety of locations. As Takeuchi and
Stevens (2011 p.7) described it, JME “refers to spontaneous and designed experiences of people using media
together...anywhere and at any time.” Although much of the research focuses on informal learning environments,
the JME goals fit very well with workplace learning. Many of the goals described by Takeuchi and Stevens (2011)
are relevant regardless of the content or focus. Their goals indicate what the designer hopes to achieve, but do not
necessarily indicate a particular design. These goals include mutual engagement (collaboration), dialogic inquiry,
co-creation (working together to solve problems or create innovations), boundary crossing (including time and
place), intention to develop (including a growing skill level), and an interface that allows a focus on the content
(Takeuchi & Stevens, 2011). Mutual engagement and co-creation speak to the collaboration necessary in the work-
place, while flexible delivery is discussed as part of the boundary crossing goal. Finally, developing and creating
new skills directly correspond to learning for doing.

Methods

As this paper is primarily a synthesis of available literature, the methods focus almost entirely on the review of liter-
ature. In this case, I began with a situated cognition focus and used foundational instructional design literature as
a theoretical base. Those articles with a focus on game-based learning were especially relevant, as well as those
providing description of design, implementation, and evaluation of such tools. From there, I moved my search to
workplace settings where such interventions had been used. Much of the available literature focuses on healthcare
work in particular, but the overall design principles remain the same across fields. Using the JME engagement
framework as a starting point, I considered what goals were especially important in the workplace and consistently
met by successful interventions both in workplace and other learning environments.

Data sources

The evidence for this paper’s argument comes primarily from the research literature. Background references
provide a foundational picture of digital instructional design, while additional sources primarily provide contexts in
which games and simulations have been used in the workplace. By comparing the two sets of literature (founda-
tional and contextual) it is possible to see what specific characteristics line up. In other words, where the goals and
principles expressed in the foundational literature are seen consistently in successful cases (contexts), a new set
of design principles forms.

Results

Perhaps the defining characteristic of workplace learning is the goal of learning for doing. In this section, I present
five design principles for achieving that goal based on the literature considered. Many of the principles are appli-
cable in varied learning environments. Each principle, however, has grounding in previous research and can be
applied directly to the design of game-based instruction for workplace learning. These principles include: user-ori-
tented learning, collaborative learning, specific learning goals, immediate feedback, and easy-to-use interfaces.

User-oriented learning

This first principle indicates a focus in design on the specific users involved. JME goals call explicitly for user-driv-
en learning (Takeuchi & Stevens, 2011). Considering the varied goals between school and workplace learning,
designers must consider the specific types of users that will engage with their tool. A focus on theoretical concepts
in the workplace, while potentially helpful as a refresher, will do little to prepare learners for direct engagement in
the tasks required of them (Le Maistre & Paré, 2004). Instead, workplace games should be focused on providing a
consistent set of experiences directly related to the task(s) being learned (Bauman & Wolfenstein, 2012b). Among
the user-specific characteristics to consider are a focus on doing some task after learning, a common goal for all
users, and a flexible learning/delivery schedule (Smith, 2003). Relevance to the actual workplace is also incredibly important. A virtual world or game, no matter how in-depth or useful, will not be used if learners cannot see ways in which it can be used (Luse, Mennecke, & Triplett, 2013).

The success of user-oriented learning can already be seen in workplace games. Existing workplace games that focus on the specific situations learners may find themselves in are especially powerful. These include such workforce games as GAMMA-EC (Stolk, Alexandrian, Gros, & Paggio, 2001), an environmental crisis management game developed to improve decision-making and communication in an emergency. GAMMA-EC, even with relatively low fidelity, allows learners to experience realistic problems that they may have to face throughout their career, such as wildfires or chemical spills. Similarly, successful experiences have been crafted within existing worlds like Second Life that model situations paramedics may find themselves in (Conradi et al., 2009), creating valuable and applicable learning.

Collaborative learning

Included in this set of principles must be a consideration of collaboration with other community members. Simply put, collaborating with others improves our learning, and their experiences and interpretations can provide us with new ways to examine and solve problems (Gee, 2008; Takeuchi & Stevens, 2011). Existing games already take advantage of collaborative designs in order to strengthen learning, build communities, and aid transfer. Games like Futura (Antle et al., 2011) and GAMMA-EC (Stolk, Alexandrian, Gros, & Paggio, 2001) allow learners to not only learn content, but engage with each other in order to develop specific skills related to the problem being faced. In healthcare learning, collaborative games (such as in Conradi et al., 2009) produce more valuable learning gains than single-player experiences (such as Cook, McAloon, O’Neill, & Beggs, 2012). Considering the workplace environment as part of the learning indicates a need for collaboration, particularly among community members of varying expertise (Le Maistre & Paré, 2004). In the workplace, learners collaborating with more experienced community members allows for joint interpretation as well as a cognitive apprenticeship of sorts, allowing the new learner to become more and more involved in the workplace (Smith, 2003) through creating innovative solutions with their peer.

Specific learning goals

Specific learning goals in any type of instructional design allows for the designer to focus on what needs to be learned. Good game design also requires specific goals within the game (what should be accomplished in the world). Specific goals set from the beginning allow for interactions to be designed with those goals in mind (Gee, 2008). Although learning goals do not need to be explicitly presented to the learner in every case, specific goals within the game itself help engage learners more (Shute & Ke, 2012). In a workplace game, these learning goals might include particular behavioral/procedural skills, time management skills, or interpersonal skills. These could them be met through achievement of in-game goals, such as completing a quest within a particular time frame.

Immediate feedback

As Gee (2008) pointed out, we learn best when we are provided with immediate feedback regarding our performance. This applies in any learning environment, but when focused on learning for some workplace task, this is especially important (Smith, 2003). Immediate feedback allows for adjustment of processes to better reflect what is needed to succeed, and collection of such data allows for formative assessment of learners’ abilities (Shute & Ke, 2012). In the workplace, this allows for trainers or peers to work more closely with learners needing additional help in a way that does not require long or expensive assessments. Games are particularly well-suited to provide this immediate feedback, with well-designed game systems able to respond in real-time to user input.

Easy-to use interface

Although it may appear as an obvious goal, creating an interface that is easy for learners to use is incredibly important, and often a problem. As Takeuchi and Stevens (2011) point out, we want our learners to be focused on the content, rather than on how to control the system itself to ensure that they will be able to achieve the learning goals rather than simply learning the mechanics. Regardless of the particular environment, when it is difficult to learn to use a virtual world or game (whether because of the physical interface or one on the game), the potential benefits are often lost (Antle et al., 2011; Conradi et al., 2009; Luse, Mennecke, & Triplett, 2013).

Significance

There is a large body of research examining the design of games and virtual worlds in both formal and informal learning environments. In workplace learning, these types of tools have perhaps even more potential due to the
unique environment the workplace creates. Despite this potential, and the current use of games and virtual worlds in healthcare and some other fields, very little work has been done to adapt the games-based learning literature to workplace training. This project seeks to contribute to this effort, while also sparking ideas for further research.

This paper presents five design principles for the goal of learning for doing in the workplace from a joint media engagement perspective. These principles provide a set of considerations for the design of learning games and virtual in the workplace. They do not, however, form a set of prescriptions, as every workplace will have different needs. The use of these principles in instructional design should improve learning outcomes, both in the workplace and in technical training programs. Future research should consider these principles and verify their appropriateness in workplace learning, as well as evaluate other design perspectives for use in the workplace. Existing university- and workplace-based efforts should also be continued going forward.

References


Designing and Tracking Play Styles in Solving the Incognitum

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Abstract: An acute understanding of how learners behave within educational games is crucial to building personalized learning games. Although most traditional instruments are designed to measure one’s intrinsic characteristic such as motivation, they may not indicate how the learner will play a specific game. In this paper, we present a study in which we use a combination of traditional instrument and gameplay data to track how learners behave in a small-scale learning game called Solving the Incognitum. Our main contribution is that this study is among the first to provide empirical evidence that learners change their play styles within the same gameplay session.

Introduction

Better understanding of players’ motivation and their gameplay patterns is crucial to build educational games that can be adapted to an individual learner’s needs and preferences. For example, by monitoring a learner’s progress in her gameplay, we may make inferences on her current motivations and dynamically adjust the game accordingly in order to improve her experience (Zhu et al., 2014).

In this paper, we present our findings about how players adopt different play styles in Solving the Incognitum, a game-based learning environment designed to support learners with different goal achievement orientations and play styles. Our particular focus is on the Achievement Goal Theory (AGT) (Elliot & McGregor, 2001) from motivation research and an AGT-based framework on player types (Foster, 2009; 2011). In our recent exploratory study with college freshmen (75 participants), we collected data on the participants’ goal achievement orientation through a series of surveys and we collected play style information from screen recordings and game telemetry data while they played the game. We study the relationship between the identified player types, the observed play style, and the learning outcome after playing Solving the Incognitum.

We present our preliminary findings that the identified player types and the observed play style did not have a significant impact on learning outcome even though all the participants demonstrated a knowledge increase between the pre and post tests. Moreover, in our exploratory study we did not find a relationship between the identified player types from our surveys and the observed play style. We also present that, based on analysis of screen recordings, most participants in our exploratory study adopted different play styles as they went through the game.

Theoretical Framework

Player types are defined by individual traits or underlying motivations of a player (Heeter, 2009). Although they cannot be observed directly, it has been suggested that one way to construct a player type is through the combination of observable player behavior and the motivations that drives her.

Motivation research has shown that there are generally two types of orientations for learning — performance and mastery (Ames, 1992; Grant & Dweck, 2003). Students with performance goal orientation focus on external goals such as scores and grades to validate their success. By contrast, students with mastery goal orientation achieve a sense of satisfaction from the detailed understanding of the work and are not influenced by extrinsic factors such as scores or grades (Riedl et. al., 2008). Finally, there are students who avoid mastery, but are not performance oriented. Based on mastery and performance orientations from Achievement Goal Theory (AGT) (Elliot & McGregor, 2001; Heeter et al., 2011), we uses Foster’s framework (2009; 2011) which proposes general categories of player types. First is Explorers, who explore their personal preferences and explore parts of the game that may not be necessary to advance. Second is Goal-Seekers, who focus on finding the fastest ways to completing the game. This means that Explorers are inclined to experience a wider range of in-game content while Goal-Seekers tend to focus on the content necessary for winning.

By contrast, play style is the “actual play behavior enacted while playing a specific game” (Magerko, 2010, p. 263). As play style is directly tied to players’ observable in-game behaviors, it is relatively straightforward to measure. However, according to previous studies using self-reported data, a player may adopt different play styles in the
same game, for instance, based on how confident he or she is about achieving her goals at a given moment, either between a play session to another or within a single play session (Foster, 2009; 2011; Heeter, 2009, Klug & Schell, 2006). Beyond player choices, the design of games themselves limits available options to players: control and expression in games are confined by their genre and their underlying design patterns and thus can only support a certain set of actions and strategies. Such limitations by game design decisions therefore constrain the possible play styles a player may engage in (Foster, 2009). Compared to existing work, the main contribution of this paper is to study play styles based on both self-reported data and observation of how learners interact with the game.

Designing for Play Styles

Solving the Incognitum is a first-person point-and-click 3D interactive learning environment for teaching the relationships between geological time and fossil records. In an environment based on the Charles W. Peale’s Museum of Art and Science, the largest natural history museum in the U.S. in the early 19th Century, the player can interact with museum exhibits including fossils, minerals, strata deposits, and portraits of renowned historical figures related to the exhibits (Figure 1). By correctly answering questions related to these exhibits, the player can eventually assemble the crown jewel of the historical museum — the skeleton of the mastodon exhumed by a scientific team led by Peale in 1801. Overall, the educational goal of the game is to teach concepts related to (a) Law of Superposition, (b) Geological Time, and (c) Mastodon Life. After a brief tutorial, the player can explore the virtual space, examine different exhibits and answer questions about them.

![Figure 1: The virtual environment is modeled after Charles W. Peale's Museum.](image)

In order to support the different play styles a player may adopt, the game is designed to provide different gameplay options. For goal seekers, whose main objective is to win the game, Solving the Incognitum provides a clear goal. In order to unlock the assembly of the mastodon skeleton, the player needs to complete four main quests. Each quest requires the player to visit several exhibits, read the information cards associated with them, and apply the knowledge they learn to answer related questions. Once the full skeleton is assembled, the player is given the option to quit or continue the game.

For explorers, the environment contains different types of exhibits grouped based on their types and associations to one another. The player can explore them based on her own interest and answer questions about certain exhibits. Although they do not contribute to the unveiling of the missing mastodon skeleton bones, visiting these optional exhibits can earn the player badges (e.g., Junior Science Historian, Master Mineralogist, Junior Paleozoic Explorer, etc.) once the player has visited certain percentage of exhibits from each category.

The location of the exhibits in the virtual museum is determined based on their type (e.g., fossils) and the geological time period they are from. This spatial organization is designed to potentially catch the differences between play styles. While an explorer may spend time in the same location to interact with certain type of exhibits or time period of her interest, a goal-seeker is more likely to move from one place to another collecting only the necessary exhibits to win the game.
To provide an overview of all the exhibits as well as the winning path, *Solving the Incognitum* has a concept map that the player can open at any time (Figure 2). On the map, all exhibits required on the four main quests to unlock the skeleton are visibly connected through solid lines. When an exhibit has been visited, it turns from transparent to full color on the map. To avoid clutter and to improve gameplay recording, the name of an exhibit will only appear when the player moves the mouse over its icon. The concept map also shows the percentage of visited exhibits in each time period and category, and the earned badges.

**Methods**

To study the relationships between player types and play style and how they affect learning in *Solving the Incognitum*, we conducted an exploratory study with college freshmen majoring in Digital Media in a required class. Our study group consisted of 75 students who volunteered to participate.

We asked each participant to first complete a 12-question pre-knowledge test about the basic earth science topics covered in the game before they played the game individually. During their gameplay, we recorded their screens and the game automatically recorded all their gameplay data. The participants were given the instruction to play the game for up to 60 minutes, though they were not told to complete the game. When they finished playing the game, the participants were asked to complete a post-knowledge acquisition questionnaire, a 15-question AGT survey (Elliot & McGregor, 2001) and an 11-question player type survey (Foster, 2011). We used Cronbach’s alpha to ensure internal reliability in the survey questions. Cronbach’s alphas for the 3 performance avoidance, 3 performance approach, 3 mastery approach, 6 mastery avoidance, 3 localized explorer, 4 comprehensive explorer, 2 achievement goal-seeker and 4 competitive goal-seeker items were .812, .896, .879, .884, .867, .751, .868 and .823 respectively. To avoid bias in the knowledge acquisition questionnaires towards either play style, the questionnaires address all of the game’s learning goals and include topics covered in both goal-related and optional exhibits. Regarding the survey, we used reliability constructs to check for internal consistency of the questions. Since the game is single-player, we only focus on the main player types of goal-seeker and explorer, without considering the social aspects that will further divide these into subcategories of the major types. In order to assign a single category label to each of the participants, the aggregated values for each of the 2 types are compared and the larger of the two is assigned as the participant’s type.

After the study, two researchers independently coded the screen recordings of all participants to identify their play style. The set of guidelines used for annotation was developed from pilot gameplay data and used for training to ensure internal consistency and validity. As we observed significant shifts of play styles in many players, we segmented the video based on the four main quests. For each segment, the coders manually annotated the video with a binary label (explorer or goal-seeker) along with 3 additional attributes: confusion, interest and the annotator’s confidence.
The coders looked for activities and behaviors regarding navigation, use of the concept map, items visited and order of actions completed. For goal-seekers, a strategy for completing the objectives was examined, as well as how the participants developed that strategy. The two strategies for completing the quests in the minimum amount of time consist in using the concept map for locating the exhibits that unlock the mastodon skeleton bones and then either locating the required items in the concept map itself or going to the unlocking exhibit and getting the list of required exhibits from there. For explorers, the main indicator is the lack of such a strategy and instead how the participants interacted with different items based on their own interests. A 3-point confusion scale was assigned to capture whether a participant appeared to understand how to navigate the environment, the goals or the usage of the concept map; or appeared to wander around without interacting with the exhibits. An additional 3-point interest scale was added to annotate participants who did not appear to be interested in the game — they did not read the material on the info cards or did not make an effort to answer the questions. When the two coders agreed that a player was confused over a predefined threshold (mean > 2.0) or interested below a predefined threshold (mean < 2.0), the observed play style label (explorer or goal-seeker) is replaced with either confused or uninterested.

Results

In this section we present our findings on the study of the relationships between player types and play style and how they affect learning in Solving the Incognitum. Note that from the data collected on the 75 participants, we discarded 17 data points due to missing instruments (video recording, gameplay data, survey or questionnaires).

Learning Outcome for Survey-Based Play Styles

Based on the surveys (AGT and play style), there were 30 goal-seekers (51.72%) and 20 explorers (34.48%). We will refer to them as survey-based (SB) player types to distinguish from the play styles we observed based in gameplay. In addition, 8 participants (13.78%) were unidentifiable as they had an even balance between the two play styles and our survey analysis did not target the approach-avoidance dimension in AGT.

The mean scores for pre-knowledge test and post-knowledge tests for all of the participants were 2.081 and 5.571 respectively out of 12 points, one point for each question in the knowledge tests. A paired sample t-test was used to measure the significance of the difference between pre-knowledge test and post-knowledge test scores within the different subgroups. When testing for significance, for all participants as well as for each subgroup of participants, the increase in the post-test was statistically significant, indicating that the game had a positive effect as a learning tool. Table 1 reports the mean and standard deviation of the tests and the effect size for each group and subgroups of motivation approaches. Explorers (SB) had the largest effect size found from the t-tests between the knowledge test scores at 1.682 standard deviations while goal-seekers had a lower effect size of 1.598 standard deviations. Explorers (SB) also had higher pre-knowledge and post-knowledge test averages.

<table>
<thead>
<tr>
<th></th>
<th>Pre-Test</th>
<th>Post-Test</th>
<th>Mean Difference**</th>
<th>n</th>
<th>Lower</th>
<th>Upper</th>
<th>p</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Participants</td>
<td>2.081</td>
<td>5.571</td>
<td>3.490</td>
<td>58</td>
<td>2.935</td>
<td>4.046</td>
<td>0.000*</td>
<td>1.652</td>
</tr>
<tr>
<td>Goal-seeker</td>
<td>1.903</td>
<td>5.283</td>
<td>3.380</td>
<td>30</td>
<td>2.590</td>
<td>4.170</td>
<td>0.000*</td>
<td>1.598</td>
</tr>
<tr>
<td>Explorer</td>
<td>2.630</td>
<td>6.007</td>
<td>3.377</td>
<td>20</td>
<td>2.437</td>
<td>4.316</td>
<td>0.000*</td>
<td>1.682</td>
</tr>
<tr>
<td>Unidentifiable</td>
<td>1.375</td>
<td>5.562</td>
<td>4.187</td>
<td>8</td>
<td>2.104</td>
<td>6.271</td>
<td>0.002*</td>
<td>1.680</td>
</tr>
</tbody>
</table>

Table 1: Summary of test scores, number of participants and effect size for the different groups identified from the AGT + player type survey (n=58).

Learning Outcome for Observed Play Styles

The 58 gameplay sessions range from 9 to 54 minutes of gameplay (mean=21.42 minutes, std=8.01 minutes). An automated logging system in the game recorded an average of 4,558 events such as mouse clicks, key presses or exhibit interactions (std=1,270). Based on our annotation, there were a total of 24 observed Goal-Seeker (41.37%), 15 Explorer (25.86%), 10 uninterested players (17.24%), 5 confused players (8.62%), and 4 couldn’t be assigned either label (6.89%).
The pre-knowledge test and post-knowledge test score means for observed explorer tendencies were 1.693 and 6.060 respectively, for observed goal-seekers they were 2.556 and 5.762, for confused players the means were 1.200 and 3.747 and for players who did not care or show interest in the content the means were 1.797 and 4.807. The detailed comparison is reported in Table 2 along with a comparison between overall observed tendency, constant tendencies and participants shifting between tendencies (described in the next section). The observed tendencies reported in this section represent an overall tendency for each participant as agreed by the annotators. A paired sample T-test used to measure the significance of the difference between pre and post knowledge test scores showed that the means for each group were significant with p values less than p=0.05 with the exception of the confused players, whose p value was p=0.125. There was no relationship found between the observed data and the results from the motivation and player style survey.

<table>
<thead>
<tr>
<th>Player Type</th>
<th>Pre-Test Mean</th>
<th>Pre-Test Std.</th>
<th>Post-Test Mean</th>
<th>Post-Test Std.</th>
<th>n</th>
<th>Lower</th>
<th>Upper</th>
<th>p</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explorer</td>
<td>1.693</td>
<td>1.185</td>
<td>6.060</td>
<td>1.909</td>
<td>15</td>
<td>3.324</td>
<td>5.503</td>
<td>.000*</td>
<td>2.243</td>
</tr>
<tr>
<td>Goal-seeker</td>
<td>2.556</td>
<td>1.269</td>
<td>5.762</td>
<td>1.963</td>
<td>24</td>
<td>2.379</td>
<td>4.035</td>
<td>.000*</td>
<td>1.636</td>
</tr>
<tr>
<td>Uninterested</td>
<td>1.797</td>
<td>1.128</td>
<td>4.807</td>
<td>1.771</td>
<td>10</td>
<td>1.625</td>
<td>4.395</td>
<td>.001*</td>
<td>1.555</td>
</tr>
<tr>
<td>Confused</td>
<td>1.200</td>
<td>1.095</td>
<td>3.747</td>
<td>3.453</td>
<td>5</td>
<td>-1.101</td>
<td>6.194</td>
<td>0.125</td>
<td>0.867</td>
</tr>
<tr>
<td>Other</td>
<td>2.500</td>
<td>1.915</td>
<td>6.783</td>
<td>2.521</td>
<td>4</td>
<td>0.609</td>
<td>7.958</td>
<td>0.035</td>
<td>2.048</td>
</tr>
<tr>
<td>Constant Explorer</td>
<td>1.750</td>
<td>1.173</td>
<td>6.350</td>
<td>1.412</td>
<td>6</td>
<td>2.765</td>
<td>6.435</td>
<td>.001*</td>
<td>2.631</td>
</tr>
<tr>
<td>Constant Goal-s.</td>
<td>2.588</td>
<td>1.353</td>
<td>5.596</td>
<td>2.083</td>
<td>8</td>
<td>1.019</td>
<td>4.998</td>
<td>.009*</td>
<td>1.264</td>
</tr>
<tr>
<td>Non-Constant</td>
<td>2.034</td>
<td>1.316</td>
<td>5.461</td>
<td>2.277</td>
<td>44</td>
<td>2.787</td>
<td>4.066</td>
<td>.000*</td>
<td>1.630</td>
</tr>
</tbody>
</table>

Table 2: Summary of test scores, number of participants and effect size for the different groups identified from the annotated observations (n=58).

Furthermore the individual question responses in the player type survey and in the pre- and post-knowledge test questionnaires were studied using Pearson correlation against the observed play style labels. The survey intends to cover the AGT player types and we expected it to have a high degree of correlation with the observed overall play style tendency for each participant and should allow us to use linear regression to predict a participant’s play style given their player type survey responses. The best performing questions from the player type survey in terms of positive correlation, with this regard are: “I am striving to avoid performing worse than others in this science game”. (0.214) and: “I prefer exploring the game world over completing particular objectives”. (0.166). Since the annotations also include extra labels for confused and uninterested participants, those two were considered as disjoint categories and the previous data studied using Pearson correlation. Counterintuitively, we found a correlation lower than expected between the knowledge gain and the observed participants labeled as confused and uninterested (0.088). On the other hand, some questions regarding typical gaming play style showed correlation with the participants observed as uninterested. The questions are: “Finding and using gaming strategies is very important to me”. (0.419) and: “I prefer exploring the game world over completing particular objectives.” (0.169).

Shifting Play Styles

Our data confirms existing theories (Foster, 2009; 2011; Heeter, 2009, Klug & Schell, 2006) that a player does not always stay with the same play style during the same gameplay session in a fixed context. Compared to existing work, our study is among the first to provide gameplay data and illustrate how players switch between different play styles.

As we observed what play style the participants adopted during their entire gameplay session, only 14 people (24.13%) exhibited a consistent play style. 8 of them adopted the goal-seeker play style and 6 explorer play style. When we classified their behavior at the granularity of a quest, the rest of the participants all made at least one shift.
Figure 3 is an alluvial diagram that shows how participants shift their observed play styles between the four quests. Each vertical block represents one of the four main quests. Each block is divided into the 5 observed play styles based on how many participants were observed to adopt that play style for a given quest. The stream fields between the blocks represent changes in the composition of the play style clusters over time. For instance, the amount of observed explorers is 30 (51.72%) in Quest 1 while the number dropped to 7 (12.07%) by Quest 4. Figure 3 shows the trend of how participants move between the styles. For example, all 9 observed goal seekers in Quest 1 continued as so in Quest 2, while 13 other participants previously identified as explorer and uninterested also adopted this play style for this quest.

Analyzing their learning outcome, we found that players that were observed to maintain a consistent explorer play style showed better performance in the post-knowledge test and an overall increase in knowledge gain compared to the rest of the players, either switching or not. The bottom rows in Table 2 summarize the results for participants with an observed constant play-style and participants who shifted between play styles.

Discussions

Our work differs from previous related research in which we use empirical data instead of self-reported data to support our results. Our major finding is that players switch their play style through a single game session in a manner that is not consistent with their identified player type from self-reported data. We attribute the substantial divergence between the player types identified in the survey and the observed play styles to the broad scope of the responses from the survey (general gaming interests and study preferences) versus the constrained nature of the learning environment we asked the participants to play.

Our analysis provides arguments to question the validity of using player types identified from survey and questionnaire results for the study of a particular game or interactive learning environment. Instead, our results indicate a weak relationship between identified player type and observed play style and show how players switch from different play styles over the course of a play session. We conducted a user study with 75 participants from which we collected 58 play session data. We observed how initially participants exhibited an explorer play style but many switched to goal-seeker play-style through the play session. We also observed many reluctant players who showed little interest in the pedagogical content presented by the learning environment. Our observations are supported by evidence gathered from the recorded gameplay data from our user study and are aligned with previous research but caution must be taken in drawing generalized conclusions as the design of the virtual environment may have a direct impact on play style.

Conclusion and Future Work

In this paper we presented the game mechanics of Solving the Incognitum, designed to allow learners of different player types to engage in different gameplay activities. Based on our study, Solving the Incognitum was able to increase the participants’ knowledge of the earth science concepts in the game, although we did not find strong correlations between learning outcome and specific player types or play style. Our data shows that the majority of our participants switched their play styles, many did so more than once, in their gameplay and we presented how and when they switched. We believe this is still an early exploratory study but raises interesting issues for future studies.

Our findings confirmed the need for tracking learners' play styles and motivation in real time. In our future work,
we plan to further analyze our recorded gameplay data and develop a player model that can recognize a player’s style and potentially motivation.

Acknowledgments

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References


Shapes and patterns of adaptive game-based learning: an experiment

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Abstract: It is often claimed that adaptive educational games keep the learner more engaged and maximize the learning taking place in the game. We explored these two claims by evaluating adaptive and non-adaptive forms of a pattern- and shape-recognition game for preschoolers. We used a Bayesian IRT model to make this game adapt in real time to the learner’s performance. Results indicate that adaptivity led to higher engagement, and we found some evidence of greater learning. We also note some important prerequisites for the success of adaptive games.

Introduction

Adaptive learning, game-based learning, and early learning are all hot topics in educational policy circles: Adaptive learning promises to help educators support the wide variety of learning needs and goals in our current educational system; game-based learning can improve engagement; and early learning sets the stage for future academic success or failure. Adaptive, game-based early learning is also a promising area of research because (a) young children learn naturally through play and (b) young children’s abilities develop rapidly, making an adaptive-learning context especially appropriate.

There is ample evidence that game-based learning improves engagement (Steinkuehler, Squire, and Barab, 2012) and that personalization improves learning (e.g., Connor, Morrison, Fishman, Schatschneider, and Underwood, 2007). The few studies of real-time adaptivity in games have found mixed results for learning and engagement (e.g., Núñez Castellar, All, and Van Looy, 2014; Orvis, Horn, and Belavich, 2008; Sampayo-Vargas, Cope, He, and Byrne, 2013); the implementations, curricula, durations, and age groups (no preschoolers) in these studies were vastly different.

Here we describe the design of an iPad-based game designed to help preschoolers learn basic concepts about shapes and patterns, and we compare learning and engagement outcomes for the adaptive and non-adaptive versions of this game.

Making a game real-time adaptive through Bayesian IRT

An educational game can be adaptive in different ways. Learners may be assessed initially and then assigned to a fixed learning path, or their path may change after each “level” of the game. At the extreme is real-time adaptivity, where the game adapts every time a learner completes a challenge. This high level of adaptivity is intended to keep the game at a “Goldilocks” level of difficulty for the learner (neither too easy nor too hard) to optimize engagement and learning.

To achieve the continuous assessment required for real-time adaptivity, we used item response theory (IRT) models (e.g., Embretson & Reise, 2000) from computerized adaptive testing (e.g., van der Linden & Glas, 2010; Wainer et al., 2000). IRT provides the tools to estimate item (i.e., challenge) difficulty and person (i.e., learner) ability on a single scale (see Figure 1). For example, in a basic model, when an item’s difficulty and a person’s estimated ability are equal, the person has a 50% probability of answering the item correctly; when the person’s ability is higher/lower than the item’s difficulty, the person is more/less likely to get the answer correct.

![Figure 1: Increasing pattern complexity and learner ability on a single scale.](image)

But games differ in important ways from tests. In tests, people typically answer many items at once, providing a
lot of data about both people’s performance and items’ difficulties. Educational games typically consist of multiple
short interactions with a few responses each. And whereas tests attempt to capture a highly accurate snapshot
measurement of a person’s ability at a specific moment in time, educational games encourage learning over time,
with the result that ability estimates change frequently. These features cause trouble for traditional computerized
adaptive testing models: There is too little information to yield an accurate assessment of a learner’s ability within
one gameplay session, but taking all measurements together to estimate ability leaves no room to monitor growth.

Researchers have developed numerous approaches to address these concerns in computerized adaptive learning
(e.g., Eggen, 2012; Klinkenberg, Straatemeier & van der Maas, 2011; Wauters, Desmet & Van Den Noortgate,
2010; 2011). Our approach is to use Bayesian IRT (for more on Bayesian IRT models, see Fox, 2010 and van der
Linden & Glas, 2010). In Bayesian IRT, prior knowledge about a person’s ability is considered in the estimation
process, so previous gameplay results can be taken into account when learners begin a subsequent play session.
To monitor change in performance over time, we weighted this prior information less heavily than if the sessions
had been played in a single assessment situation. In this way, we could counter the effect of short test length by
incorporating additional information, while still allowing measures of ability to change over time.

Study Description

We conducted a field experiment to measure engagement and learning in adaptive and non-adaptive versions
of a learning game for preschool-aged children; we also measured learning in a control group not playing either
version of the game. We recruited families in the US with a single child between the ages of 2.5 to 4.5 and an iPad
2 or later with wireless Internet access at home. Household income, ethnicity, and parent education varied widely
in the sample. Participants and their parents used an iPad app created for this study (described further below) at
home to complete pre- and posttests and for all game play.

All participants began by completing a pretest with nine questions about shapes and nine about patterns. Partic-
ipants were then randomly assigned to the adaptive (n = 44), non-adaptive (n = 47) or control (n = 48) condition,
with condition assignment stratified by pretest score. During the following six weeks, participants in the adaptive
and non-adaptive conditions were asked to use the iPad app to play games designed to assess and teach shape
identification/manipulation and pattern recognition. The six weeks were divided into 18 lessons, with each lesson
lasting two or three days. During each lesson, participants were asked to play each of four games at least once, af-
ter which they could replay games as often as they wished. After six weeks, all participants were asked to complete
an 18-question posttest (a parallel form of the pretest), which resulted in 36 (adaptive), 39 (non-adaptive), and 40
(control) completed posttests. Participants in the control group were given access to the game after completing
the posttest.

For both the adaptive and non-adaptive conditions, each game was designed to continuously measure participant
ability. For only the adaptive condition, participants were then presented challenges (i.e., items) with an expected
70% probability of correct response. For participants in the non-adaptive condition, challenge difficulty was in-
creased at the beginning of the third and then every other lesson (i.e., every four to five days), regardless of the
participant’s ability or whether the participant had played once, multiple times, or not at all during that lesson.

Gameplay

An iPad app was created to advance shape understanding and to teach pattern recognition and extension to pre-
schoolers using two shape games and two pattern games, along with short educational video clips. Within each of
these two domains, gameplay was largely the same.

In the two shape games, participants worked on shape identification and manipulation (translation, rotation, scal-
ing, and composition). Participants were shown a set of shapes at the bottom of the screen, varying from simple
shapes like a circle or square to less familiar shapes like a pentagon or irregular octagon. In the easiest levels,
participants had to match a target shape presented at the top of the screen. In more difficult levels, participants
had to identify shapes by name only (e.g., “Tap the square”) or rotate shapes to fit an outline. In the hardest levels,
participants had to compose an outlined shape “puzzle” from multiple pieces, dragging them to the target area and
rotating them to fit.

In the two pattern games, participants were shown a sequence of objects (such as ABAB, ABCABC, or ABBABB)
and had to choose the correct object(s) to continue the pattern. At the easiest level, participants saw objects “A”
and “B” in an ABAB pattern and asked, “What comes next?” with the choice of another “A” item or an unrelated
“C” item. Higher levels had more difficult distractor objects (e.g., both “A” and “B” objects in the example above)
and asked for multiple pattern elements rather than simply the next element. In the highest levels, participants first
defined their own sequence of objects and then repeated that sequence.

Figure 2: Screenshots of the two shapes games

Figure 3: Screenshots of the two patterns games

In all four games, participants were given corrective feedback and hints after incorrect responses, with multiple chances to provide the right answer (although only the first response counted towards ability estimation). In addition, participants were shown short video clips between the games to reinforce the concepts they had just been working on.

Results

Engagement

The first measure of engagement we looked at was the duration of play sessions, defined as the time between opening and closing the app that contained the games. Figure 4 shows the distribution of the duration per play session in minutes for the adaptive and non-adaptive conditions. Because the distributions are skewed (as is often the case with measures of time or duration), we took the log of the durations and assessed whether there was a difference in log(duration) between conditions with a linear mixed model with random effects for the participants. The difference was significant (\( \beta = 6.10, \text{df} = 1, p = .01 \)). The average duration of play sessions was 10.4 minutes in the adaptive condition and 8.7 minutes in the non-adaptive condition.

Next we looked at the retention of participants over lessons (the 2-3 day periods in which the participants were supposed to play all four games at least once). Because we expected usage to decrease (or decay) exponentially over time, we used log(lesson number) as a predictor, as well as condition and the interaction between log(lesson number) and condition. First, we fit a logistic regression model predicting whether participants in the two conditions played in a certain lesson period. We found a significant decrease in the probability of playing over time (\( b = -.89, z = -9.39, p < .001 \)) but no significant negative time-by-condition interaction.

Another way to look at retention is to consider the number of times participants played within each lesson period. Because this is a count (which is naturally very skewed) and because there were many zero counts, we performed a negative binomial regression analysis, with the same predictors as our previous analysis: log(lesson number), condition, and their interaction. There was a significant decrease in number of playthroughs per lesson for the
adaptive condition ($b = -.68, z = -7.03, p < .001$), but this decrease was steeper for the non-adaptive condition, as indicated by a significant interaction effect ($b = -.30, z = -3.393, p < .001$). Figure 5 illustrates these results. The dotted lines represent the observed average number of playthroughs in each lesson, and the solid lines represent the number of playthroughs predicted by the negative binomial regression model. Retention is significantly lower in the non-adaptive than in the adaptive condition.

![Figure 4: Distribution of play session duration in the adaptive and non-adaptive condition](image)

![Figure 5: Retention of learners over time: Number of playthroughs in each of the lesson periods.](image)

**Learning**

First we looked at pre-/posttest score changes, but there were no differences among the adaptive, non-adaptive and control conditions. (We will elaborate more on these results in the discussion.)
Next we looked at in-game performance measures, using ability estimates calculated throughout the study to see how ability estimates at the end of each playthrough changed over time. For both domains (shapes and patterns), we ran a linear mixed model with random effects for the participants, and fixed effects for lesson, condition, and the lesson-by-condition interaction.

Figure 6 presents results for the shapes and patterns domains. In the shapes games, the adaptive and non-adaptive conditions started out at equal ability ($b = -.04, t = -.29$). There was no increase in ability for the non-adaptive condition ($b = .01, t = 2.22$), but a positive interaction effect ($b = .02, t = 3.521$) shows a significant increase in ability for the adaptive condition over lessons ($= 12.38, df = 1, p < .001$). In the patterns games, the non-adaptive group started out at a slightly but not significantly ($= 2.05, df = 1, p = .15$) lower level after the first lesson than the adaptive group ($b = -.23, t = -1.38$). The ability in both conditions increased ($= 48.46, df = 1, p < .001$) but the interaction effect indicated that the increase in ability over lessons was not different for the non-adaptive than for the adaptive condition. We elaborate on possible causes for these mixed results below.

Adaptivity

One way to check the adaptive mechanism is to evaluate the percentage of items per playthrough answered correctly during the game and how this changed over lesson periods. In the adaptive condition, this percentage should stay at 70% (our target percentage when matching items to ability estimates). For the non-adaptive condition, the percentage correct should be high in the first lessons and decrease over time, because challenges were designed to increase in difficulty regardless of whether or how well the participant played. The results of a logistic mixed regression confirmed these expectations: The average percentage correct in the adaptive condition was 67% in the patterns game and 74% in the shapes game, and it did not change significantly over lessons. A significant interaction indicated a decrease in percentage correct for the non-adaptive condition in both the patterns ($b = -.1, z = -10.92, p < .01$) and shapes ($b = -.07 z = -7.72, p < .01$) domains.

Another way to check the adaptive mechanism is to evaluate whether the adaptive version of the game was able to adapt to the level of the participant adequately. To evaluate this, we looked at the in-game participant-ability estimates and the difficulties of the items offered to the participants in the adaptive condition. Because participants were given items that they were expected to answer correctly with 70% probability, the threshold they needed to reach for moving up in item difficulty was equal to the item's difficulty + 0.5. Figure 7 shows that item-difficulty thresholds (bold lines) and in-game participant-ability estimates (dotted lines) matched quite well for the shapes games. For the patterns games, however, the adaptivity of the games was not optimal: The range of item difficulties for this domain was too narrow, overlapping only with a small percentage of the actual participant abilities. Therefore, participants with very low or high ability got “stuck” on one level of the game.
Discussion

Our results clearly support the claim that adaptivity in educational games leads to more engagement. The participants in the adaptive condition played longer sessions than the participants in the non-adaptive condition, and the number of playthroughs per lesson period decreased more over time for the non-adaptive than for the adaptive condition.

The results are more mixed for the claim that adaptivity leads to greater learning. In the shapes domain, we found evidence of improvements in learning performance in the adaptive condition relative to the non-adaptive condition, but the pre-/posttest measures showed no condition differences, and the patterns domain showed no differences in learning for the two conditions.

The failure of pre-/posttest measures to show any differences is quite possibly due to the low reliability of the instruments with our participants (Cronbach’s α ranged from .45 to .69 on the subscales). It is also possible that the instruments were not sensitive enough to overcome the effects of parental “support” in the tests: In a post-study survey, 75% of parents reported having assisted at least a little with either the pre- or posttest, even though they were explicitly instructed not to. Another possible explanation could be that staying focused and completing an 18-item test was simply too ambitious for our preschoolers (e.g., Jones, Rothbart & Posner, 2003).

The learning results of the patterns domain might be explained by the inferior functioning of the adaptive mechanism in the patterns games. Specifically, the range of difficulty levels for the games’ challenges did not match the actual abilities of the participants playing the games, so the majority of adaptive-condition participants got “stuck” in either the easiest or hardest game challenges. In the non-adaptive condition, participants received challenges of increasing difficulty regardless of their performance, which could explain why these learners showed equal learning over time.

In conclusion, our study provided evidence of increased engagement in adaptive games and mixed evidence for increased learning. One important lesson from this experiment for designers of adaptive learning games is to include challenges (i.e., items) spanning a wide enough range of difficulties to match the full range of learners’ abilities. This requires some form of item calibration (testing challenges with diverse learners to assess their difficulties) during the design of the game so that gaps in challenge difficulty can be filled with appropriately difficult new challenges. Future work on adaptive games could include investigating more efficient ways to calibrate item difficulties in adaptive games, to more quickly achieve the necessary range of challenges without increasing the already substantial work of recruiting learners solely for this process. Another important lesson from this experi-
ment is that adaptive learning games of this kind can be effective even with children as young as three years old. This is particularly important given that children vary tremendously in their levels of skill as well as their rates of development in this age range, and it suggests that more work could be done to develop effective learning games to provide more tailored learning experiences in this key developmental period.

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Situating Big Data Across Heterogeneous Data Sets of Game Data Exhaust, Class Assessment Measures, and Student Talk

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Abstract: This project seeks to marry theories of situated cognition to the big data movement by connecting clickstream data from technologies in isolation to key forms of multimodal data available from their contexts of use. Using a data corpus gathered from a five-day implementation of the STEM game Virulent (targeting cellular biology), we are combining multiple analytic strategies commonly considered incommensurate including educational data mining, qualitative coding, discourse analysis, natural language processing, and standard classroom assessments. In this paper, we review the project goals and preliminary findings, and discuss the benefits and drawbacks to analysis across heterogeneous data sets. Our goal is to provide a more complete model for big data analysis, one that includes both talk and play data equally or, where not possible, identify its limitations so that future “data rich” attempts on learning might be better informed by the limitations of technology-rich but talk-poor data sets.

One of the defining questions for education over the next decade is, how do we shift education from a data poor to a data rich activity? (T. Kalil, personal communication, September 1, 2013). “Big data” techniques (the capture, curation, storage, and analysis of massive, complex data sets spanning large numbers of individuals) have made progress in areas such as content knowledge, inquiry practice, and, to a lesser extent, interest, but significant work remains in areas such as identity, participation, and epistemology – domains historically studied through discourse analysis and other forms of qualitative methods. The majority of data streams used in big data analyses are “data exhaust” from technologies considered largely in isolation. We know, however, that such technologies are socio-technical artifacts (Bijker, 1995) whose potential for learning, like that of any instructional tool, is highly influenced by its context of use. Whether it’s a textbook, calculator, or high-end 3-D graphical data display, a tool is only as good as the activities and practices in which it is embedded. Thus, if we want to catalyze progress toward more expanded frameworks for learning goals that include tricky variables such as identity and dispositions, then, we must include not only the data streams from technology and tool use but also talk and interaction data that surround it. And we would be wise to build on the last several decades of discourse and content analytic techniques used routinely in more qualitatively oriented research.

This project seeks to marry theories of situated cognition to the big data movement by connecting clickstream data to key forms of multimodal data available from their contexts of use. Using a data corpus gathered from a five-day game-based implementation of the STEM game Virulent (targeting cellular biology), we are combining multiple analytic strategies commonly considered incommensurate, including educational data mining, learning analytics, quantification of qualitative coding, natural language processing, and standard classroom assessments. The data include: clickstream telemetry data; individual and group discourse; individual and curricular artifacts; classroom assessments; and online forum postings. In this paper, we describe the context of our investigation, including the game used and its attending curricula, and then detail our data collection methods thus far. We discuss the benefits and drawbacks to analysis across heterogeneous data sets and our current attempts to develop a more complete model for big data analysis, one that includes both talk and play data equally or, where not possible, identify its limitations so that future “data rich” attempts on learning are better informed by the limitations of technology-rich but context-poor (and talk-poor) data sets.

The Game & Activities

Virulent (Figure 1) is a real-time strategy game about viral infection and the cellular immune system. Players control the fictional “Raven” virus and guide it to infect a host organism. Virulent allows players to ‘hijack’ cellular parts such as mitochondria, protein receptors, and nuclear pores, in an approximation of a viral life cycle. Players also utilize host cell ribosomes to enable translation of viral mRNA fragments into proteins to use as power-ups.
Additionally, Virulent features a graphical almanac where players read about different units, enemies, and cellular structures found in the game, such as proteasomes, budding sites, and viral genomes.

We developed a five-day role-playing curriculum based on the game focusing on a fictional outbreak of the Raven virus. The overarching narrative of the role-playing unit was that the Center for Disease Control (CDC) needed young innovative scientists (the students) to help them figure out how to stop a dangerous outbreak of the virus. At the beginning of the unit, the class received a pre-recorded video conference call from actors pretending to be CDC scientists and were given the mission of using their “digiscope” (their iPad with the Virulent game software on it) to figure out how the virus attacks cells and develop a strategy for stopping it. The curriculum unit lasted five days total (90 minutes per session). Each day, students received updates on the status of the outbreak from the “CDC” (Figure 2). Participants were divided into small “research teams” of 3-4 students; each team was responsible for using the game to create a model of how the virus and cell interact. Each team had to present their model to their peers and to the CDC scientists (via video). On the fifth and final day, the CDC gave teams three plausible intervention ideas to fight the outbreak of the virus (develop a vaccine, use an RNA interference treatment, or inhibit the cell’s mitochondria) along with outside information sources about each solution (a news article about vaccines, an adapted science journal article about RNA interference, and a mock textbook page about mitochondria). Participants then attempted to reach consensus in a whole class debate as to which solution they should recommend to the CDC based on their model and the outside resources given and converged on a final course of action.

Data Collection

Data was collected in three separate contexts: as part of a spring break camp run by GLS called Game-a-Palooza (N=34 across 3 cohort groups), within in a single class at a local private school’s extended day program (N=11), and as a unit within a larger summer camp run by the Boys and Girls Club (N=27). Across all three contexts, participants were separated into their research teams (n=3-4) with each team supported by a facilitator. We assembled teams semi-randomly (based on age) but allowed players to switch teams to enable participants to play with friends or siblings also enrolled in the event. Over the course of five 90-minute sessions, the research team was the primary context for interaction.
Across these nested groupings, we collected multiple data streams from each participant. For each individual participant, across all five 90-minute sessions, we recorded all in-game telemetry data via our backend data framework, the Assessment Data Aggregator for Gaming Environments (ADAGE). ADAGE (Owen & Halverson, 2013) is a tool for capturing and tagging clickstream data to correspond with moves, decisions, and events within the game, allowing for analysis of player actions in-game to assess learning and triangulate those in-game play patterns against other external measures. We also collected the in-room complement to this telemetry data stream: the complete stream of verbal data via lavalier audio recorders. We collected individual pre-/post-assessments, including: Likert items measuring attitudes about, interest in, and confidence in science; multiple-choice and open-ended items testing specific Virulent-related content; and creating a drawing of a scientist. We also collected all individual paper artifacts such as diagrams, worksheets and models. For each team, we collected: photographs of their models of the virus (to capture model creation and revision over time) and their short video explaining and justifying their model. For each cohort (n=15-20), we video-recorded classroom presentations of models of the virus and debate of proposed solutions for the epidemic, and we did daily interviews with the teacher. We also performed 28 stimulated recall interviews with participants several weeks after the unit was completed to understand participants’ persistent understanding of and attitudes towards the content and to specifically prompt discussion of model revisions over the five days. We are using the Qualitative Data Analysis Software MAXQDA as the central data hub for our qualitative data.

Data Analysis

Four primary forms of analysis comprise our overall strategy: educational data mining and learning analytics, the quantification of qualitative codes, natural language processing modeling of student discourse and text, and pre/post traditional assessments.

Big data efforts in educational research fall under the general rubric of educational data mining (EDM) or learning analytics (LA), where EDM describes broad analysis of a large set of learners (>1K) and LA describes deeper analysis of a smaller set. EDM has predicted how in-game behavior relates to cognitive-affect and performance metrics (Baker, D’Mello, Rodrigo & Graesser, 2010); assessed intuitive and formal understanding of specific physics content (Clark & Martinez-Garza, 2012); and demonstrated student learning of programming through strategic game mechanics (Berland, Martin, Benton, Petrick Smith, & Davis, 2013). Our ADAGE data framework guides game developers to articulate the content model of their games through a metadata tagging process that facilitates data mining and exploration as well as matching play patterns to key events in game play (Owen, Shapiro & Halverson, 2013). Variables for analysis for Virulent are included in Table 1. Note that the variables listed do not entail specific research questions, but require additional referential work in order to answer questions of interest.

<table>
<thead>
<tr>
<th>Virulent Telemetry Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Play Time Totals (in- and out-of-session)</td>
</tr>
<tr>
<td>Levels Played, Level Success (pass/fail, time taken, number of attempts)</td>
</tr>
<tr>
<td>Scores per Level (units lost, units destroyed)</td>
</tr>
<tr>
<td>Challenge Completions (judged by coin rewards criteria)</td>
</tr>
<tr>
<td>Cell Resource Use (mRNA creation, protein creation)</td>
</tr>
<tr>
<td>Time Spent on Level Intro Panel (instructions)</td>
</tr>
<tr>
<td>Time Spent in Almanac, Almanac Entries Referenced</td>
</tr>
<tr>
<td>Spawn, Death, and Collision Locations of Game-Controlled and Player-Controlled Resources</td>
</tr>
<tr>
<td>Target Selection by Game-Controlled Resources (whenever a game-controlled resource targets a player-controlled resource)</td>
</tr>
</tbody>
</table>

Table 1. Telemetry variables for analysis in Virulent.

Two forms of contextual data analysis are being conducted: The UW-Madison team focuses on quantified qualitative coding of the data corpus while a second analytic team at Arizona State University, led by Danielle McNamara,
focuses on natural language processing analyses. Analysis in Madison includes an “a priori” six construct coding scheme – based on the National Academy of Science’s “six strands of science learning” framework (Bell & Lewenstein, 2009): (a) interest, (b) content knowledge, (c) inquiry practice, (d) epistemological disposition, (e) longer term participation in the field, and (f) identity development within the domain – and “ground up” constructs related to the six primary themes that arise from the data. We assess aggregated patterns through code counts (where possible) and examine interrelationships among our codes, noting any discursive features (e.g., keywords, grammar) that cluster with codes which could be explored for natural language processing at ASU. The ASU lab applies techniques from natural language processing to find patterns within the textual data corpus in terms of lexical density and sophistication, syntactic complexity, cohesive devices, and other discourse features using tools including the Linguistic Inquiry Word Count (LIWC; Pennebaker, Booth, & Francis, 2007) and Coh-Metrix (Graesser, McNamara, & Kulikowich, 2011; McNamara, Graesser, McCarthy, & Cai, in press). Such tools have been used in a variety of contexts to understand the processes involved in both discourse comprehension and production. When used together, they can be extremely powerful, capturing a wide range of psychological and linguistic attributes of text (e.g., Crossley & McNamara, 2012; Varner, Roscoe, & McNamara, 2013).

Results from these two approaches to contextual data analysis can be merged in order to assess how and where patterns of discourse features and human-coded trajectories of learning converge. We know that some features of discourse and artifacts that are crucial to context and meaning can be meaningfully quantified (e.g., discourse markers, Schiffrin, 1993; quantifiable codes, Chi, 1997) for comparison to patterns in telemetry data sets while the frequency of other structures is less meaningful (e.g., singular utterances that signal a crucial transition in an interaction may only appear once but once is enough, Gee, 2010). Thus, our task is to determine fruitful areas where patterns uncovered through human interpretation co-locate with patterns discerned through NLP (Natural Language Processing) and other automated means. This combination of analyses enables to cast a wide, empirically robust net on socio-material interactions.

Discussion

Data Collection Challenges

Collecting a rich, multi-modal dataset presents a series of difficult challenges. First, assembling the right team of researchers and designers is non-trivial. Data collection alone required master teachers, trained and supported facilitators, an outreach coordinator, and several undergraduate interns whose job was only to keep track of students and their data as they moved about the facilities. Analysis of the corpus will require experience in EDM, inferential statistics, qualitative inquiry, quantified codes, NLP, discourse analysis, and both game and curricular design.

Although data were carefully labeled throughout the event and we had a dedicated researcher whose sole focus was data collection and organization, lossy data was unavoidable. To facilitate the tracking of each individual participant across the data set, we used lavalier name-badges with an integrated audio recorder and unique QR codes in place of logins, as logins (and passwords) can be used inconsistently. Despite efforts to collect complete data streams on each and every student, absences were common – and because much of the activity was group-based, we had a constant renegotiation of groups, roles, and membership. One researcher tracked the makeup of each group on each day, but analyses will have to be mindful of the flux of participants between/across groups. Such shifts in team composition generate noise in the data corpus for both assessed impact and learning progressions, but are unavoidable in a voluntary event. Future analyses need to include how team composition, stability, and cohesion impact attitudinal and conceptual change.

There are also basic limitations to telemetry data that can be collected on iPads. We intended to log the positions of all player-controlled and game-controlled objects at all times given that players manage and manipulate a whole system of assets. However, due to the large number of moving objects on-screen during higher levels and an iPad’s limited processing power, recording that volume of data was impossible. As a result, we opted to only record the paths of player-controlled objects, with the position of game-controlled objects recorded only upon a significant event (e.g., an object appears on screen). This reduction still resulted in over two million lines of data but sufficiently reduced the load on the iPads.

Additionally, the transcription and integration of 60 separate audio files, one of our largest and richest sources of data in the study, is non-trivial. Each participant was issued a small recorder the size of a USB drive that stayed in their name badge throughout the event, ensuring that every small group or whole cohort discussion was recorded from multiple points. This system created much-needed redundancy in our recordings, allowing us to get around ill-placed recorders and fidgety subjects by providing us multiple copies to select from. The resulting data corpus, however, is roughly 10,000 minutes of audio data that must be transcribed and stitched together into single coherent transcripts of student talk.
Data Analysis Challenges

Our first challenge to analysis of this large corpus is choosing the right unit of analysis given the various configurations of group, cohort, and class. The data collection strategies used enable analysis on the individual level, group level (n=3-4), cohort level (n=15), and event level (n=20-45). If we examine gameplay data only at the individual level, we may miss effects that players had on each other as they played the game together. Across all analyses, we need to carefully consider the nestedness of any data points, which can be influenced by team dynamics, facilitator styles, and overall event context.

A second challenge to analysis is the resourcefulness required to clean the telemetry data. No matter how well the data architecture is designed, in practice its first several runs generate repeated events that need to be found and removed. Play times can be skewed by players simply leaving their iPads running. Moreover, we know from the last decade of games based research that players often have unique game-play strategies, but identifying them within the datasets can be a daunting challenge. In the case of Virulent and given data collection constraints on the iPad, we can only collect the positions of player controlled objects and not game controlled objects, making it even more difficult to determine play-styles based on moment-by-moment choices in relation to the current in-game context of events.

A third and perhaps most crucial challenge to analysis is the complexity of our initial plan for quantifying qualitative data. Our initial “a priori” coding scheme is based on all six strands of the National Academy of Science’s (Bell & Lewenstein, 2009) informal science learning framework, and thus errs on the side of comprehensiveness rather than depth. This scheme will likely need to be iterated and dramatically reduced in scope if we hope to have any sense of reliability not just within-analysis but between analysis and depth. Our “ground up” strategy for generating additional related codes is again comprehensive and needs to be narrowed to key discourse markers or other reliable (and ideally countable) cues in order to intersect in meaningful ways with both the EDM/LA and NLP data analyses. With such a large corpus, any attempt to analyze data line by line, turn by turn, and frame by frame will have to be conducted on small, strategically sampled excerpts of data, not the corpus overall. Addressing both challenges will require multiple iterations, cross-disciplinary communication, and patience.

There is an inescapable tension in combining rich qualitative data with quantitative data. In order to link the qualitative audio data to in-game clickstream data and, ideally, some score on a pre/post test, it needs to be quantified in some way. The parts of the audio data that are easiest to quantify, such as a count of vocabulary words used by a participant, may not be the most meaningful. The game almanac is a case in point. In Virulent, the almanac provides players with just-in-time information about the cell, virus, and immune system and all uses of this almanac are recorded by ADAGE. One obvious path for analysis across our disparate strategies is to compare each individual’s in-game almanac use to players’ vocabulary in pre-/post-assessments and interviews and key word counts from audio data. Such analyses will allow us to more accurately account for individual vocabulary use and development over time and its relation to gain on pre/post assessments. Whether such vocabulary are the constructs most worth investigation is an open question.

Conclusion

This project uses big data research techniques to provide a quantifiable approach to understanding learning in context. Current efforts struggle to measure learning in complex learning environments at scale due to difficulties in capturing how learners interact with a broad range of tools and resources across time. Game-based learning approaches, in addition to providing a rich data exhaust, can demonstrate for learners how and why science is useful and provide them experiences using science to solve problems, which are pedagogical approaches known to increase participation in science (Bell & Lewenstein, 2009). Assessing learning in action through games rather than post hoc enables educators to collapse formative and summative assessments into routine assessments within an integrated learning activity, providing better learning data and more valid claims about what students know. If a defining question for education now is how to move education from a data poor to a data rich activity, and we stay committed to frameworks for learning that include more than simply declarative knowledge and rote skills, then we must take seriously the creation of big data systems that can handle richer data and richer educational constructs. The proliferation of digital devices and distribution platforms makes the rapid expansion of a system inevitable; the next stage in this line of inquiry is to consider the full ecosystem of learning to take into account context and not just technology.

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Problematizing Games and Learning: The Ideal Trajectory and Cultural Ideologies

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Abstract: In this presentation, I will problematize claims about the educational value of learning through video game cultures by examining critiques from critical digital studies and critical cultural studies. The first problem with the claims made about learning through video game cultures is that it assumes an ideal trajectory towards video game participation. The second problem with the claims made about learning through video game cultures is that they do not address explicitly the embedded cultural hegemony that students are also learning. By bringing these concerns into the discourse and proposing possible alternative approaches, this presentation aims to engage with this medium from a critical position in the field of games and learning.

Introduction

As an art educator and player, I am deeply intrigued by the attention on video games and learning, as it suggests new ways of conceptualizing education and school curricula. Using the content, mechanism, and experiences of engaging with this medium as curriculum, schools have appropriated this cultural practice to demonstrate the need for active participation in any semiotic domain. Beyond the realm of education, many video game players are learning to become active cultural participants in both the society at large and within specific video game cultures.

As Dyer-Witheford & de Peuter (2009) pointed out, “scholars can be said to have responded to this young medium with one of three broad stances: condemnatory, celebratory, or critical, positions whose popularity and influences have approximately followed a chronological sequence” (p. xxiv). Currently, scholarship on video game as an educational medium has bypassed the condemnatory phase, and takes a predominately celebratory position (Whitton, 2014). However, I am critical of certain celebratory claims made about learning through participating in video game cultures.

The cultural practices within the video game cultures in relation to the society at large has not gone unchallenged, and the classroom application of these practices also has its problems. Players and students are learning to become active participants of cultural practices, but what is the value of this learning when the cultural practices are situated within a stratified and hegemonic society? Critical Internet Studies suggest that we should, “especially take a look at how freedom of speech and freedom of assembly are limited by unequal conditions of access (money, education, age, etc) and the domination of visibility and attention by big economic and political organizations” (Fuchs, 2012, p.404).

In this presentation, I will problematize the celebratory claims about the educational value of learning through video game cultures by examining critiques from critical digital studies and critical cultural studies. Specifically, I will address the ideal trajectory of learning through video game participation assumed by educational scholars and the cultural ideologies dominating this cultural practice. By bringing these concerns into the discourse and proposing possible alternative approaches, this presentation aims to engage with this medium from a critical position in the field of games and learning.

An Ideal Trajectory

The first problem with claims made about learning cultural participation through video game cultures is that it often assumes an ideal trajectory towards video game participation. The ideal trajectory refers to learning that happens through active participation in all the cultural practices within this domain. Players are all able to learn to decode this semiotic domain through engaging in play that embodies this domain.

According to Gee (2007) and Duncan (2009), the educational value of video games lies in the developmental path of video game cultural participation. In the beginning, players are merely consumers. They learn to play the game by playing it alone and playing with others. They become familiar with the rules that govern the game world, or semiotic domain. They also acquire membership in related affinity spaces that supports their consumption in existing media as well as their production of modified media. With the knowledge of the game world and support of affinity spaces, players are encouraged to transition into prosumers. By becoming prosumers, players are able to exercise the designer mindset and begin to think critically and systematically about the medium and the domain. They are able to see the limitations existing in the domain, and propose modifications to the existing restrictions or creative
solutions to improve the domain.

However, this argument does not address the issues of exclusion that often happens through cultural barriers. The uncritical application of commercial games in schools furthers existing exclusions by assuming a universal experience among students. This ideal trajectory can be broken down in terms of two assumptions: the ideal player and the ideal game.

**The Ideal Player**

In the ideal trajectory, the ideal player is central to the conclusion that video game players become learners of cultural participation. The ideal players are able to access video games and participate in full as active prosumers within affinity spaces. This assumption disregards the issue that video game as a medium is situated within a socio-cultural context. Existing hierarchies and stratified social relations within a society influence who is able to produce and consume media and how media is produced and consumed. These relations are brought into the virtual worlds through digital divides.

Beyond the digital divide between developed and developing countries, there is a digital divide among generations or same-age cohorts (Coleman & Dyer-Witheford, 2007). The first form of digital divide stems from class (Fuchs, 2012). This divide may take the form of simply denying access to platforms where video games are played. The more pressing and easily neglected divide comes in terms of the proficiency and literacy about the medium inherent in the ways this medium is accessed. Players who can only play at library computers are significantly limited in their access. In a practical sense, this translates into exclusion. Players who have access to games at home and even have the economic power to purchase advanced technological hardware with better graphics or Internet speed are going to have a significantly different experience of engagement and degree of participation.

Another form of digital divide stems from cultural identities, including race and gender. The digital space is overwhelmingly white (McPherson, 2012). While the issue of race is related to the issue of class, it is also a fact that the semiotic domains of video games have constructed practices and languages that speaks to a predominantly White audience. At the same time, genres of video games have revolved around subjects that have long been associated with masculine domains (Taylor, 2006). Even though female gamers are no longer a rarity, the recent #Gamergate incident, where female gamers and game designers were the victim of cyber bullying, goes on to demonstrate how players continue to receive differential treatment based on gender (Hathaway, 2014). As video game cultures are semiotic domains that are more associated with certain cultural identities in real-life, they are not equally welcoming to all players and those with outlier identities may not progress in the same way as the "ideal" player (Nakamura, 2000; Taylor, 2006).

If schools do not address this assumption of the ideal player, adopting video game cultural practices as curriculum reinforces the existing hierarchy of engagement. Students who have been more proficient in this medium will probably show greater interest and perform better as video games speak to domain knowledge with which they are already familiar. At the same time, disenfranchised players may be further disengaged in schools.

**The Ideal Game**

One problem with discussing video game cultures is that there are such a wide variety of genres with which players engage. Though the assumption of the ideal game is often made explicit in educational scholars’ discussion of learning through video game cultures, the term “video game cultures” may be an over generalization. Projecting a single learning trajectory for how different players might engage with a given cultural script is also to overgeneralize.

Gee (2007) and Squire (2011) have claimed that the learning trajectory they are formulating largely depends on “good games” that build learning principles into the designs. Good games allow players to learn the semiotic domain in an efficient manner, while allowing for experimentation and failures. However, transition into active cultural participation relies heavily on affinity spaces, and these may not exist for all good games. At the same time, even if there are active affinity spaces, the level of engagement is not guaranteed.

In their argument about the value of video games as curriculum, Parks (2008) and Schulzke (2012) refer to, “serious games” that present a sense of social realism and prompt problem-solving of real-life issues. Serious games certainly may challenge players to consider consequences in ways that may not occur during casual play, but such games remain on the margins of video game culture. Ironically, this marginal status may be precisely because of the educative function. As most popular games are popular largely because of their amusement and entertainment value, serious games often reject the norms of having players become powerful agents with god-like abilities—
qualities that are desirable to many players (Flanagan, 2009). The independent development of serious games also means that they are less well known; the developers do not have the same access to marketing and publicity. Because of this, the learning that serious games engender may take the form of isolated incidents in schools instead of mirroring larger cultural practices.

Perhaps the only way to avoid these problems is through overt recognition of the ideal trajectory and conscious actions toward addressing its limitations. This trajectory may apply to some players, but it must be understood that it is not the only trajectory. Similar to children’s development in drawing, there is no linear developmental model that can adequately generalize the multiple learning trajectories. Instead, Duncum (2000) proposed a “diverse pathways and multiple endpoints” (Duncum, 2000, p. 38) model of development that places emphasis on understanding individuals’ learning trajectories. Given the diversity of personal experiences, it may be more fruitful to propose multiple pathways and multiple endpoints of video game engagement across different genres and players.

Cultural Ideologies

The second problem with the claims made about learning through video game cultures is that they often do not address explicitly the embedded cultural hegemony that students are also learning. By cultural hegemony, I mean the beliefs, values, and norms that are imposed and have acquired consent as cultural norms, which maintain the status quo (Gramsci, 1971; Rose, 2012). It is the ideologies that are shared among most people but benefit only a small group of people. Video game players do learn to become active cultural participants in both the society at large and the specific video game cultures. But what specific cultural ideologies are accompanying this practice? In the following, I will address two prevalent ideologies within video game cultures, which is the meritocratic norm and play as free, or uncompensated labor.

Meritocratic Norm

Pulos (2013) and Flanagan (2009) claims that video game as a medium is shaped by and contributes to the cultural hegemony of the socio-historical context within which it is situated. Nowadays, video games can be found in most countries around the world, but this medium is most developed in capitalist societies with contemporary liberal democracies, such as the United States and South Korea (Dyer-Witheford & de Peuter, 2009). In such societies, the “meritocratic norm” is a large part of the cultural hegemony (Schulzke, 2012). According to Kernohan (1998), the meritocratic norm is the belief that, “natural ability should determine material ability to form, revise, and pursue a conception of the good” (as cited in Schulzke, 2012). The success and failure of an individual and his or her mobility within the social hierarchy is viewed as a direct result of his or her work ethic.

The idea that individuals have the power to control their destiny, despite structural limitations, is reflected in most popular media, and this includes video games (Schulzke, 2012). Instead of confronting it, the procedural rhetoric built into the technological aspect of the medium mirrors this meritocratic norm. Players are constantly given feedback through point systems or verbal comments that allow the player to modify their behavior in pursuit of the goal. In many popular video game titles, players are placed into a position of powerful world-makers. The prosperity of that world is a direct consequence of the judgment and abilities of the player. At the same time, players’ abilities are often empowered through various strengths they have chosen to take on during the character creation period or build up over time in the game. In role-playing games or first-person-shooters, players become heroic figures that are capable of defeating the enemy against the odds (with extra lives and multiple chances). “Many video games do indirectly support this norm with the amount of control they give players over the game world and their characters” (Schulzke, 2012); in Schulzke’s view, this distances gameplay from “social realism.” Through the embodiment of this norm in the gameplay, players are learning to accept this hegemony as a necessary component of this semiotic domain. As the term hegemony suggests, this norm is not only accepted in this domain but also operates as a guiding principle in many other semiotic domains. As domain mapping enables players to access other semiotic domains with similar beliefs and worldviews, participating in video game cultures connects the player to other cultural practices that also embody this norm, which again naturalizes and reinforces this perspective. By adopting these mechanics in school curriculum, educators further reinforce the norm.

Playbor

Combining the word play with labor, Kücklich (2005) used the term “playbour” to describe the precarious labor that gamers voluntarily provide through leisure play. Producing cultural artifacts has become a central part of play, just as prosumers have become an identity that characterizes video game cultures. As the boundaries between work and leisure are increasingly blurred, playbor characterizes the new mode of production that relies on the disguise of labor as play, which quickens the cycle of exchange with greater productivity (Dyer-Witheford & de Peuter, 2009; Bulut, 2013). Playbor leads to the production of mods, or add-ons to existing games. It may take the form
of user-generated avatars or community-made object models, which embodies use and exchange value among other video game players. While this leisure play is uncompensated, the game industries have capitalized and commodified their production.

While capitalizing on production from leisure is not new, the issue with playbor in video game cultures today lies in video game industries’ reliance on these unpaid labors. Playbor becomes an intrinsic aspect to what Dyer-Witheford and de Peuter (2009) describes as the ever-evolving capitalist Empire logic.

However, an ideology opposing the hegemonic structure is taking shape in this digital era. It is the understanding that the interactivity of networked participation through WEB 2.0 allows for democratic deliberations that undermine and subvert centralized mass media’s transmission of capitalist logic (Fuchs, 2012; McChesney, 2013). Instead of becoming passive audiences whose agency is limited through one-way communication, consumers are becoming cultural producers and talking back to the hegemonic values. In video game cultures, affinity spaces that practice modding are seen as rejecting the one-way consumption model while constructing their own commodities that allow for new forms of economic exchanges. This echoes the hacker mindset in video game development that views their actions as challenging the copyright logic that shapes and cultivates capitalism.

While these practices are endangering the hegemonic model, it is equally dangerous to accept without question the idea that this act liberates us from capitalism and turns us into autonomous producers. These marginalized territories (independent producers, etc.) are being enveloped in the new immaterial labor economy and constantly being colonized by the ever-evolving global capitalist Empire (Dyer-Witheford & de Peuter, 2009). Hardt and Negri (2004) argued that current capitalism’s major labor force is characterized as immaterial labors, “labour that creates immaterial products, such as knowledge, information, communication, a relationship, or an emotional response” (as cited in Allen, 2011, p. 202). As the commodities produced are immaterial, it is easy to miss the relationship with capitalism and to forget that we are making, doing, or creating commodities that circulate in the existing mode of production that generates value.

In video games cultures, this immaterial labor is being harvested by the capitalist Empire through the normalization of “playbor.” When players participating in affinity spaces produce mods, they are not only helping with the publicity of the original game, but also providing voluntary and free labor to generate new commodities for exchange within the video game industry. In fact, many large video game publishers have bought out successful mods and publish them under the company name. This encourages the affinity spaces to offer more immaterial labor in competition with each other to create ever better modifications in hopes of being bought out and achieving fame (Bulut, 2013). This allows the publishing houses to harvest the collective production of the network of players, which produces “far beyond the studio and the waged development team” (Dyer-Witheford & de Peuter, 2009). Players, then, are becoming immaterial laborers that participate in the continuum of productivity within the capitalist Empire without questioning their exploitation.

As was discussed earlier, video game players are learning to become active cultural participants in both the society at large and the specific video game cultures. However, considering the problematic practices in existing societies, does this mean that video game players are merely acquiring and practicing social norms and dominant ideologies? As learning is experiences that open doors for more experiences, does this mean that these experiences are only opening doors to other semiotic domains that practice the same values? Are players actually learning to become docile citizens of the existing social hierarchy?

Towards Critical Play

Given the need for multiple learning trajectories and keeping a consideration for social reconstruction in mind, this paper ends with a discussion about further research needed regarding critical learning and critical play. If the ideal learning trajectory postulated by educational scholars is problematic in that it does not specify the cultural ideologies learned and practiced by players, it is doubtful that most players are able to achieve “critical learning,” which is “learning to think of semiotic domains as design spaces that manipulate us in certain ways and that we can manipulate in certain ways” (Gee, 2007, p. 36). Affinity spaces do provide a space where players are able to organize and construct alternatives, but before we can conclude that video game cultures enable players to become active participants of society, more research needs to be done to examine the threshold of players becoming producers of this semiotic domain. At the same time, we also need to question whether prosumers may challenge the dominant ideologies and create their own cultural artifacts. How may the video game cultural practices be geared towards social reconstruction, instead of social reinforcement?

One domain to consider is the independent producers of video games. Flanagan (2009) said that critical play is “characterized by a careful examination of social, cultural, political, or even personal themes that function as alter-
nates to popular play spaces” (as cited in Schulzke, 2012). When large productions of popular video game titles have become another form of mass media ideological warfare, independently developed games that often stem from user-generated content may become useful sites to analyze the possibilities of critical play. Dyer-Witheford and de Peuter (2009) used the term “games of multitude” to describe games that create “new forms of subjectivity, new movement opposing global capital, and alternatives” to the existing Empire structure (pp. 187-188). If “we are interested in video games as social and cultural artifacts involved in the constitution of the player as a citizen in current societies” (Muñoz & El-Hani, 2012, p. 911), then researching and understanding players engaging in creating alternative video game cultures is essential to further our discussion.

References


Symposia
Game-A-Palooza: Games, Fun, Learning

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Abstract: There is a long-standing desire to marry games and education. The naturally occurring interest and investment found in games provides much promise to embed games with desired content knowledge and impart it to players. However, the best ways to do so remain non-trivial. Often games are treated as a black box and forced into classrooms. Other times, games are created for the classroom, but do not carry the engaging properties thought to be inherent in them. We at Games+Learning+Society (GLS) believe both the games and curricula around them need to be carefully crafted to complement each other. To this end, we created an informal learning event called Game-A-Palooza in which students participated in 3 curricula designed around 5 educational games. Although each game can be played on its own, we designed the curricula to supplement the materials embedded in them. From these games and curricula, we obtained multiple and diverse data streams – from quantitative click-stream data of each player’s in-game actions to audio data of student interaction during each session to physical artifacts created by teams. The result was an event that provided free all-day spring-break activities for local kids while providing our center a large and diverse data set. In this symposium, we detail the design of each game and its attending curriculum, our data collection efforts and plans for analysis, and the challenges we encountered in creating and implementing such an event.

Because of the interest and engagement that they elicit, games have great potential for education. However, it remains non-trivial to find the best ways to harness this power. We at Games+Learning+Society (GLS) believe the best ways to use games for learning is to embed content-rich games into curricula and activities designed to empower the goals of the games. To best leverage this, data is collected from all of our games and activities through click-stream telemetry, and curricula artifacts. These data provide insight into the game mechanics and curriculum design that best promote learning through games and their surrounding curricula. To this end, we at GLS created an event called Game-A-Palooza (GaP). GaP contained 3 curricula wrapping around 5 games previously made by the center and affiliates. The aim of the event was to allow us (a) to provide a free childcare option during spring break with entertaining and educational programming for local middle-school kids, and (b) to collect heterogeneous data sets – click-stream game behavior data, talk audio, group video, physical artifacts, and pre-post measures from the curriculum activities – for cross analysis to look for patterns between in-game behaviors in-group behaviors, whole cohort activities, and individual pre/post assessment. In what follows, we detail the overall structure of the event and its logic, the 3 game-based curricula implemented during GaP.

Overall Structure

Our aim was to create a hybrid space where students could engage in game-based activities related to but not driven by school standards and assessments. A primary concern was to ensure that the event did not seem like “school dressed up as gaming”, and thus, we aimed to maintain engagement at a high level across the games, curricula, and event. As such, GaP was structured in a way that gave the players as much flexible time as possible to play and socialize throughout the event with minimal pretests, posttests, and submission of assignments. Because of this, GaP was organized more like a conference or a camp rather than standard school. Participants were separated into three cohorts that rotated between three 90-minute sessions throughout the day. At the beginning of each day, between sessions, during lunch, and during the final 90 minutes of extended day, students were encouraged to play the games informally and socialize within or across cohorts. Participants were also given
individual iPads for the entire 5 days and were allowed to take them home to play informally. An online community environment, closed to non-participants and non-teachers, was also provided for out-of-program communication and posting. In addition, across all three curricula and interstitial programming for GaP, we developed an achievement and point/reward system dubbed “Coin Rewards” in which players were given a list of optional achievements across the entire 5-day program; as they completed achievements, students would earn coins that could then be exchanged for prizes. The achievements ranged from weird-silly (e.g. post a story on the forums that connects all three curricula together in a single storyline) to hard-core difficult (e.g. survive for 2.5 minutes in the “Last Genome Standing” challenge in Virulent) and were designed to incentivize participants to go beyond the structure of the curricular goals and engage in broader forms of gameplay.

In order to maximize the potential of the 5 educational games, curricula were designed so in-game play and out-of-game play were components of one another, with the game directly tied to real world activities. Taking the learning goals of the games as the basic anchor point for subsequent design, we created curricular activities including competitions, role-playing activities, and original non-digital games to foster deeper exploration of the in-game content and to encourage players to articulate what they learned to one another and within individual and group projects that doubled as assessment measures.

We anticipated collecting data from multiple sources, including but not limited to: gameplay behaviors through telemetry data, group talk data from audio recorders positioned by each group, video recordings of full cohort meetings, artifacts from curricula activities, gameplay behaviors from informal play outside of the sessions, achievement completion sheets, pre and post surveys, and post-event stimulated recall interviews. Through analysis of these heterogeneous forms of data, we aim to link gameplay behaviors and curriculum activities with learning and engagement. In what follows, we detail the design of each game and its attending curriculum, our data collection efforts and plans for analysis, and the challenges we encountered in creating and implementing such an event.

**Virulent**

**Game**

Virulent is a strategy game through which players learn about viral replication, and how the body’s immune system reacts to fight infection (see Figure 1). Controlling the Raven virus, players move through levels by infecting host cells, stealing precious resources and fighting the immune system with viral proteins. Each level takes players deeper into the microscopic world of virions through a combination of visual and audio directions. Virulent meets numerous NextGen Science and Common Core standards and was designed for individuals 9 and up.

![Figure 1: Virulent](image)

**Curriculum Design**

Participants role-played as scientists recruited by the Center for Disease Control (CDC) to stop an international Raven virus epidemic. Cohorts were divided into “research teams” with tablets referred to as “digiscopes” and game levels as “microscopic slides” (see Figure 2). After viewing each microscopic slide, participants took field notes on virus and immune system behavior. Participants also watched pre-recorded videos from mock CDC scientists before each day’s investigation. Daily videos were used to update participants on the progress of the Raven virus spreading, thus creating a narrative that helped drive participation.
The curriculum was completed over five days. The first day was spent introducing participants to the *Virulent* game. As scientists, participants watched a video from the mock-CDC and wrote preliminary recommendations on how to stop the Raven virus from spreading further. Each participant received a clipboard, lab coat, and digiscope to support this role-playing experience. The second day included gameplay and model making. Participants created models of the virus and its efforts to replicate. Models were updated and shared through self-directed videos on the third day. The fourth day consisted of cohort presentations and ended with an “emergency” call; the CDC was now infected by the Raven virus. Three hypothetical solutions for stopping the Raven virus were presented on the final day. Research teams determined which solution was best based on articles from journals, media, and textbooks that were adapted to the content. Teams presented their findings to the cohort, debated, and voted for which solution to use.

*Figure 2: Research groups working together to fight the Raven virus.*

**Data Streams**

Preliminary demographic data was collected from participants, and a pre-assessment on content relating to viruses and cell biology was administered prior to the first session. This same assessment was administered on the final day to measure differences in content learned. USB audio recorders captured conversations between team members during cohort sessions, model making, and formal game play. Model creation and group work was photographed each consecutive day. Self-directed videos from participants, along with video recordings of the final cohort debate, were also collected. Click-stream gameplay behavior recorded all game mechanics used. An online portal where participants posed questions, shared pictures, and exchanged game strategies was tracked. Recall interviews with students and the curriculum developer provided a reflection of the gaming experience as a whole. Finally, field notes from facilitators on group work and game play were also collected.

**Challenges and Future Directions**

GaP took place during spring break, which elicited expectations that the event would be decidedly un-school-like and attracted existing friendship and sibling networks. While many enjoyed the planned activities, some participants ignored activities or assessments that seemed too much like the worksheets found in class because it reminded them of schoolwork. Group productivity was also sometimes influenced by relationships in the cohort (e.g., siblings) and participants with prior experience in playing *Virulent* were often less engaged in the curriculum. Another challenge was that, while team-work best suited the pedagogical outcomes of the project, it created complications for the research outcomes by adding within-team and within-facilitator confounding effects. Future analysis of science understanding, model-based reasoning, content acquisition, and interest will have to be responsive to this challenge by addressing nesting of individuals within group within cohort within overall intervention.

**Anatomy Browser/Oncology**

**Games**

*Oncology* is a role-playing game developed by GLS and available through BrainPOP (see Figure 3). As the doctor, players assess a patient’s symptoms, order scans, and then use radiation to treat cancerous tumors. On CT scans of the affected area, players highlight cancerous tissue on each layer and use two radiation beams to focus treatment on the tumor. Players earn ratings for the percentage of cancer they highlighted and for the percentage of tumor killed versus the healthy tissue affected by the radiation. Students played through three scenarios of the game during GaP, diagnosing and treating three patients in-game. Session facilitators also created a fourth scenario for the final activity, which included roleplaying and diagnosing with other players, described more in the next section.
Anatomy Browser, also developed by GLS and available as an iOS app, is a simulation of the human body, where users can tap on organs for identification or focus on or fade whole organ systems from view in order to isolate or compare them (see Figure 3). Other components of the application include a GI Tract explorer, where users can try to guide a ship through the digestive tract, and 3D puzzles in which users try to piece together an organ system using sagittal (right and left), axial (top and bottom), and coronal (front and back) views.

Figure 3: Oncology and Anatomy Browser.

Curriculum Design & Data Streams

Through the use of Oncology and Anatomy Browser, students worked together as a large group or broke into groups of 3-4 and explored how a medical team works to diagnose and treat cancer. The pedagogical goals were an introduction to anatomy and physiology, to medical careers, and to medical teamwork. Through Anatomy Browser, students used the GI Tract explorer, and the 3D puzzle components of the simulation and then used what they had learned to draw a life-size model of one organ system, labeling the organs and identifying possible types of associated cancers. The two games provided platforms for exploration and experience, with the final session culminating in a live role-play, requiring use of knowledge gained across the games.

During the live role-play of scenario 4, each group role-played as a team of medical professionals making a diagnosis and proposing a treatment. Each group was comprised of a doctor, who interacted with the patient; a CT technician, who obtained the scans; and a radiologist, who interpreted the scans and collaborated with the doctor. Students had one session to play this out, write a script, and produce a video. The videos produced were particularly illustrative of student misconceptions of the workflow from diagnosis to recovery and how doctors use evidence from scans to determine treatment. Writing a script required students to delineate roles, furthering the idea that medical work requires cross-functional collaboration. Students volunteered to act out the script for recording while others took on responsibilities of directing, writing, or filming.

Players completed a pre-curriculum assessment, created a paper model of an organ system, and made videos while completing scenario 4, providing data on content knowledge development. At pretest, students were unfamiliar with radiation and the work of oncologists, yet 32 out of 42 students reported that they personally knew someone who had been diagnosed with cancer. Only 5 out of 42 students expressed interest working in the medical field.

Challenges and Future Directions

Before the GaP event, Oncology and Anatomy Browser were created within the same grant program and by the same design team, but had not been used together within a single activity. As the first trial run of the curriculum, we found promising direction, but there remain some kinks that need to be worked out. Future directions include refining the curriculum and defining and measuring more concrete outcomes. For instance, activities that allowed students to work at their own pace greatly increased engagement. The video activity should be expanded to two sessions so that students could spend the first day playing out “scenario 4” and writing the script, teachers could take time to provide feedback on the scripts, and then the last class period would be spent revising and filming. Integrating feedback into the script writing process would allow time to resolve misconceptions and improve understanding. Finally, a more tightly connected pre- and post-test for familiarity with vocabulary and medical careers would provide feedback as to whether students were connecting with this part of the curriculum.

Econauts & Citizen Science

Games

Econauts is a multiplayer iPad game currently in the alpha stage of development by GLS (see Figure 4). The game
presents players with a choice of career—lumber, mining, or farming—with the overall goal of building a business and making $8,000. Each career makes money in a different way. The lumber career cuts down trees and eventually turns them into houses to rent; the mining career digs up ore and turns it into automobiles; the farming career grows and harvests corn to turn into different types of food to sell at the grocery store. However, because they are in the same game world, players’ actions have an effect on their career productivity as well as the productivity of other players. For example, mining ore too close to a lake causes the lake to become polluted, therefore decreasing the property value of houses built on the lake. By providing fast, repeatable game sessions, it is the goal of the developers of Econauts to provide players with an educational platform to test their theories on the human impacts on the environment while creating an experience that engages them through conflict, collaboration, and competition.

Citizen Science is an online adventure puzzle game developed by GLS and Filament Games in which a player must go back in time to gather evidence to explain the eutrophication of a local lake (see Figure 4). Using a variety of in-game scientific tools, players create their arguments for how to change the future of the lake, learning the different social factors and variables that contributed to the pollution.

Curriculum Design

This session of GaP was centered on teaching/promoting environmental science concepts such as the complex interactions of different variables in the environment as well as human impacts on the environment as specified in the NextGen Standards. Econauts was used as the centerpiece for this session, driving student interest with a competitive multiplayer experience. Citizen Science was used in tandem with Econauts as a way for students to experiment with their theories on what impacts the environment in Econauts so they might gain a competitive edge in subsequent playthroughs.

Also, in line with constructionist learning theory (Papert & Harel, 1991), students participated in an activity for creating their own custom Econauts maps that would later be imported into the game. Given the alpha state of the game, there were some difficulties importing all of these maps into Econauts. However, students found this activity to be particularly engaging. The maps also gave insight into student thinking processes. For instance, one group of students produced a map that contained an area specifically for farming (see Figure 5). When asked about this space, the group indicated that, by and large, farmers did not pollute lakes; neglecting the effects of fertilizer and pesticide runoff. Such misconceptions suggest that further work could be done on highlighting the human impacts that farmers can have on groundwater and lakes.

Figure 4: Econauts and Citizen Science.
Challenges and Future Directions

Generally, the curriculum was very well-received by the players, and provided data that generated unexpected insights. These data only serve to encourage further curriculum development. For instance, creating more targeted and specific tasks that highlight what has been suggested in these data will help validate this Econauts pilot and help to link participant understanding of the game to participant understanding of the real world. For instance, the current version of the game only has one win condition: Make $8,000. However, the system is designed to have different situations that players would have to navigate. For instance, how would a win condition of “Make $8,000 AND Keep Global Pollution Under X Amount” change player thought processes? Furthermore, creating maps to help players achieve the aforementioned condition or, better still, a condition that simulates current events may prove insightful.

Discussion

As a community service, GaP was considered an overwhelming success by both the participants and their parents. In each of the three sessions, curricula and games complimented each other in ways we did not expect, resulting in high levels of satisfaction and observable changes in content competency. One observation was that the games and the curricula were not the mere sum of their parts; together they created something more powerful for learning the embedded material. For instance, at the beginning of the week, some players were more engaged in the game than the curriculum around it, but as the game and curriculum entwined, they became more interested in the content. In just 5 days, players who seemed to be uninterested in learning had developed a passion for the content and were showing high levels of competency; an end state neither the game nor the curriculum alone could produce. As a data collection effort, our internal teams were equally satisfied. Across all five games, data collection included not only telemetry data but talk and interaction data as well as individual and group assessment artifacts that were crucially all connected across modality and context by individual participant number. Our hope is that, through the resulting corpus, we can examine individual and group learning progressions across time (by game login, by session, by day) and across context (by game, by facilitator, by teacher). Thus, GLS plans to make this event a yearly event provided as a service to community parents looking for an enrichment activity suitable for kids during spring break holiday when many parents simply do not have ready access to high quality childcare.

The event was not without its difficulties, however. First, regular and stable attendance was difficult to achieve. For the analyses planned, we needed a minimum of 60 participants attending all 5 days of the event. Although the number of participants who registered met our targets, many participants signed up but did not attend or did not attend regularly. Second, accommodation for attendees with special needs. Our event was intended to be inclusive and to accommodate a somewhat generous age range (middle school and early high school) but we were under-prepared for the number of participants with learning difficulties that attended. In at least one case, in order to prevent disruption of the other players in the program, we had to request parent pickup before activities were completed. In future iterations, we will need to explicitly ask about special accommodations needed and make every attempt to accommodate for them. Third, the Coin Rewards achievement system proved to be a highly motivating tool for engagement and informal play, shaping in some ways how and why different students differentially engaged in the three designed curricula. Analyses of our data will have to somehow account for its unanticipated yet, in places, rather keen impact. Fourth and finally, our online community tool was reasonably leveraged during the five-day program but largely under-utilized by students. Our general impression was that spring break may well not be the time to ask kids to do additional educational screen-time at home.

Figure 5: Player created map for Econauts.
References


Game Your Life: Health, Behavior, and Personal Data Gaming

Cynthia Carter Ching, University of California Davis
Sara Schaefer, University of California Davis
Mary K. Stewart, University of California Davis
Danielle Hagood, University of California Davis

Abstract: This session presents a novel genre of games, personal data gaming, in which players wear digital monitoring devices that collect data about aspects of their everyday lives and behaviors, and then the data become useful in a game context. We describe the genre itself and our game design, applications in a health education context, and results from a multi-year DBR study of personal data gaming with middle school youth, specifically students’ motivations and engagements as well as socio-economic comparisons across field sites.

Introduction

Gaming scholars and designers assert that games can leverage transformative change, within individuals and within society as a whole, because games afford risk and experimentation within rich simulated realities, and they also offer opportunities for complex identity work in a low-threshold, low-threat environment (e.g., Bogost, 2011). With few exceptions, however, empirical studies of such transformation—what it looks like in terms of everyday behavior and how it takes place—are rare. The Quantified Self movement similarly claims that life altering behavioral change is possible when users employ wearable devices and other technologies to collect and analyze data about their own lives, and then employ findings from that data toward more informed decision making (Lee, 2013; Swan, 2012; Wolf, 2010). Combining these two approaches, gaming and personal data, has vast potential for creating a new genre of playful and planful cyberlearning technology that fosters personal change.

This session presents such a novel genre of games, personal data gaming, in which players wear digital monitoring devices that collect data about physical activity aspects of their everyday lives and behaviors, and then the data become useful in a rich game context. Each of the four papers to be presented in this session describes in turn: (a) game development within in a health education context, and how that development is related to other kinds of gaming and health data innovations; (b) the development of our personal data game itself, currently funded by the National Science Foundation, and the design principles it is based on; and (c-d) results from a multi-year DBR study of personal data gaming with middle school youth.

Fun for Health/Health for Fun

Sara Schaefer

Metabolic health problems in the U.S. have reached epidemic proportions. Excess weight and obesity affect two-thirds of the adult population, and chronic diseases are responsible for nearly 70% of deaths (U.S. DHHS, 2012). Childhood obesity affects 18% of young people and is a strong predictor of dangerous chronic diseases later in life (Reilly & Kelly, 2011). These trends have been blamed, at least partially, on the ubiquity of computing and entertainment technology. “Screen time,” which includes video gaming, is blamed for low rates of physical activity across the developmental spectrum (Gordon-Larson, Nelsen, & Popkin, 2004; Hager, 2006; Vandewater, Shim, & Caplovitz, 2004). Many obesity prevention interventions target reduction of screen time to encourage youth to be more physically active.

The growing Games for Health movement is changing the negative dialogue on gaming among health researchers, with the advent of games designed to inspire fitness and manage disease (Lu, et al, 2013; Rahmani & Boren, 2012). Exergames, video games that involve exercise such as the Nintendo Wii have shown to be as effective as traditional aerobic exercise (Guderian, 2010). Playing Dance Dance Revolution has been shown to equate to moderate intensity exercise for kids, making it “a safe, fun, and valuable means of promoting energy expenditure” (Graf et al, 2009). Research on exergames has shown moderate effect on weight; about 40% of overweight and obese youth who played exergames showed positive effects (Lu et al., 2013, Douglass-Bonner, 2013). More research on effectiveness is needed, particularly among overweight and obese youth. A study showed that healthy youth who are already physically active were more likely to engage in active gaming as a recreational choice than overweight and/or sedentary youth (Wethington et al., 2013). Researchers suggest that brief increases in physical activity during exergaming do not translate to real world behavior change (NYT, 2012).
Research has shown that some games do have promise in affecting real world behavior change on topics related to health and beyond. For example, people who received workout advice through virtual reality game Second Life (Figure 1a) reported more positive changes in healthy eating and physical activity than people who went to a traditional gym, but weight loss was the same in both groups (Graf, 2009). Games can also integrate behavior change theories and principles, like Squire’s Quest! (see Figure 1b) which is designed to encourage children to increase their fruit and vegetable consumption (Baranowski, 2003).

The Quantified Self is another movement that offers a technology driven solution to health. It suggests that powerful personal transformation place via using wearable devices, leading to improved awareness of how personal health metrics are connected to everyday behavioral patterns such as step counts, heart rate, food intake, etc (Lee, 2013; McFriedes, 2013; Wolf, 2010). But without the existing motivation to collect one’s own personal fitness data and use that data for decision-making purposes, corresponding behavioral change may not be forthcoming. Health improvement studies that have attempted to introduce pedometers or other activity tracking devices as an intervention, to motivate increased movement and weight loss among overweight and obese participants, usually have found short-term novelty effects on incidental exercise behavior but not long-term changes (Gardener & Campagna, 2011; Schofield, Mummery, & Schofield, 2005).

Our project takes these two technology-based approaches, self tracking and video-gaming, and combines them, essentially making health “gameable”. In Project GETUP (Gaming to Educate Teens to Understand Personal health) youth players use Fitbit physical activity monitors to measure their own fitness and physical activity, and learn to engage in data over the long term. Game play then engages them in planning and hypothesis testing that can lead to sustainable behavioral change.

Personal Data Gaming: Genre and Design

Cynthia Carter Ching

Game scholars are starting to examine games as persuasive technologies, including those that foster ethical or pro-social behavior (Jenkins, et al, 2009; Steinkuehler & Owen, 2013, Horn et al, 2014). Research on learning in and around games demonstrates that, using the tools available to them through sense making in game worlds, youth players often engage in sophisticated reasoning from data and use evidence-driven argumentation to form and test hypotheses about play strategies, avatar builds, mods, weapon selection, etc (Squire, et al, 2005; Zimmerman, 2007). This reasoning, articulation, and data-driven decision making is often far more sophisticated than what these players are able to demonstrate in a school setting (Steinkuehler & Duncan, 2008). Yet data that comes from participants’ off-screen lives has largely not been part of this kind of in-game data inquiry. While Quantified Self (QS) technologies provide a myriad of “real-life” data that could be leveraged in a game environment, existing QS approaches are largely designed for mainstream, middle-class adult populations who already have existing technological infrastructures to support syncing and analysis (Authors, 2014; Lee, 2013). Additionally, the forms that QS data streams and their accompanying dashboards take (typically query-able databases returning multiple types of graphs and/or charts) also require levels of data literacy that many youth, particularly from underserved populations, tend to struggle with (Gándara & Contreras, 2009; Vahey, et al, 2006).
In our lab, we took on the development of a personal data gaming model that integrates the power of gaming to create enjoyment, capture the imagination, and engage learners, combined with the personal data analysis and reflection of a Quantified Self approach to health and fitness, in a form factor that is low-threshold, accessible to data literacy challenges, and easily integrated into an educational environment. Informing our ongoing development are several principles about the relationship between gaming and personal data, in our case step-counts and other data from Fitbit activity monitors.

We determined first, via youth user groups and early prototype testing feedback at participating fieldsites, that the game world has to be compelling. Youth were very clear that the idea of a game explicitly about health and fitness would be *boring* and *school-like*. Consequently, we developed *Terra*, a game about a team of astronauts and explorers discovering and developing a far-off planet. Second, it is not sufficient for a game to deliver only bonuses for physical activity; rather, real-world physical activity has to actually drive the action in the game. In our case *Terra* converts daily Fitbit steps into energy points that are required for planet exploration and development (see Figure 2).

![Figure 2: Energy screen showing fitbit steps](image)

A third principle is that the game needs to contain alternative visual representations of personal data, not only in terms of daily totals (as in Figure 2) but also aggregates. Our participating youth were largely uninterested in and unmotivated by the kinds of personal data representations provided to them on the Fitbit website, which consisted of bar graphs, pie charts, line graphs, and other mathematical representations. In *Terra*, the evolving landscape that the players create becomes an aggregate representation of their physical activity over time (see Figure 3), as the extent of exploration and the kinds of buildings, creatures, and land features that players attain are contingent on their energy levels each day. Finally, a fourth principle is that the game world should not only enable players to see the results of their daily physical activity after it happens, but it should also help them plan for and set long-term goals for future physical activity. We are currently working on developing unlockable features in the game that can be attained via players setting long-term physical activity goals and attaining them. As we continue working on development of *Terra*, we also want to further flesh out these design principles for the expansion of possibilities for personal data gaming and to inform other similar developments by others in this space.
Motivating Physical Activity and Reflection on Personal Fitness

Mary K. Stewart

Health tracking technologies are changing the way people engage with health and lifestyle management (Klasnja, 2012; Swan, 2009). Healthy behaviors acquired early in life are most effective for disease prevention (CDC, 2014), but feasibility of health tracking among youth is unclear. This study analyzed focus groups that assessed the extent to which wearing a Fitbit physical activity monitoring device motivated physical activity behaviors and reflection on personal fitness.

Our research team conducted and analyzed focus groups and interviews. Recordings were transcribed, and researchers used a grounded theory approach to create codes that described common and interesting patterns and perspectives. All coding and analyses were conducted in Dedoose, a web-based software application for collaborative data analysis. We identified three codes that will be discussed in detail during this presentation: awareness/noticing, increased activity, and social competition.

<table>
<thead>
<tr>
<th>Code Name</th>
<th>Frequency of Code Occurrences</th>
<th>Code Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awareness/Noticing</td>
<td>High (more than 50)</td>
<td>Use of device to make observations about self and/or others</td>
</tr>
<tr>
<td>Increased Activity</td>
<td>Moderate (30-40)</td>
<td>Deliberate actions to increase step count</td>
</tr>
<tr>
<td>Social Competition</td>
<td>Low (less than 20)</td>
<td>Comparing data with peers to see who has the most steps</td>
</tr>
</tbody>
</table>

Table 1: Code Frequency & Meaning

In our focus groups, many students explained that the device increased their awareness of their physical activity (i.e., they were surprised or impressed by the amount of steps they took or the calories they burned in a day). Sometimes this awareness presented itself as broad generalizations about daily activities (“I take 10,000 steps a day”), and sometimes as particular instances that increased their step count, such as soccer practice or walking around the neighborhood. Some participants also extended their awareness of physical activity to reflection on their personal fitness. As one student explained, “the Fitbit’s gonna make you recognize how much calories you’re burning and tell you if you’re lazy or not.”

This awareness, coupled with social competitiveness or collaboration, motivated some students to increase their activity. Several participants reported using the Fitbit to compete with each other: one male participant said, “Me and my friends, we would always see who could get the most steps in the day, who can get the most miles in a day...who could burn the most calories in a day.” While some female participants also reported competing with their friends, these comments were often framed within the context of working collectively to increase personal activity data: a girl participant said, “It was fun to, like, compare the steps... we’d be like, oh lets do this and talk and walk.”

In addition to increased activity in social situations, several participants described initial unsustainable changes to their activities, such as shaking the device or running in place. Others reported more sustainable attempts, such as walking to school, playing basketball at lunch, or participating more in P.E. However, as the novelty of the device waned, participants started to forget they were wearing it and abandoned attempts to increase their activity.

Consequently, while our research indicates that wearable devices can motivate youth to both increase their physical activity and reflect on their fitness, the presence of the device is not sufficient to consistently motivate behavior change. One possible explanation that the next presenter discusses in more detail is that socioeconomic factors and community environment have an important influence on youth behavior.

Socioeconomic Challenges to Implementation and Impact with Diverse Youth

Danielle Hagood

Students from two dissimilar schools make up the counterpoint case studies in this project. Students recruited at School A included mainly lower socioeconomic (SES) and racial minority students (N = 40, M_age = 12.6) participating
in an after school program at a middle school in urban Sacramento. Conversely, students recruited from School B included students from a well-resourced community (N = 61, M = 13.7) enrolled an educational technology elective course at a junior high school. The school is located in a university town at the rural bounds outside Sacramento. These two unlike cases spurred our consideration comparisons of SES differences in both methodological planning and exploring student experiences. Data from our interviews and observations informed further exploration of how youth from these two different schools engage with health tracking, activity monitor use, and help to identify equitable avenues for using health tracking in health education.

<table>
<thead>
<tr>
<th>Technology at School</th>
<th>School A</th>
<th>School B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limited technological resources; old model laptop computers and inconsistent internet bandwidth. Charging issues with computers led to researchers bringing equipment.</td>
<td>Working computers in a lab with desktop computer stations and decent internet. The lab is enriched with a 3D printer, CNC mill, and various software (e.g. video game design).</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technology at Home</th>
<th>School A</th>
<th>School B</th>
</tr>
</thead>
<tbody>
<tr>
<td>85% own a computer at home; 67% access the internet at home; 40% own cell phone</td>
<td>98% of own a computer at home 96% access the internet at home 85% own a cell phone</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nearby Environment</th>
<th>School A</th>
<th>School B</th>
</tr>
</thead>
<tbody>
<tr>
<td>The middle school located in an urban neighborhood in an urban district of a major metropolitan area with busy traffic due to close proximity to a highway interstate and industrial factory nearby.</td>
<td>The junior high school sits off a moderately busy street with several greenbelt and bicycle routes for easy access to the campus on the edge of a small town containing a large research university.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Barriers to Exercise</th>
<th>School A</th>
<th>School B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety; few options for after-school teams and clubs.</td>
<td>Proximity to school; busy scheduling.</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Comparison of Higher and Lower SES Cases

Though the device-and-game model in this study allows a more direct and quantified link to individuals’ behavior and affords self-reflection on typical physical activity patterns, as discussed in “quantified self” literature (Swan, 2012), a criticism of the quantified self movement is that it tends to target well-resourced adults (Lee, 2013; Author, 2014). Resources of both technological capabilities and environmental conduciveness to activity separate the students in our case studies.

Such concerns extend to the viability of health tracking for teaching healthy behaviors to diverse youth. Limitations in adequate training, programmatic support, and technology access, necessary to sustain ongoing engagement, may create an equity gap precluding lower SES students from benefiting in both health and data literacy. Our initial findings suggest that SES is related a divide in both the implementation and uptake of physical activity monitor use patterns and behavior change.

Conclusions

While wearable devices, personal data, and exergaming are becoming more visible in the commercial marketplace, these innovations have not yet made significant inroads into formal and informal educational environments. It may only be a matter of time before this happens, however, as personal data has close connections to science and mathematics standards for data literacy (Lee, 2013; Lyons, 2014). One of our goals for research and development is to get in front of this inevitability and have developed playful and empowering applications that put youth in charge of their own physical activity decisions and their own data. Based on our findings so far, however, (a) designing game features that not only reward physical activity but encourage reflection and sustainable change, and (b) overcoming challenges to equitable access across settings and socio-economic status of participating communities will be key in this ongoing endeavor.

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Learning Through Design: ARIS
David Gagnon, Wisconsin Institutes for Discovery
Rachelle Vang, University of Wisconsin – Madison
Brianna Litts, Utah State University

Abstract: This project represents four case studies conducted across two distinctly different undergraduate courses where learners used media as a tool to build their own location-based mobile narrative experience. Our goal is to better understand how to facilitate a learning through design process using ARIS, an open source tool for creating mobile, locative games, narratives, and field research activities (Holden, Gagnon, Litts, & Smith, 2013). Using a Design Based Research (Brown, 1992; DBRC, 2003) methodology we altered the instructional approach across four iterations in order to explore the relationships between the design tools, design process, and content. We hope to use our findings to inform the development of future design projects.

Purpose
In this project we used four designed cases (Reigeluth & An, 2009) to explore the following goals:
1. Understand the design trajectories learners take when creating media experiences with ARIS, a location-based mobile production tool.
2. Identify challenges, breakthroughs and critical moments experienced by students during the design process.
3. Use our findings to further refine how ARIS might be used within design-based learning contexts.

Context
In the Spring of 2013 and 2014, we conducted the pilot study described here in partnership with Dr. Erica Halverson and Dr. Jon McKenzie in their Digital Media and Literacies and English courses at the University of Wisconsin-Madison (see Table 1). The goals of the courses were to:
- understand the affordances and constraints of digital mediums as tools for representation and apply those understandings during the creation of digital artifacts;
- be able to make appropriate design decisions and critically reflect upon the creative process and product;
- learn to work in deep collaboration with peers to achieve design goals.

While we picked these classes based on their common commitment to understanding media, representation and design, they also differed in some significant ways. McKenzie's class was an upper level English class that focused on using media as a design tool. Each group was assigned a topic with supporting documents and websites to draw upon for their project. The students in this class did the main bulk of their work outside of the lectures and discussion sections. Halverson's class, on the other hand, was an elective course with a mix of students from all grade levels and majors and focused on using media as way to represent thoughts and ideas in the classroom.

For these pilots we chose to use ARIS, an open source tool for creating mobile, locative games, narratives, and field research activities (Holden, Gagnon, Litts, & Smith, 2013). With ARIS, learners can author mobile, locative media experiences using a web-based tool and then interact with and test these experiences in specific places or locations using an iOS-based application on a mobile device.
<table>
<thead>
<tr>
<th>Iteration 1: Digital Media and Literacies, Halverson, 2013</th>
<th>Week -1</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
<th>Week 6</th>
<th>Week 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to ARIS lecture. Idea brainstorming activity</td>
<td>ARIS Technical Training</td>
<td>Storyboard Design Lecture, Storyboarding activity</td>
<td>Just in Time support for ARIS, individual work time</td>
<td>Unsupervised work time</td>
<td>Project Due, Playtest others’ designs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iteration 2: Stories, Maps and Media, McKenzie, 2013</td>
<td>Introduction to ARIS lecture</td>
<td>45 minute technical Training</td>
<td>Throwaway Design Due. Research Topic thinking about ARIS objects</td>
<td>15 minute requirements tutorial, Just in Time support for individual work time</td>
<td>Just in Time support for individual work time</td>
<td>Final projects due</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place and Community Lecture, 1 hour technical training. Pitch ideas online</td>
<td>Team Formation. ARIS object cards activity.</td>
<td>Storyboard Design Lecture. Team Formation 2nd Try. Storyboarding activity (throwaway cards)</td>
<td>15 minute requirements tutorial, Just in Time support for individual work time</td>
<td>Final projects due</td>
<td></td>
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**Table 1: Weekly Schedule Across Iterations.**

**Data**

Using a Design Based Research (DBR) approach, we collected data at different points during each of the seven-week interventions to help us identify changes in students’ confidence levels, comfort using ARIS, and beliefs about the usefulness of ARIS as a design tool. We used the following instruments to collect the data:

- Weekly student surveys, including three scale-like questions and an open-ended comments section.
- Final student design reflections written at the conclusion of the ARIS project.
- Short student interviews throughout the process.

We intentionally collected data at different time points during the design process in order to: (a) better understand how students experience the design process when building something using ARIS, and (b) identify the structures and resources that best support learners’ progression through the design process.

**Data: Confidence, Usefulness and Comfort**

The following graphs (Figure 2, Figure 3, Figure 4, Figure 5) represent the responses from the weekly student surveys. The surveys consisted of three questions: one measured their confidence level in their own project (design
focused), another measured the perceived usefulness of the day’s activity (tool-focused), and the last measured students’ level of comfort with using ARIS.

Figure 2: Graph for Iteration 1.

Figure 3: Graph of Iteration 2.

Figure 4: Graph of Iteration 3
Data: Content, Design, and Tool

The data in this section explores the relationship between design, content and tool. Design is the story students want to convey. Content is the necessary information the story is required to have. Tool includes both having a basic knowledge of ARIS and the capabilities of the software. Iterations one and three did not have a content component to the course however iterations two and four did. The graphs below (Figure 6, Figure 7) represent the self-reported amount of time spent on each aspect of tool, design and content in iterations two and four.
In addition to the data shown in these tables we also collected and analyzed personal feedback and reflections of students based on their responses from interviews and their final design documents.

**Initial Findings**

Generally, the first set of graphs (see Figures 2-5) illustrates that learners had a positive experience throughout the ARIS project. Though our survey targeted different characteristics of the making process, the graphs echo Halverson’s (2011) *representational trajectory* - her take on meta-representational competence (diSessa, 2004) - because as students started the project they had lower confidence in working with the tool as a result of being focused on the design and content parts. Further, *representational trajectories* are ones that “begin with a focus on content of their stories, move to a focus on how the tools of the medium afford a representation of these ideas, and end with a consideration of the relationship between these two aspects” (pp. 37).

The most concerning feature of the first set of graphs above (see Figures 2-5) is the drop in confidence during week two. This drop in confidence happened a week after the Software Training for Students (STS) and a week before representing their ideas using storyboard cards. From the first iteration we learned that we had to find a better way to introduce the tool to the students. Therefore we shortened the beginning training for the remaining iterations. Starting with the easy, basic STS training made ARIS seem easy to use. Students gained a boost in confidence in their ability to create a complicated game. However once they started working on the project and realized the gravity of the situation, the students became disheartened. This trend is also due to the fact that students spent a lot of time thinking of the affordances, but little to no time thinking of the constraints of the ARIS tool.

The second set of graphs (see Figures 6, 7) illustrates that students rarely thought of the technical aspect of the project in week three compared to future weeks. Between iterations two and four we took three steps to try to level the graph:

1. Lesson the amount of technical training in the first week (1.5-2 hr lesson to 30-45 minutes).
2. Spread out the ARIS technical training using a “just in time” method (Gee, 2003).
3. Have a staff member from the research team available every class to offer support.

After implementing these three steps between iterations two and four, there was a change in the relationship between design and content. In the second iteration design and content closely followed each other. In iteration four, the technical aspect had a similar trend as design. The second iteration in McKenzie’s class (see Figure 7) had less sharp changes in the three aspects than the first (see Figure 6).

**Moments of Reconciliation**

Throughout the project, there were moments when students realized the tool could not construct what they wanted to create. Their design did not make sense anymore due to the tool. These moments were captured when students talked about their projects:
“We would create something and it would be working and then we would add something else and something would go wrong” (student 12, final design doc).

“While laying out the design of the game we encountered many problems with the placement and setup of the plaques and locations. Sometimes the text would not save and other times the media picture would get deleted. Also, ARIS would not allow for videos over 35 seconds, so some of the messages of the project may be lost because of the lack of video time” (student 16, final design doc).

In order help students overcome these challenges we:

1. Created analog design tools: cards that introduced the ARIS lingo
2. Implemented a “throwaway game” design activity in iterations two and four

We found that it is imperative that learners understand the affordances and constraints of ARIS in order to effectively design with it. To foster this thinking, we used design cards to support storyboarding. The goal of the cards is threefold: (a) to offer a concrete outlet for ideas; (b) to situate ideas within the constraints of the tool; and (c) to immerse learners within the vocabulary of the tool. The design cards were a success:

“We worked on our layout of the application by creating a story that would establish a good flow from start to finish. We did this by creating a diagram demonstrating how we plan to tie each location with the steady flow from one event to another” (student 7, final design doc).

“I think that the concept of having different tasks and characters are relatively easy as a concept but once you have to start thinking about it as an experience not only of your experience but other people’s experience step for step and really the process of A to B to C regard-um separated from a general experience. I think it was a tough one but it was necessary and I think it was good from us” (student 4, interview).

Students in Jon McKenzie’s class who participated in the throwaway game were more likely than other groups to consider the constraints of ARIS during their subsequent design work. This thought process and focus on the technical aspect of ARIS escalated as the project came to an end.

Resistance to Online Community

An observation we had during the end of iteration four was that although we encouraged students to use the ARIS online community for support with their project, not many students used it. When inquired as to why, students stated they wanted to search the site for answers before posting their questions and preferred asking a peer. We concluded that students prefer to talk to people who they can physically interact with. For future references, we are thinking of how to make the online community feel more appealing, welcoming and less intimidating to students.

Conclusion

Overall, students who participated in this project gained a robust knowledge of design, both as a content area and as a process, when building projects in ARIS. With future studies, we will continue to develop our understanding of how to best support learners’ negotiation between design and the associated tool(s). As we move forward with this line of inquiry we plan to explore a more content-focused study to understand how students negotiate content (in addition to their design) within the boundaries of the tool. Put differently, we’ve shown that learners gain design knowledge through producing media experiences with ARIS, and we hope to next find that learners gain more specific content knowledge through producing media experiences with ARIS. Our end goal is to develop an instructional method to equip future educators to support learners throughout their design process with ARIS.

References


Teacher Pioneers: Adventures with Media, Pedagogy, and Play in K-16 Learning

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Colby Toefl-Grehl, Utah State University
David Ng, University of British Columbia
Deborah Fields, Utah State University
Kip Glazer, Independence High School & Pepperdine University
Lucas Cook, Indiana University
Sean Duncan, Indiana University
Seann Dikkers, Ohio University
Steve Isaacs, William Annin Middle School
Trent Hergenrader, Rochester Institute of Technology
Jeremiah Holden (discussant), University of Colorado Denver
*Speakers listed in alphabetical order by first name

Abstract: This symposium brings together a myriad of K-16 teachers and authors who have designed, built, and implemented digital media or game-based learning in their classrooms. Speaker experiences range from elementary school to teacher professional development, from science to game design to English, from behavioral management to e-textiles, and many things in between! This session will focus on supporting small group sessions with these pioneers, and discussions of the practical aspects of using such technologies in the messy, surprising, and delightful context of classrooms, schools, and other learning environments.

Teachers often must play the part of the pioneer if changes are to be made. Pioneers forge ahead in spite of difficulty, learning all they can before striking out for new territory. They study maps, anecdotal records, and talk to those on the edge of the frontier. They take old knowledge with them, but expect to develop new strategies, solve novel problems, create new language to describe what they see, and share what they learn with those who have not yet made the journey. Pioneers learn as they go. (Armstrong & Bezuk, 1995, p. 187)

Teachers and professors across the world are being inspired by new digital tools to create unique and immersive classroom learning experiences, ranging from Minecraft to Portal to Civilization-inspired low-tech games and physical, hands-on learning experiences. While each experimenting teacher designs for his or her own classroom, it is important to better define and understand this design process in context of real teaching so that we can more effectively build training, support, and cultivate innovative practices. Each creation requires a certain amount of technological or game-design know-how, and the support systems for each vary widely. While online communities for some tools have emerged organically, each teacher beginning to build such a space starts at square one: researching the building processes in the tool, brainstorming and designing an environment that fits his or her educational objectives, building the environment or tool, implementing it in a classroom, then re-evaluating the design and often rebuilding. This evaluation process is the key to future design efforts: teachers watch their students very carefully for engagement, motivation, and learning, beyond the traditional classroom experience, and strive to use each technology to its fullest potential.

This symposium session presents multiple themed panels by the minds behind a forthcoming curated book, Teacher Pioneers: Visions from the Edge of the Map (Williams, Ed., forthcoming). Each presenter has designed, built, and implemented some form of digital media or game-based experience across diverse learning environments ranging from elementary school to teacher professional development, from science to game design to English, and engaging with a wide range of tools and goals, such as behavioral management, e-textiles, or augmented reality.

Symposium Structure

This symposium will be focused primarily on small group presentations and discussions, à la a roundtable format, with each roundtable organized by theme (discussed below). Presenters will briefly share their classroom experiences with digital media, and then facilitate questions and discussions, with an emphasis on practical and pragmatic advice for designing, building, and implementing in their elementary through higher education contexts. Each attendee will have the opportunity to visit two of the three themed roundtables in their session, and the dis-
cussant will tie together the three themes, highlight some common challenges in doing such work in the classroom, and end with an exhortation to keep pioneering with digital media in the classroom. See Table 1 for the detailed breakdown.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Participants</th>
<th>Time Allocated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to symposium, presenters, themes, and structure</td>
<td>Chair</td>
<td>5 minutes</td>
</tr>
<tr>
<td>Roundtable Session 1</td>
<td>Presenters organized by theme</td>
<td>20 minutes</td>
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<tr>
<td>Transition from Session 1 to Session 2</td>
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<td>2 minutes</td>
</tr>
<tr>
<td>Roundtable Session 2</td>
<td>Presenters organized by theme</td>
<td>20 minutes</td>
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<tr>
<td>Discussant comments</td>
<td>Discussant</td>
<td>10 minutes</td>
</tr>
<tr>
<td>Closing comments</td>
<td>Chair</td>
<td>3 minutes</td>
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Table 1: The symposium structure.

The two themes for roundtable sessions emerged from the authors’ stories of their own classroom work, and are Designing, Building, & Iterating, and Broadening the View.

Designing, Building, & Iterating focuses on the successes and failures of designing, building, implementing, evaluating, and/or iterating for specific classroom goals and learning objectives. Presenters’ backgrounds range in grade, technology, content area, and approach, so each presenter will briefly share their particular experience in classrooms, and solicit specific questions from the attendees. If attendees do not have immediate questions, presenters will provide starter topics and work to facilitate a full-table discussion.

Broadening the View focuses on the provocative use of digital media in unusual ways, such as redesigning the entire special education program in a school, or “hacking” teacher professional development by reconsidering the traditional structure in light of game structures. Presenters will briefly share their experience and how they have specifically broadened the view, and solicit specific questions from the attendees. If attendees do not have immediate questions, presenters will provide starter topics and work to facilitate a full-table discussion.

Participants

Organizing and presiding over the structure as chair will be Caro Williams-Pierce, a doctoral candidate at the University of Wisconsin-Madison who studies games and learning in mathematics contexts, and is editing the forthcoming book. Serving as the discussant will be Jeremiah Holden, a teacher educator and learning scientist who is author of the Teacher Pioneers concluding chapter. Other presenters are described below, organized by themed roundtable.

The roundtable Designing, Building, & Iterating will include: Alainya Kavaloski, a doctoral candidate who studies emerging media representations of border conflict and teaches place-based game design at the undergraduate level; Kip Glazer, a high school teacher who uses game creation as a pedagogical strategy in the classroom; Steve Isaacs, a teacher of game design and development who will share how the iterative design process is a common thread and important pedagogical principle visited in all class projects; and Trent Hergenrader, an English professor who uses role-playing games as models for critical thinking and creative writing with undergraduates.

The roundtable Broadening the View will include: David Ng, a director of a science literacy lab, with an interest in science translation and communication practices that involve collaborations between scientists and artists; Deborah Fields, an assistant professor of learning sciences who engages kids and teachers in using computational media to make their own personalized creations that bring together learning and interest development; Lucas Cook, a doctoral student who studies learning sciences, who previously designed and implemented a behavioral game in middle school; Sean Duncan, a learning scientist and professor who studies games and learning; and Seann Dikkers, an assistant professor of educational studies who previously served as an administrator and middle school classroom teacher for fourteen years using games and portfolio-based learning pedagogies in his classroom (i.e., Dikkers, in press).
Significance to the Field

*Teacher Pioneers: Visions from the Edge of the Map* has a provocative premise: Educators can creatively design and usefully research game-based learning, and such approaches to teaching and learning can and should transform schooling. The teachers, designers, and researchers featured in this symposium demonstrate that educators can adopt new tools, like games and other digital media, and methods, like game-based learning and playful pedagogy, to support their students’ learning. As the field of games and learning matures, evidence routinely suggests that teachers can adopt games to meet the needs of learners in their classrooms. Researchers, however, know less about how a range of educators—both those in formal school classrooms and those in other designed learning environments—creatively adapt (rather than adopt) various forms of games and playful experiences to amplify the interest-driven needs of diverse learners and also opportunities for disciplinary inquiry. Perhaps most importantly, little research describes educators as creators of novel game designs, as professionals committed to practitioner inquiry, and also as iterative play-testers at the intersection of media authoring, game design, and pedagogical innovation. The participants of this symposium have begun to advance a critical and necessary narrative as games and learning pioneers.

References


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Learning with Commercial Games: The Case of Nordahl Grieg High School, Norway

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Tobias Staaby, Nordahl Grieg High School
Aleksander Husøy, Nordahl Grieg High School

Abstract: In this symposium paper, we will report our experience with using off-the-shelf video games at Nordahl Grieg High School over the last 3-4 years. We are two teachers, plus a researcher who has become involved since the fall 2014 as part of an upstart research project. A broad range of game-centred teaching units have been tried out, by ourselves and others, across 5 different subjects and totalling roughly 200 classroom hours. We will discuss what we have learned so far, discuss some key strategies and guiding principles, and present some preliminary findings from a recent classroom study.

Zombie-based Critical Learning with Games (Tobias Staaby)

A couple of years ago, I got the urge to test the validity of an idea I had a few days earlier: can a commercial video game be a good catalyst for classroom discussion, and can games provide a learning space that is set apart from the space normally associated with learning. What could be the benefit of such a space, if any?

First of all: why would one want a learning space that stands apart from what students normally learn and the context they learn it in? Should not one want a game that gives a learning environment that is as realistic and closely connected to the curriculum as possible? Rather than using video games that have a close correlation with learning goals, in many ways replacing a textbook or other source of content, I argue that the educational use of video games does not require a one-to-one relationship between learning content and game content.

The method is different from the more common use of educational games, where the game provides the learning content or where game mechanics simulate the skills intended for the student to learn. Rather, it is up to the individual educator using this approach to identify the points where either the content or activities of the game overlap with the contents or curriculum of the school subject, or to find spaces in the game or gameplay activities that can facilitate learning. It is learning with games rather than learning from games. The teacher can very well use the game in tandem with more traditional learning sources, like textbooks, web pages and educational films. This approach also gives the teacher a lot of versatility and flexibility when designing a unit using games, instead of being restricted to the framework the game developer has provided.

Gee (2007) writes about the importance of “active” and “critical” learning. This is learning that goes beyond just mastering the content, by incorporating the knowledge in the way one acts within it. Active learning, then, is about seeing the world in new ways and using this as preparation for future learning (Gee, 2007, p. 24). What is needed for “active learning” to become “critical learning”, is for the learner to “learn not only how to understand and produce meanings in a particular semiotic domain but, in addition, needs to learn how to think about the domain at a “meta” level as a complex system of interrelated parts” (Gee 2007, p. 25). Gee further explains that the learner “also needs to learn how to innovate in the domain – how to produce meanings that, while recognizable to experts on the domain, are seen as somehow novel or unpredictable”.

As Gee (2007) notes, critical learning requires learners to innovate and think about a subject at a “meta” level. In my experience, it is more difficult for my students to innovate and, equally important, formulate individual, original and independent solutions and answers to the tasks given to them when they have a strong conception that there is a “correct answer”, or if they are working with material that simply doesn’t allow or have room for individual interpretations. Therefore, I would argue that it sometimes is to the students’ advantage that they are introduced to new concepts in a “baggage free” environment, so to speak; one that isn’t already laden with pre-existing conceptions and where all new ground is already broken. There has to be some space left in which the student can innovate. The mismatch between the video game and the subject matter is therefore a productive mismatch, since this creates more space for the student to formulate creative and innovative solutions to a task.

Learning does not come from the students achieving success and mastery in the game. In fact, winning the game is completely detached from learning goals. This may seem like an obvious statement, but it is important, especially when dealing with games not designed for educational purposes. There has to be some real-world “output”, a test, student essay, presentation or the like, that puts the learning goals in a context completely detached from the video game. In other words: the student has to “translate” the learning that takes place in the context of or in
tandem with the game into other contexts, independently of the game. The need for this translation is what gives room for active, critical learning. I will demonstrate what I mean by using my experiences from teaching ethics with Telltale Games’s The Walking Dead (2012).

An Example of Learning with Games: The Walking Dead and Moral Philosophy

The Walking Dead by Telltale Games is a post-apocalyptic dystopian point-and-click/action-adventure game with a big emphasis on narrative and branching story. The world as we know it is in ruins, along with most of its people, who have become flesh-eating walking corpses, save for a few desperate survivors. The player takes the role of one of these survivors, Lee Everett, and guides him through a harrowing story of how humanity copes when civilization crumbles around them. The main way of interacting with the game is through dialogue choices, where the player can select from up to four options depending on the situation. Truly dangerous situations resulting in player death and failure are relatively few, and most of the game’s challenge comes in the form of a wide variety of difficult moral dilemmas. These can be anything from deciding whether to steal food from an abandoned car, deciding whether to lie or to tell the truth, or whose life to save then you can only save one. The game is divided into episodes, with ten episodes across two seasons.

When teaching ethics with The Walking Dead, learning does not necessarily take place during gameplay, but rather alongside gameplay. In this unit, I structure the class as follows: I start by giving a short presentation of the four ethical theories I want my students to learn: consequential ethics, ethics of virtue, relational ethics, and ethics of duty. We then start playing the game, which I have set up on the classroom projector. I let my students take care of the actual gameplay. When we come to a dilemma within the game, we pause the game, and for the first four dilemmas, I give a short lecture on the ethical theories one at a time, each theory linked to a suitable dilemma demonstrating the nuances of the theory at hand. I then ask my students to discuss how to solve the dilemma, talking to the individual groups and summarizing the various arguments. I then put the dilemma to the vote, where I have made a poll using an online survey tool called “Kahoot” to let each student vote anonymously. Whatever answer gets the most votes is the one we act upon in the game. Now, of course we could have just started with the real-life dilemmas and worked our way from there, and my students would still have been able to grasp the core concepts (people have been studying moral philosophy long before the advent for video games, after all). However, this would not be a baggage free environment. Discussing contemporary issues like abortion or capital punishment would not necessarily be ideal for the students, since these issues have already been more or less hollowed out by politicians, journalists, pundits, and so on. The game introduces the students to activities and/or concepts that the students can use as a basis for learning. In other words: the game serves up the expressions, and the teacher and the students work together to fill these with content. The Walking Dead introduces the students to difficult ethical dilemmas, and together we put them in the context of moral philosophy. Put simply, the games gives us something to talk about, rather than having to discuss the ethical theories in a vacuum, or in a context too heavily laden with baggage.

These repeated passes using ethical theories as a way of discussing ethical dilemmas in The Walking Dead gradually deepens and improves the students’ literacy in the domain of moral philosophy. In order to reach what Gee (2007) refers to as critical learning, learning how to “think about the domain at a “meta” level as a complex system of interrelated parts”, they have to be able to abstract the core concepts of moral philosophy and apply them to other situations and contexts. In other words, they must learn how to connect the meanings of utilitarianism, relational ethics etc. from instances in the game to different dilemmas in other environments. In the final part of the unit, I divided the students into groups, where they discussed real-world dilemmas using the ethical theories they learned earlier in the unit, while I sat across the table and observed. In these debates, they were to evaluate the implications of each ethical theory according to the dilemma at hand. I evaluated them based on how well they were able to formulate individual answers and solutions to the dilemmas - that is: not parroting an argument from a media pundit, news article or the like, and whether or not they are able to make meaningful responses to statements from other group members. An important part of the evaluation was to what degree they were able to use their knowledge of ethical theories as foundation for their arguments, and how sensitive these arguments were to the nuances of a given dilemma and the traits of each given ethical theory. Failure to do so, like making generalized statements not particular to any given dilemma or ethical theory, would indicate that the student still had a way to go before truly understanding the subject matter. Over the course of these debates, most of the students were able to demonstrate knowledge of and ability to use the ethical theories in their own individual way, which indicated to me that The Walking Dead helped them learn, if not better, than at least just as well as if we were using more traditional learning tools.

My students sometimes expressed frustration over the fact that some of the dilemmas in The Walking Dead results in the same outcomes no matter what you do. To this, I answer that the actual consequence is not as important as the reflection the dilemma itself provokes. In other words, when using The Walking Dead as a context...
for ethical discussion, what the mechanical implications of our actions are in the game is of little interest to us; the really interesting part – the learning itself – comes in between the gameplay, before and after an action is taken in the game. Instead of serving connections between the game and real-world dilemmas up-front, this approach encourages students to find an answer themselves. “Okay, now I’ve understood what answers utilitarianism looks like in the world of The Walking Dead. Now, what happens when we have an utilitarian perspective on real world issues?” Giving a meaningful answer to this problem requires recognizing patterns and abstract concepts, and being able to apply them to real-world phenomena.

Using Civilization IV as a Tool for Deepening Understanding and Promoting Learning Retention In Social Science and English (Aleksander Husøy)

Some time ago, I came across Kurt Squire’s dissertation Replaying History (2004), on the use of Sid Meier’s Civilization III to teach history. Inspired by his work, I went about creating lesson plans for a four-week cross-curricular project using Sid Meier’s Civilization IV (Firaxis Games, 2005) in my English and Social Studies classes. Having used this game with Grade 11 General Studies students of 28-30 students over 3 years, I believe I have gained some insights into the factors that determine the success of a massive game-centred unit.

Civilization IV is a complex turn-based strategy game in which the player is tasked with leading a state from early history and into modern times. In order to succeed, the player needs to be able to balance the time and resources required for the various needs of a fledgling state. How much effort should be devoted to technological development vs. national defence vs. developing infrastructure? In addition the player needs to make difficult decisions with regards to diplomacy, maintaining friendly relations with his closest allies while avoiding alienating other actors in the international community. The game can thereby function as a simulation modelling many of those processes in social science that we want our students to gain an understanding of.

In earlier attempts at using games from the Civilization series in education, the units have been based on modifications of the game particularly designed to illustrate specific events, particularly in History courses. Examples of this include Ed Webb and Todd Bryant’s work using the game “to grapple with the historical puzzle of the conquest of Mesoamerica by relatively small numbers of Europeans in the late 15th Century and 16th Century” (Webb, 2013) and Shawn Graham’s use of the game to illustrate the Roman civil war of 69 AD (Graham, 2010). My approach differs significantly from this. Students were let loose to explore the game much in the same way as a recreational player would. This means that the scenarios that they encountered would be very different than actual historic events. A student playing as Victoria I of England, might find herself invaded by a technologically superior Zulu nation. In another instance Mao will make attempts, to no avail, at convincing the Americans to give up State Property. The who’s who of history is however irrelevant to the aims of this unit. The types of situation that the students encounter are key.

Playing this game, students will enter into a variety of diplomatic agreements, they will need to take a stand on how they want to run their nation, they will see their civilization’s finances crumble as they neglect their infrastructure. These experiences found a basis for discussing the how, when and why such events happen in the world today. By letting students experience and examine the consequences of choices taken by nations within the framework of a game, the idea is that they become competent to apply the social science concepts they encounter in the game when studying events in the real world.

A central principle to my approach is that what takes place within the framework of the game should be just one component of the learning unit. Textbooks or other source materials, and not least, activities and interactions between students are crucial to the effectiveness of any game centred learning unit I have run this far. Civilization IV in and of itself has plenty of learning potential, but it is through the exercise of discussion, and identifying parallels to real world situations this game becomes truly potent. This encourages deep learning (Fullan & Langworthy, 2014), and allows for better learning retention.

Ideally, much of the learning process in a Civilization IV unit will be learner driven. Students should be introduced to some of the theories and concepts that they will be likely to encounter in the game before they start playing, and the must be given the opportunity to reflect upon these without too much interference from the teacher. The role of the educator in such a unit is to a large extent to facilitate student discussions and provide “just-in-time” learning, assisting students in connecting the dots between what they experience within the game, and learning aims from the social science curriculum. This can often be achieved by asking the right questions, leaving it to the students to draw the parallels.
Some examples of learning situations that occurred while working with *Civilization IV*:

- One concept that many Norwegian students struggle with in understanding the causes of poverty in developing country, is the importance of infrastructure. Having identified that the reason their state’s economy’s dire straits in the game were due to them neglecting developing infrastructure, students reflected on how limited access to roads, sanitation and electricity affects the prospects of developing countries.

- In *Civilization IV* the quality of your relationship with other civilizations is determined by factors like religion, political preferences, international agreements and past events. These are made explicit to the player through the user interface. Having identified the factors that determine how well they get along with other nations in the game, lead to a series of discussions of how political cleavages between nations or groups complicate conflict resolution in international politics.

- Towards the middle of a game of *Civilization IV*, players will face a first encounter with a civilization from another continent that is often vastly technologically superior or inferior to their own. This meeting will often result in the downfall of the inferior civilization by being conquered or being made a vassal of the dominant state. Observing the processes that take place following such a meeting, allows the student to reflect upon the meetings between European colonists and any indigenous peoples, as well as their long term consequences.

In order for students to use this game to attain deeper learning, some of the relevant concepts need already to be introduced, for instance through lectures, reading materials etc. Students will need to become thoroughly acquainted with the gameplay of *Civilization IV*. They do by no means need to become expert gamers, but they need to become sufficiently competent to understand central features of the game mechanics. Finally, they will need to be able to apply both the concepts in international relations and the models of interaction to relevant real-world examples. Since the game illustrates how interactions between nations play out generally, rather than attempting to replicate historic events, concepts from the game can be applied to a range of contemporary situations. Making use of each of these aspects to attain a greater understanding of the others can, in part be achieved through student reflection and instruction. However to enable deeper learning, i.e ensuring that the learning process “becomes the focal point for the mutual discovery, creation and use of knowledge” (Fullan & Langworthy, 2014, p. 3), one has to facilitate a dialogical process where students can collaborate to reach these insights.

By experiencing and discussing these processes, and comparing and contrasting them to their real world equivalents, many of my students exhibit a deeper understanding of their subject materials than students in classes where I did not run this unit. Furthermore, learning retention seems to be stronger for those of my students with whom I ran this unit, than with students where the same materials were covered using textbooks, lectures and group work. Two years after my first run of this project, I conducted short informal survey with a random sampling of my former students. Half of which were were in a class where I covered the topic of International Relations without the use of a game. The students who took part in the *Civilization* project expressed a better recollection of the concepts we covered, and were able to a greater extent able to apply these to current events in international relations. The size and scope of this survey is by no means sufficient to yield definitive results, but the relationship between the use of games and learning retention is certainly deserving of further study.

Though *Civilization IV* can serve to give students a better understanding of a whole range of Social Science concepts, the game is by no means a perfect model. This is a game designed as an entertainment product, and as such accuracy in its rendition of reality is often sacrificed for playability. For instance though the player can select between several different forms of Government, the penalties and bonuses associated with these function more to balance the game mechanics than to accurately portray them. The game gives the player dictatorial, if not to say godlike powers to administer his civilization. Regardless of whether the player runs a theocratic police state or has embraced both universal suffrage and free speech, there are no internal checks on the player’s authority.

These discrepancies might be viewed as a limitation to the relevance of this game as a teaching tool, but in my opinion, these inaccuracies serve an important purpose. Any model is by definition limited. However, models and simplifications are often taken at face value by high school students, and form lasting misconceptions. Representations of reality in all media sacrifice nuance for clarity, entertainment or force of argument. Though teachers may point this out, students’ takeaway from textbooks, film etc. is that these are accurate and precise depictions of reality. Students are far more accustomed to viewing the representations of reality found in games with a critical view. By discussing and examining to which extent the worldview presented in *Civilization IV* is accurate, this also opens the students’ minds to also approach information presented in other media with a healthy sense of scepticism.
A further caveat to using this approach is that for those students who never got on board with this game had substantially worse learning outcomes than students in classes where the material is approached without using Civilization IV. Regardless of the teaching method, some units work better or worse for different students. Seeing as this was an extensive unit, running over 4 weeks, it left students who were unable or unwilling to learn the game mechanics in the early phases, without the necessary framework to make effective use of the game in their learning. This framework is absolutely crucial for students to benefit from this approach to learning. Though most of my students had an improved learning outcome, it needs to be balanced against those few students who had a significantly worse outcome from using this game. In the first two years I ran this unit between 2-4 out of 30 students fell into the group that gained only a limited understanding of the game. This had a tremendous negative effect on their learning outcome. Therefore, in order to run a unit of this scope, one must carefully assess the likelihood of each student's willingness to invest time learning game mechanics that they might not immediately see the purpose of. Preferably, one should also have a fallback option for those students identified to have limited learning outputs.

Civilization IV is not, and will never be the ideal teaching tool for most classrooms. The game requires a substantial time investment by both teachers and students to acquire a sufficient understanding of a fairly complex set of game mechanics. Yet, highly motivated teachers who are competent in their subject and have a solid understanding of the strengths and limitations of using games for learning may encourage deeper learning and better learning retention with a unit like this. The principles that this unit is based on should also be applicable to many other game-centred learning situations.

Situated Learning with Off-The-Shelf Games: Key Approaches and Challenges (Rune Klevjer)

Nordahl Grieg High School is emerging as a privileged site for practice-based research and innovation in the field of games and education. No other schools in Norway, or elsewhere as I am aware of, are investing in similarly comprehensive efforts to develop the use of commercial computer games an established classroom practice. The primary driver has been the teaching staff themselves, without whom little but promises and strategies would remain; at best maybe we would have a couple of isolated experiments, driven by external agendas and expertise. From a researcher's point of view, this is a chance to participate in the development of a field driven by the practitioners themselves, taking the double role as teachers and action-researchers. I believe that the prospects for building something of real impact, in classrooms as well in the field of education more broadly, is much stronger in such a case than in situations where schools are being persuaded to accommodate academic initiatives.

The research project that we are planning for the period 2016-2020 will address classroom strategies and pedagogies as well as challenges at the institutional and organisational level. In the latter area of study, key aims will be to develop and share pedagogical models, teacher competencies and resources, organisational frameworks, and research-based methodologies. At the classroom level, a pedagogic profile is already emerging, although aims and methodologies are still diverse and the trajectories ahead far from settled. First, the off-the-shelf approach implies a particular way of conceptualising the role of games in the classroom. In school, a commercial game is a found object, not designed for the occasion. As Staaby points out, students are asked to learn with the games, in a way that is more similar to working with a literary novella or a documentary film (or visiting a gallery) than to working with a textbook or a specially designed task-set. Game play is embedded within a larger package of activities, which are governed by fairly traditional didactic considerations, although generally committed to an activity-oriented approach to learning.

The Nordahl Grieg off-the-shelf approach also involves a strong media education aspect; learning with games is an opportunity to also learn about games. The teachers are cultural and educational curators, who want to bring original media into the classroom, not some pedagogical derivative of them. Finding games that they can themselves appreciate and enjoy is of crucial importance; they need to able to tell their students that this is a good game, worthy of their time and effort. Not all students will be motivated by games, but they will at least have a chance to engage with good stuff. Media education topics are part of the curriculum in Norwegian language classes, and also in English, where students have for example played Gone Home (Fulbright Company, 2013) as a way of studying English language and literature. Looking across the curriculum, we want students to learn about about how they are learning (or not learning), and how working with games compares to working with other types of material.

Second, in The Walking Dead classroom as well as in the Civilization IV classroom, there is a common emphasis on situated, first-hand learning, resonating with a long tradition of simulation and gaming in education. Tansey and Unwin (1969) reports how participants in the 1957 Jefferson Township school-administration simulation «... experienced fears, doubts, satisfaction; they became tired and frustrated, but most of all they became the person with the job to do and the problem to solve. This was obviously learning by doing» (1969, p. 11). Whereas students playing Civilization IV get to immerse themselves in a web of interconnected parameters, attempting to get a grip
on «how social or cultural systems work in the world” (Bogost, 2008, p. 136), playing *The Walking Dead* is not similarly simulation-based, at least not in the strict sense. Instead, the role-playing element is stronger and more focused. The task is to situate yourself, fictionally and perceptually, as “the person with the problem to solve”. In both cases, however, games are utilised as situating gateways to learning. Through play and classroom dialogue, students are placed in situations that encourage reflection on a few core concepts, with the aim of putting them on the track of active and engaged learning. We should note that both types of games support situated engagement in a fictional domain. The gap between, on one hand, the game’s extra-curricular (or “zombified”) world-models and, on the other hand, the conceptual models sanctioned by the curriculum, is, as Staaby explains above, seen as an advantage rather than as an unwanted barrier to overcome. As in Kurt Squire’s seminal study on *Civilization III* in the classroom (2003), the goal is to have students engaged in such a way that they start asking relevant questions to the teacher and to each other. For this to happen, they need to care enough to invest work in the gameplay situation, and to be prepared to push themselves beyond looking for ready-made formulations, canned reflections, and the safety of cut-and-paste outputs.

The experience documented from the *The Walking Dead* case so far also supports the idea that “zombie-based” learning can take place through whole-class play via the projector. This appears to confirm Lee and Probert’s finding that whole-class playing of *Civilization III* can work as a gateway to engaged learning in high-school social studies, even if the possible connections between game and curriculum content were «…much less direct than some teachers may be used to» (Lee and Probert, 2010, p. 24). Perhaps the whole-class strategy can be seen as a minimum or entry-level model of situated learning with games, sacrificing the benefits of first-hand individual gaming for higher inclusion, stronger control, lower time investment, and easier logistics. The main pedagogic strength seems to lie in its potential to engage the whole class in structured discussions.

Based on the teacher’s observations, as well as my own preliminary findings from a two-week classroom study on Husøy’s social studies unit during October 2014 – which was broken off earlier than planned – inclusion and gaming competency are central issues when teaching regular classes with a game like *Civilization IV*. This type of game is more strongly associated with particular preference groups and cultural identities than, say, a documentary film, and we must expect this to influence the social dynamic in the classroom. The data so far, especially from group interviews, indicate a polarising tendency among the students, opposing those who were highly engaged and enthusiastic to those who claimed to be completely lost. The former group were almost exclusively boys, experienced with video games. The latter group were inexperienced with games, and mostly girls (although with a couple of exceptions). In the group interviews, a majority of the girls stated, repeatedly, that they did not understand anything of the game. Although slightly exaggerated, classroom observations confirm that most of the girls did indeed fail to get a sufficient grip of basic gameplay. In contrast, experienced gamers displayed a level of engagement that is rarely seen in students’ work on theoretical subjects. The way in which they reflected on their own learning experience closely echoed ideals of experience-based and situated learning. For example, one of the students elaborated on how his own experience in the game made him understand very well the “strong temptation” there may be for a state to expand thorough colonisation.

As could be expected, struggling students felt that the game was too complex and difficult. All students, however, complained that the teacher should have spent more time teaching the basics of the game in front of the class. They were clearly not at all worried that such traditional teaching would “ruin the fun” or undermine the autonomy of the gaming experience, quite the contrary. In the words of one of the experienced gamers: “In maths, the teacher shows us how to do a task. It is the same with solving something in the game. The teacher must show us how to play”. Many also pointed more generally to the high level of open-ended and self-directed learning as a major obstacle to learning.

The preliminary findings from the *Civilization IV* class highlight a few methodological challenges that will be addressed during the main project period. Through the observations and group interviews, the need for log data or other ways of documenting the students’ game playing in detail has become more apparent. The gameplay experience is at the core of this variant of game-centred learning, and the student’s self-reporting on their own competence and playing style needs to be compared with objective data. Solid log data would also allow us to compare students’ game playing patterns and competencies with the material they produce for our evaluation and assessment, essentially looking for links between types of engagement and types of learning outcomes. In terms of the games themselves, less demanding yet meaty enough simulation games will be worth trying out, as well as closer-to-reality simulation games – to which role-playing could possibly add some of the immersion and sense of urgency that characterises engaged situated learning. Finally, the preliminary findings illustrate the need for qualitative research on the social dynamics of game preferences and competencies among Norwegian teenagers, which appears, perhaps unsurprisingly, to play very significantly into classroom situations.
References


Where the Rubber Meets the (Cross)Road: Insights into Game-Based Learning & Assessment Design

Abstract: Human agency—the power to shape a course of action (Bandura, 2006)—has long been held central to empowered, self-regulated learning (Pintrich, 1999). Implicit in this choice-centered learning is the ability to take different pathways towards a solution, a key affordance of games as a medium to deliver engaging, effective educational experiences (c.f. Salen & Zimmerman, 2004). The work in this symposium reflects a holistic design goal in game-based learning—integrated learning and assessment which can support multiple pathways to learning. This integrated design is discussed from four perspectives: teacher-facing UI design, learning game design (integrated instruction & assessment), psychometric assessment analysis, and exploratory data mining of emergent learner patterns.

One Theme, Multiple Pathways: An Overview

V. Elizabeth Owen, GlassLab Games

Human agency—the “power to shape…circumstances” and a “course” of action (Bandura, 2006, p. 164)—has long been held central to empowered, self-regulated learning (Pintrich, 1999; Glaser, 1996). Implicit in this choice-centered learning is the ability to take different pathways towards a solution (Pintrich, 2000). Indeed, multiple pathways of strategy in problem solving is a trademark of authentic assessment in rich, interactive learning contexts (c.f. Schank, 2011; Mayrath et al., 2012). One powerful vehicle for self-regulated learning can be the scaffolded, engaging microworlds of games (Rieber, 1996). Good games provide well-ordered problems in which students are the drivers of their own experience, able to customize strategy with low cost of failure (Gee, 2005). As data-rich environments which offer roles, goals, and agency (e.g. Norton, 2008; Steinkuehler et al., 2012), digital games can integrate instruction and assessment for optimal, adaptive support of individual learner choices.

The work in this symposium reflects our core design goal—integrated learning and assessment which can support multiple pathways to learning, a key affordance of games as a medium to deliver engaging, effective educational experiences (Salen & Zimmerman, 2004). The four proposed symposium presentations explore challenges and insights into core components of this process: teacher-facing UI design, learning game design (integrated instruction & assessment), psychometric assessment analysis, and exploratory data mining of unexpected learner patterns.

Each themed around multiple pathways, these studies are based in current learning game design, development, and analysis efforts at GlassLab (in partnership with Educational Testing Service and Pearson). The first discusses design efforts around GlassLab’s online dashboard, optimizing visibility of game-based learning to educators (critical constituents in UI design). “Teacher Portal Design” discusses considerations and lessons learned around designing multiple representations of data that are simple yet richly informative. Next, “Designing on Mars” centers on a design process that fosters and assesses students’ learning, and yields, rich multi-path learning data for the dashboards. In alignment with designed game tasks, “Game-based Assessment of Argumentation Skills” next shares psychometric analysis of event-stream data. It represents varied player choices in the form of evidence fragments, and evaluates the relationship of specific action combinations to learning outcomes. Lastly, “Mining Multiple Learner Pathways” uses an exploratory approach. Leveraging event-stream data beyond the initially designed evidence fragments, this analysis uses Educational Data Mining (Baker & Yacef, 2009) to mine organic (and unexpected) learner trajectories.

References


There is great interest in the use of data by teachers to inform instruction. Research has repeatedly shown that student achievement improves dramatically when teachers are provided with information about their students’ learning (Hattie, 2009). The use of learning games in classrooms exponentially increases the amount of student learning data available. However, these same systems also remove the teacher from direct interaction with students’ work products. If the promise of game data to reshape education is to be met, we must find ways to communicate the information from digital activities to teachers in ways that help them make instructional decisions in the classroom (Fishman et al., 2015).

Indeed, as the conduit for opening game-based learning to students across the country, teachers are critical constituents in user-friendly UI design. A main goal of our work here was informed design of an educator portal for visibility of learner progress, thus optimizing classroom facilitation tools. We describe the teacher interview process, key feedback takeaways, and resulting iterative UI designs used to make learning visible to educators who are facilitating game-based education in the classroom. Multiple representations of data are considered, both in terms of showing variations in student play patterns, as well as optimizing final visuals for an educator audience with different forms of data transparency.

To begin the process, we conducted a series of iterative think-aloud studies with teachers in an effort to understand how they interpret data displays of their students’ game activity. We began by identifying particularly instructional decisions to target, including: what should I teach next, how should I group students, and what support do particular students need? We designed displays targeting these questions and conducted 3 cycles of think-aloud and design iteration. Results of these iterations led to many designs, including those shown below (Figure 1). These utilize simple color schemes, improved intuitive shape representations, and class-wide as well as individual student views.
Some particular lessons learned fall under four main themes. First, considering the nature of the data, one challenge is educator difficulty in understanding visualizations that represent the probability of mastery. Information overload emerged as another theme, as hover interaction or “tooltip” prove difficult to teachers to make use of in whole class views. Next, in showing learner progress, teachers often confound level of gameplay, formative learning progress, and summative content mastery. Lastly, in distinguishing these kinds of learner progressions, actionable data become important in two ways: first, teachers need tools that quickly help them spot trends in the class group, so that they can quickly target groups of students for re-teaching or extension; second, in order to apply the information about student progress, teachers also benefit from suggestions regarding instructional strategies that will be most effective in addressing the learning issues surfaced in the reports.

Overall, this teacher interview process, ensuing feedback, and ongoing refinement loop supported optimized, iterative UI design. Throughout the process, these insights helped greatly to help make learning visible to educators facilitating game-based education in the classroom.

References


Designing on Mars: Learning, Assessment, & Game Designed Together

Erin Hoffman, GlassLab Games

This section of the symposium focuses on the GlassLab learning game design process and how it brings together designers from the learning, assessment, and game design spaces to collaborate on a game product. In Mars Generation One: Argubot Academy, GlassLab learning, assessment, and game designers worked together on a hybrid process based on evidence-centered design (Mislevy, Corrigan et al., 2014; Mislevy, Steinberg, & Almond, 2003; Riconscente, Mislevy & Corrigan, in press) to create a new game design methodology that first considers a learning performance, then matches it to a game mechanic, then tunes that game mechanic to reveal a student’s thinking. Within the learning game, the content being assessed should guide the selection of relevant tasks, as well as the rational development of content-based scoring criteria and rubrics (c.f. Messick, 1994).

A product of this integration is an assessment-aligned design process for GlassLab learning games. Generally, our game design begins with learning and assessment designers mapping a competency and teaching it to the game team. Once the competency is identified, fundamental design work involves mapping it to a core loop of learning tasks in-game. Specifically: 1) a game is always built around a core mechanic; 2) the mechanic is a set of verbs that create a core loop; and 3) if the core doesn’t match the learning, the learning never happens. Assessment is inherent here, where event-stream data from the core loop provide task-aligned learning evidence. Narrative variations on the loop provide occasions for multiple play pathways. An example of the core loop in MGO is shown in Figure 2. In iterative development of this loop and game narrative, the approach to playtesting is discussed, as well
as strengths and weaknesses of the process as we perceive them at this stage of development. Common pitfalls will be discussed as well as ways to mitigate them, including strategies now being used to develop GlassLab’s latest learning game: an HTML5 product to teach proportional reasoning to 7th graders.

**Figure 2: Learning Game Core Loop: Mars Generation One**

At the end of the presentation we will discuss our revised thinking—how the methodology has changed between products—and discuss further modifications being made to the process with the current math product. We’ll also provide a brief comparison between developing for two similar-in-difficulty but widely variant in content competencies (argumentation and proportional reasoning).

**References**


**Game-based Assessment of Argumentation Skills**

G. Tanner Jackson, Educational Testing Service

Maria Bertling, Educational Testing Service

Game-based assessment (GBA) is progressing beyond just promises (Gee, 2007; Klopfer, Osterweil, & Salen, 2009), emerging as an empirically supported and reasoned approach to learning and assessment (Mislevy et al., 2014). GBA takes particular advantage of the interactivity and engagement games are built around to provide rich data streams and multiple sources of evidence for a given construct. An important driver to this work is that significant investment in the development and validation of cognitive models (e.g., learning progressions) provides a robust basis for underlying game design and allows for making detailed and actionable claims about student performance. Particularly, leveraging the development guidelines of *Evidence Centered game Design* (ECgD; Hoffman, John, Makany, 2014) provides educators and researchers with the necessary arguments and principled design practices to produce quality assessment games.

*Mars Generation One: Argubot Academy* (MGO; developed using ECgD by GlassLab and Educational Testing Service) teaches and assesses students’ argumentation skills through an RPG-adventure-based educational game for the iPad. Targeted argumentation skills were selected from an existing learning progression (Song, Deane, Graf, & van Rijn, 2013) and implemented within MGO as different game mechanics (i.e., explore, equip, battle) involving aspects of argument identification, organization, and evaluation.

Approximately 590 middle school students interacted with MGO and completed a pre- and post-test on argumen-
tation knowledge. Results showed mean differences in test-scores with students’ performing significantly higher on the post-test than the pre-test, t(588)=10.779, p<.001, Cohen’s d=0.44. Additionally, significant correlations among in-game evidence and the external argumentation measures (displayed in Figure 1) indicate that previously hypothesized telemetry evidence fragments (identified during the ECgD process) are relevant to the construct of argumentation and can be used to draw connections between student performance in the game and their knowledge of argumentation. Additionally, subgroups of students (high or low levels of prior argumentation knowledge) were compared and different patterns of relations were discovered between learning gains (post – pre) and in-game evidence fragments. Thus, students’ prior knowledge contributes significantly to their learning gains from different components within the game.

Figure 1: Correlations among in-game evidence fragments and argumentation anchor measures. *p < .05. **p < .01.

These findings extend previous research by demonstrating not only the feasibility of tackling hard-to-measure constructs and 21st century skills within game-based assessments, but also the importance of providing a multitude of interaction mechanisms with rich, diverse sources of evidence. We showed examples of evidence fragments for a latent construct (argumentation) that were derived from in-game process data and that can serve as significant indicators of learning.

References


Adventure on the Red Planet: Mining Multiple Learner Pathways in Mars Generation One

V. Elizabeth Owen, GlassLab Games
Kristen E. DiCerbo, Pearson

Upon landing on the mysterious Red Planet, players can begin to make a series of individual choices that affect civic decisions in the game Mars Generation One: Argubot Academy (MGO; GlassLab, Inc., 2014). In the game, players learn critical argumentation skills and decide the fate of their city by sending Argubots into battles of persuasion. Since there is more than one pathway through the game, and each player brings their own approach
to play (e.g. Bartle, 1996; Yee, 2006), ways of capturing these paths must center on moment-to-moment student decisions (not one pre-defined “right” track). In other words, the analysis methods used to understand this player experience need to be as sensitive to organic player choice as the game itself. One aligned field is Educational Data Mining (EDM), which has developed methods to mine organic patterns from digital educational settings (Baker & Yacef, 2009).

This study explores multiple, organic play pathways in relationship to enjoyment and learning outcomes in Mars Generation One, as built on fine-grained event-stream data of each student using EDM. Since these player paths can consist of many different kinds of actions (not just a few predetermined learning moments), the identification of salient game events for the analysis (also called feature selection or feature engineering, e.g., Guyon & Elisseeff, 2003) presents a significant challenge (c.f. Halverson & Owen, 2014). The exploration of MGO has two parts: 1) The feature engineering process—distilling hundreds of click-stream event types into a set optimal for analysis; and 2) Building a predictive learner model—mining organic play patterns and multiple pathways based on these foundational data features. These two layers fuse to focus on the question: what organic in-game trajectories are most characteristic of learning and enjoyment in Mars Generation One?

Data Collection

In fall 2014, over 500 middle-school students across the country played MGO as part of their regular school day, spanning 5 hours over the course of a week. Outcome measures included the CBAL, a validated external measure of argumentation created by ETS, as well as a shorter argumentation measure that was piloted with the game. The latter was a close argumentation measure was designed to be an assessment of learning more tightly aligned to specific game skills than the more distally-related CBAL measure. An additional survey gathered information on student engagement (including enjoyment, effort, and self-reported learning). During play, hundreds of unique player actions and game events were logged for a recorded total of over 2 million click-stream events.

Feature Engineering

To help focus on event-stream actions salient to analysis, we looked at play through three lenses: base game progress, in-game success and failure as aligned with core design, and exploration and boundary testing. Features measuring base progress through the digital world (e.g. time elapsed, missions complete, etc.) have been features successfully used in game-based EDM modeling (e.g. DiCerbo & Kidwai, 2013; Baker & Clarke-Midura, 2013), while understanding success and failure relationships has yielded insights into failing productively (e.g. Kapur, 2006; Juul, 2013). Similarly, game research suggests that certain kinds of players have paths of exploration (Salen & Zimmerman, 2004) and failure-filled boundary testing (Owen, 2014) positively related to learning.

Outcome Variables

The outcome variables of learning and enjoyment were also refined for analysis. The CBAL scores and the close argumentation measure post-scores were selected as learning outcomes. The self-report engagement survey, however, measured multiple construct: enjoyment, competition, effort, difficulty, and self-reported learning. An exploratory factor analysis revealed three constructs: enjoyment, effort, and self-reported learning. Each of these three subscores then became a distinct outcome variable to be used in the predictive model.

Mining Play Patterns: Building a Predictive Learning Model

Next, we established predictive modeling to explore students’ play patterns in relationship to these final outcome variables: argumentation skill, enjoyment, effort, and self-reported learning. Core EDM predictive algorithms (Baker & Siemens, 2014) were used from the family of classification and regression trees (CART)—specifically M5Prime, JRip, Naïve Bayes, J48, and PART. Preliminary results suggest strong multiple play pathways in relationship to learning and enjoyment as predicted by event-stream player actions (themed along progress, success, failure, and exploration). Results will be discussed in terms of prominent click-stream events in the model, emergent play trajectories, and outcome variables of best fit.

Mining the game data—themed along progress, success, failure and exploration—to predictively model learning and enjoyment can impact learning, game, UI, and curriculum design. For example, where organic (and perhaps unexpected) play pathways arise in positive relationship to learning gives the game designer opportunity to scaffold in just-in-time support. Emergent learning-related data features augments Evidence Centered Design (Mislevy & Haertel, 1996) assessment models, supplementing initial lists of hypothesized evidence fragments. Overall, both the methods and results here provide insight into the relationship between micro-level game actions and large scale learning goals.
References


Leveling Up: 
Measuring and Leveraging Implicit STEM learning in Games

Abstract: Games provide an important vehicle for educators to promote and study learning. This symposium will examine research on measuring implicit game-based learning and teachers leveraging its relationship for explicit (e.g., school-based) STEM learning. The authors have developed a series of learning games that simulate authentic scientific phenomena, providing a learning mechanic for players to dwell in that phenomena and build their implicit understandings. The data logs generated through digital gameplay were mined to understand the patterns of play that may be related to implicit learning—the development of knowledge that is not yet explicitly formalized. Teachers used examples from games to help bridge implicit game-based learning to explicit STEM concepts taught in class.

Presentation 1: Framing of Implicit Learning in Games

Jodi Asbell-Clarke, Educational Gaming Environments group at TERC
Elizabeth Rowe, Educational Gaming Environments group at TERC

The theoretical framing that guides the research is based in a model of implicit learning, explored more commonly in psychology, philosophy, and sociology (e.g., Collins, 2010; Polanyi, 1966; Reber, 1993). Implicit knowledge is, by definition, largely unexpressed by the learner. Explicit knowledge is what educators typically attempt to measure in learning assessments. Implicit learning is considered foundational to all knowledge (Polanyi, 1966), but has not made headway in educational research because until now, it has been particularly difficult to measure. This framework differentiates between explicit knowledge, what we can express, from implicit knowing, what we are able to do. Cook and Brown (1999) argue that implicit and explicit knowledge can aid one another, claiming that a dynamic affordance of the interaction between acquisition and usage of knowledge such that knowledge and knowing (the doing that is associated with knowledge) are linked. A classic example used in implicit knowledge literature is learning to ride a bicycle. One does not need to formalize the physics to ride a bike, but familiarity with the sensations of riding often help students learn the physics.

Games present a rich opportunity to support and measure implicit learning (Thomas & Brown, 2011). Players are often immersed in problem-solving situations where they experiment with the mechanics to understand the rule system, using trial and error with helpful feedback and rewards for motivation and sustained engagement (NRC, 2011). Reber (1993) suggests that experimental procedures to measure implicit learning should be (a) novel to the learner, (b) complex enough to not be “cracked” easily, (c) emotionally neutral to the learner, and (d) synthetic and arbitrary. Many games fulfill these criteria quite nicely.

We argue, however, that games must be designed with attention to learning and measurement. Plass and his colleagues (2011) suggest designers must carefully identify and align the game mechanics, learning mechanics, and assessment mechanics. Game mechanics are what the player does in the game, learning mechanics are the activities through which the player learns a construct, and assessment mechanics are the diagnostics that provide evidence of that learning.

Our work considers game, learning, and assessment mechanics as part of the overall game design. Our games use simple game mechanics found in many popular games (e.g., get a ball to a goal without crashing into other balls; or solving puzzles to point lasers to hit a target) within a scientifically accurate simulation. By creating increasingly complex situations in which a player must grapple with the consequences of scientific laws and phenomena, we are creating an environment in which the game and learning mechanics are well aligned. Presentations 2 and 3 describe our methods for developing the in-game assessment mechanics, relying on observed play patterns rather than pre-defined metrics.

Impulse

In Impulse, players are immersed in what is known to physicists as an n-body simulator, where all the balls have mass and obey Newton’s laws of motion (Figure 1). Players must use an impulse (a click or touch on the screen) to move their ball into the goal without crashing into ambient balls. As the levels of the game increase, more ambient balls are introduced, with varying mass.
Figure 1: A screenshot from Impulse. The player is the green particle and is going towards the cyan goal in the bottom-left corner. Red, blue, and white particles have different masses.

As players reach higher levels with greater numbers and variety of masses of balls, they need to “study” the balls’ behavior to predict the motion of balls so that they can guide their ball to the goal, not run out of energy, and avoid collision with other balls.

Quantum Spectre

Quantum Spectre is a puzzle-style game designed to immerse players in a simulated optics bench and improve their implicit understanding of the concepts of focal length, angle of incidence equals angle of reflection, and slope. Each level requires the player to direct one or more laser beams to targets while (potentially) avoiding obstacles (Figure 2). For each level, an inventory provides the player with access to resources, such as flat and curved (concave, convex, and double-sided) mirrors, (concave and convex) lenses, beam-splitters, and more, that can be placed and oriented within the puzzle and that interact with and direct the laser beams in a scientifically accurate manner. When the appropriate color laser beam(s) have reached all the targets, a level is complete.

Figure 2: Two Quantum Spectre puzzles

The player earns three “stars” if the puzzle has been solved in the fewest possible moves, two “stars” for a low number of extra moves, and one “star” for any solution. A player can go onto the next level as soon as a puzzle is complete, regardless of the number of moves used, but the stars system provides an incentive for level replay and an understanding of the puzzle’s solution.
There are three steps to our emergent method of building in-game measures of implicit science learning: (a) Video coding as ground truth; (b) Building automated detectors; and (c) Validating detectors with pre-post assessment data. We chose this emergent approach due to the open-ended nature of the game space (millions of paths through each level of Impulse) and not wanting to a priori select specific player behaviors as evidence of an implicit understanding without a detailed observation of how they played.

**Video Coding as Ground Truth**

Strategic moves are the actions (clicks) players take within a game that have an intended outcome consistent with the goal of the game. In Impulse, the goal of the game is moving the player ball to the goal without colliding with other balls. Using three-minute segments of videos with screen capture of 69 high school students playing Impulse, we identified and reliably coded six strategic moves (Table 1). This video coding later grounds the detectors with meaningful human labels.

<table>
<thead>
<tr>
<th>Strategic Move</th>
<th>Definition</th>
<th>Kappa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Float</td>
<td>The player ball was not acted upon for more than 1 second</td>
<td>0.759</td>
</tr>
<tr>
<td>Move toward goal</td>
<td>The learner intended to move the player ball toward the goal</td>
<td>0.809</td>
</tr>
<tr>
<td>Stop/slow down</td>
<td>The learner intended to stop or slow the motion of the player ball</td>
<td>0.720</td>
</tr>
<tr>
<td>Keep player path clear</td>
<td>The learner intended to move non-player balls to keep the path of the player ball clear</td>
<td>0.819</td>
</tr>
<tr>
<td>Keep goal clear</td>
<td>The learner intended to move non-player balls to keep goal clear</td>
<td>0.832</td>
</tr>
<tr>
<td>Buffer</td>
<td>The learner intended to create a buffer between the player and other balls to avoid collision</td>
<td>0.772</td>
</tr>
</tbody>
</table>

Source: Rowe, Baker & Asbell-Clarke (2014)

**Table 1: Strategic moves, definitions, and Cohen’s Kappas**

Two of these strategic moves, Float and Stop/Slow Down, are consistent with an implicit understanding of Newton’s First Law—an object will keep moving unless acted upon by a force. Float is the passive version of Newton’s First Law, requiring no action on the part of the player. Stop/Slow Down requires players to actively oppose the motion of the player ball. The remaining four strategies, while useful game strategies, were not hypothesized to support implicit science learning.

Newton’s Second Law—that different mass particles react differently to the same force—required examining sequences of fast moves. Besides the player ball, there were four other types of balls each with a color signifying a different mass (in order from least to most massive): blue, red, white, dark grey. The blue, red, and white balls also increased in size (consistent with the same density of ball) but the dark grey ball was most massive and smallest in size. This was to ensure that mass was being differentiated in players’ behaviors rather than size.

To analyze whether students were behaving as if they understood Newton’s Second Law, we coded information about the target of a click and whether or not the target of the current click was the same as the previous click (Table 2). Kappas for these codes exceeded 0.80 (Rowe et al., 2014b). These codes were combined to determine if players consistently used more force (clicks) to move the heavier balls than the lighter ones. From these codes, the number of consecutive clicks (e.g., sequence length) for each color target was calculated. We found that players impart more force for the heavier balls, even the grey balls that are much smaller in diameter, indicating that it is indeed mass, rather than size, that motivates their increase of force (Rowe, Asbell-Clarke & Baker, in press).

**Building Automated Detectors**

Impulse logs every game event as well as the location of every object in the game space. Recorded game events include level starts/ends, pausing and resuming the game, as well as moves and states salient to the individual game. From this raw game log, we distill features such as the speed of the player ball and the time since the last click. These distilled features are added to the original clickstream data. Using the synchronized timestamps, these
features are then aggregated at the click level to map to the labels provided by the video coder.

Classifiers (strategic move 0=absent; 1=present) were created using J48 decision trees within RapidMiner 5.3 that mapped the player behaviors in the features distilled from the clickstream data to the human labels, cross-validating at the student level. The goal of these classifiers was to develop an automated, algorithmic way of analyzing the logs of student interaction that would come to the same judgments as a human being. All detectors for the strategic moves discussed here had cross-validated Kappas between 0.51 and 0.86 and A' between 0.78 and 0.97 (Rowe et al., 2014b).

**Validate Detectors with Pre-Post Assessment Data**

We applied automated detectors of strategic moves to a new and larger sample of gameplay data. These data were collected as part of national implementation study of Impulse. This study compared 213 students in 21 classrooms that only played the game and 180 students in 18 classrooms where the players’ teacher used game examples to bridge the implicit science learning in the game with explicit science content covered in class. Path analyses suggest the mediating role of strategic moves on students’ implicit science learning is different between the two conditions (Rowe, Baker & Asbell-Clarke, 2015).

**Presentation 3. Interaction networks to measure implicit science learning**

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Understanding user behavior in complex problem solving tasks is important for both assessing learning and for the design of content. Problem solving is an important skill across all STEM (science, technology, engineering, and math) fields. One strong benefit of digital learning environments is the large amounts of student log-data that we can collect. This data provides measurements of problem-solving behavior at a detail that were not possible before. However, the data is not easy for developers or instructors to use in ways that inform teaching and learning.

To provide insight into student problem-solving behavior in interactive systems, we have developed a complex Interaction Network (IN) representation of student-game interactions (Eagle, Brown, Rowe, Asbell-Clarke, Barnes, & Edwards, 2015). An Interaction Network is a complex network representation of all observed student-game interactions for a given problem. We define an interaction as a \{(Start\_State, Action, End\_State)\} tuple. A state represents the moves a student has made up until a given point. As a simplified example, consider a checkers game. At the beginning of the game, the Start\_State is the set of standard locations of all checker pieces. The Actions are all of the possible moves a player could make (e.g., one or two spaces forward). The End\_States are the set of checker locations after one checker piece had been moved. These End\_States become the Start\_States for the next set of moves the player makes. The interaction network would be all possible combinations of Start\_States, Actions, End\_States from the beginning to end of a game.

These Interaction Networks have been used to provide instructors and game developers with visualizations of their user’s problem-solving behaviors (Johnson, Eagle, & Barnes, 2013, Eagle, Johnson, Barnes, & Boyce, 2013). Clustering similar states within Interaction Networks together, we can observe differences student’s high-level approaches towards solving the problem (Eagle & Barnes, 2014; Hicks, Peddycord & Barnes, 2014). The resulting clustered representation is called an Approach Map. Within a propositional logic tutor, this Approach Map technique was able to help demonstrate significant between-group differences in problem solving approaches for an experimental and control group (Eagle & Barnes, 2014; Hicks, Peddycord, & Barnes, 2014).
Interaction Networks in Quantum Spectre

In this work, we apply Interaction Networks to data from Quantum Spectre to derive understanding and insight about (a) what common correct strategies students use (b) what common science (and puzzle errors students make; and (c) where in the game-play sequence students are most likely to quit. This paper reports Interaction Networks built from gameplay data of 195 high school students playing Level 18 of Quantum Spectre. Of these students, 101 (52%) were in the Bridge group and 94 (48%) were in the Games group. In Level 18, the science concepts of interest are the angle of incidence equals the angle of refraction and slope.

Figure 3: Quantum Spectre, Level 18 puzzle state-to-state transitions for one solution path

Figure 3 shows an example of a single student attempt of level 18 in Quantum Spectre, mapped into a sequence of states (screenshots) with edges (arrows) for each action (move or rotate) the student took. Each edge is labeled with the action the student player took to change the game state; for example Move (2,3) represents moving a mirror to position (2,3). To construct an Interaction Network for a problem, we take the union of all of student puzzle solution attempts and merge actions (edges) and states (vertices) that are the same according to a matching function. The usefulness of an Interaction Network for visual analytics is determined by the quality of the state representation, the granularity of the actions, and the matching function.

The first step in modeling gameplay data as an Interaction Network is to determine a suitable state representation and matching function. In games, our first attempt is to serialize the game state – in other words, record everything the game needs to recreate the current status of the game. In Quantum Spectre, this is a list of the game objects that players can interact with and their current position and rotation. Level 18 has 2 flat mirrors. We ignore the distinction between objects of the same type, so the order of placement does not matter.

For level 18, using this representation for 6145 student-transactions produced an Interaction Network with 916 states and 1614 edges. We applied basic filtering, removing states that occurred for only one student, to simplify the network further to 322 states and 874 edges. We first applied the Approach Map technique (Eagle & Barnes, 2014) to cluster these interactions into 18 region states (clusters of highly-connected states) and 30 edges. Since each region represents multiple states with varying types of errors (i.e., the clusters were not sorting on the types of errors making the regions difficult to interpret), we then developed an Approach Map with laser shape representation for regions. A “laser shape” representation consists of a list of the targets that are hit by a particular colored laser and a list of the angles that the laser beam takes on its path. Laser shapes are what player is trying to alter to solve the puzzle and it is the shape of the path that provides feedback about the accuracy of their placement and rotation of the mirrors, so it is not surprising laser shapes provided a more parsimonious, interpretable visualization.

We found that some game states in the puzzle were equivalent in terms of their correctness, and showed the same player proficiencies or errors. To group these equivalent states and reduce the number of states, we calculated the shape of the laser as it passed through any objects on the board. Figure 4 shows one laser shape and the three states it represents, where red circles are targets the laser beam should pass through, the red arrow is the laser source, and the black curves are mirrors. This approach preserves the relevant properties of a board state while ignoring distance traveled, which does not matter for correctness.

Figure 4: The far left is the LaserShape and represents all three of the other states
We combined the Interaction Network extraction, reduction, graph mining, and visualization to build the Approach Map shown in Figure 5. The regions have been outlined according to the correctness of states they represent, with correct states contributing green to the edge and region outline colors, and incorrect states contributing orange. Regions with full orange outlines represent incorrect solutions, and those with green outlines are correct. Blue-outlined regions have a combination of correct and incorrect, or not yet complete, actions. We have grouped what we call a “confusion region” with a dashed line, to illustrate the various incorrect attempts students make.

![Figure 5: The Approach Map for Level 18.](image)

These representations enable game developers and learning scientists to better understand the broad patterns in the behaviors of players solving the puzzle. Players who start and stay in the confusion region seem to be able to solve the puzzle for one target but not for two. Instructors and developers who want to explore the individual regions can “zoom in” on the internal states of each cluster region. Learning scientists will label these internal states for their evidence of a lack of science understanding. Labeling clusters in using these visualizations saves a large amount of coding time and makes reliable coding easier to achieve. In our future work, we plan to apply these data-driven visualizations and graph mining techniques across several levels of Quantum Spectre, and look for ways to provide summaries across problems and look for differences in learning between groups.

**Presentation 4. Teachers Bridging Implicit to Explicit Learning**

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The connections that people make socially and cognitively in other web spaces (game affinity sites) and in person (e.g., in a classroom) around a game are a large part of game-based learning. Jim Gee (2008) refers to this as the Big “G” Game. Teaching methods that leverage game-based implicit learning must provide tools for teachers to “see” the learning and respond to it. The teachers may not be as likely as their students to be playing the newest game in the app store, but teachers are embracing game-based education and would like more opportunities to use games as vehicles for learning (Cooney, 2012).

We conducted a national implementation study with three groups of high school learners:

a) the **Games** group whose teachers encourage students to play Impulse outside of class;

b) the **Bridge** group whose teachers encourage students to play Impulse outside of class and use examples from the game (bridge activities) when they teach related content in class;

c) the **Control** group that does not play the game or use bridge activities.

As reported previously at GLS, this study has shown significant STEM learning gains in Bridge classes, with the largest effect among students in non-honor/AP classes (Rowe et al., 2014a). When a teacher uses game examples to help bridge the game-based implicit learning to STEM content discussed explicitly in the classroom, students have higher gains on pre/post tests about related science content than students in the Control classes. To
unpack these findings further, we have been analyzing logs of teacher activity modeled after the SCOOP Notebook developed by CRESST (Borko, Stecher & Kuffner, 2007). The coding system developed for this study focuses on the type of classroom activities (e.g., direct instruction, hands-on activities, etc.); the science content taught (e.g., Newton’s Laws, forces, etc.); and game-based pedagogies used (e.g., using game examples during instruction, modeling game play, discussing the game, etc.). To confirm the reliability of the coding system, 10 of the 50 teacher logs are double-coded by our independent evaluators with an average Cohen’s Kappa of 0.71.

Two types of analyses using these logs are being conducted. The first set of analyses compares student demographics, teacher background, and science pedagogy and content covered in Honors/AP and non-Honors/AP across the Control, Game, and Bridge groups. The second set of analyses describes the game-based pedagogies used in the 18 Bridge classrooms. The game-based pedagogies (e.g., frequency with which examples were used, the amount of teacher or student modeling of game play) in 6 Honors/AP classrooms will be compared to the pedagogies used in the 12 non-Honors/AP classrooms.

Since submission, we found few group differences in student demographics, teacher background, and science pedagogy/content coverage that might explain these findings (Rowe, Bardar, Asbell-Clarke, Shane-Simpson, Roberts, in press). There were significant differences, however, between Honors/AP and non-Honors/AP classes in their use of specific game-based pedagogies.

References


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Well Played
**Love Is a Battlefield: A Comparative Analysis of Love as a Game Mechanic and Sartre’s *Being and Nothingness***

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**Abstract:** This piece uses a semiotic textual analysis to discuss love-based mechanics in particular games, namely *Fire Emblem: Awakening*, *Persona 3* and *Persona 4*, and the *Harvest Moon* series. These games’ love-based mechanics share an archetypical construction that posits a problematic discourse of love that revokes subjectivity and agency from the (usually non-player) characters who serve as objects of love for the player character. That rhetoric of love is then compared to that of Jean-Paul Sartre in *Being and Nothingness* in order to explore how these games’ mechanics of love undermine the diversity of games’ narratives and people’s actual experiences of love.

**Introduction**

A point often missed by the contentions and tensions in the current climate of the gaming community, diversity does not only lie in sex/gender and skin tone. Indeed, diversity is more usefully considered a difference in experiences, differences that sometimes accompany those more physical markers but mean much more for people’s interactions with others and the world. One such kind of experience is that of love, a ubiquitous, historied, and multifaceted theme that has been represented and investigated in many media forms, including games. Although narratives of love and the discourse of those narratives in games vary widely, the use and discourse of love as a mechanic or set of mechanics (i.e. the actions performed by the player to interact with a game; Sicart, 2008) does not show this range and depth. In this paper and the accompanying presentation, love-based mechanics will be discussed through an archetypical representation, traceable through several well-known video game franchises. These games’ generalizable love-based mechanics posit a problematic discourse of love that revokes subjectivity and agency from the (usually non-player) characters who serve as objects of love for the player character, who gains power over others without repercussions or resistance from any agent other than the player and also embodies the extreme and usually unfulfilled desires described by Jean-Paul Sartre in *Being and Nothingness*. To investigate the dynamics at hand in these mechanics, I will be using a semiotic textual analysis to collect instances of discourse, i.e. moments or fragments of meaning-making, to then contextualize these elements in the structure of the text and amongst taxonomic precedents across texts. Through deconstructing the rhetoric of love in these mechanics, I will compare that rhetoric to Jean-Paul Sartre’s work on love, the self, “the Other,” and the violence enacted between these in *Being and Nothingness* (1993) to further scrutinize the relationship between power and romance in games, exploring how the dominant portrayal of playable love does not reflect a diversity of experiences and instead invites a space for deeply embedded, structural forms of violence.

As games’ narratives and audiovisual presentations grow in complexity, verisimilitude, and artistic depth, games’ representations of love as an emotionally nuanced and significant theme have been able to interact with a large range of love stories that can be both profoundly moving and challenging. However, in the actual mechanics, the procedural, operational rhetoric of games, love has primarily been either absent or simplified. Even in many well-known, best-selling, and critically acclaimed games and game series, love-as-mechanic can be reduced to a simple template: the player character has a choice of potential love-objects; the player character initiates courtship via time spent with or goods given to the chosen love-object; the love-object falls in love with the player character; and the love-object produces benefit for the player character. This situating of love is an archetype in the sense used by Umberto Eco (1985), as “a preestablished and frequently reappearing narrative situation” that perpetuates an emotional response when the audience reencounters that situation in other texts (p. 5). In this case, that emotional response is the dynamic, or the experienced affective effects of game mechanics (Sicart, 2008), here the mechanics of love.

In order to deconstruct and closely examine this “intertextual archetype” (Eco, 1985, p. 5), the games *Fire Emblem: Awakening* (Intelligent Systems, Nintendo SPD, 2013), *Persona 3 Portable* (Atlus, 2010) and *Persona 4* (Atlus, 2008), and the *Harvest Moon* series (Marvelous Interactive) will be presented as case studies from which to tease out how this archetype works, indeed, intertextually. Although other games do use love as a mechanic (and arguably also adhere to the proposed archetype of love), the current case studies were chosen for deeper analysis due to love’s pivotal role within each game’s or series’s narrative and mechanics. In *Fire Emblem*, the pairing of characters (units) during battle results not only in much stronger and more resilient units, but these pairings also result in marriage and, at a certain point in the game, in the appearance of their children, who have traveled from
the future to rectify devastating events before they can occur. These children become some of the most powerful units in the game, thus imbuing them with great mechanical as well as narrative power. In *Persona 3* and *Persona 4*, the main/player character teams up with groups of fellow high school students to solve mysteries and fight evil entities in worlds connected to but apart from the characters’ own. The conceit is that the power to fight these entities is gained through the strength of heart found through close bonds of friendship (including romance), and the game consists mostly of players balancing spending free time with people in the main character’s life and battling alongside some of those people. In *Harvest Moon*, the player is an up and coming farmer who restores a farm from some sort of ruin, building a role for him- or herself in the neighboring village and in the romantic life of a neighboring villager. Player characters must marry to produce a child (which occurs automatically after marriage) for the game to consider play successful and thus allow the player to progress past deadlines for these actions. These games are narratively and aesthetically different, yet their mechanical progression through love mirrors the archetype defined above, so I will use these games to closely read how that archetype works, but the case studies’ specificity is less important to my argument than their structure.

To explore my case studies, each stage of the archetype will be taken as its own unit, or as “frames,” to use Eco’s (1985) terminology for “stereotyped situations” recurring recognizably but still satisfyingly across texts (pp. 4-5). Here I consider frames as subsections of the archetype, as distinguishable from how Eco defines archetypes as the “magic” or personally/culturally fascinating version of an intertextual frame. The archetype is here a system that arises from the use of multiple frames that interact with each other predictably and meaningfully in the texts, much like how game mechanics interact with each other to produce a system of rules and thus create a world through limitations and delineations.

**Framing the Archetype**

The first frame of the archetype is the choosing of the love-object. During this stage, the player is often at the mercy of the game creators; few games have the capacity for players to choose any other character or object in the text as an object of performed love, likely due to the manual work needed to materialize such actions through dialogue (written or spoken), animations, and narrative branches (1). Thus, the player’s scripted choices of love-object tends to reflect certain cultural assumptions, usually limiting players to heteronormative in-game relationships. However, once this is accepted by the player, the love-object shows no resistance. In *Fire Emblem: Awakening*, certain character pairs have the option to achieve S-Rank Support, or the last of four potential ranks, achieved through interactions during battles and demarcated by narrative interludes in which the characters involved converse with one another. As long as that S-Rank Support is achievable (marked for the player as present or absent on a menu), eventually reaching it guarantees that the characters will declare their mutual love and marry. Though the narrative between each pair was chosen by the game’s creators, the only mechanical choices to be made are those of the player: which characters to pair, how to achieve higher rankings, and whether or not to watch the scenes between those characters.

In *Fire Emblem*, these choices are repeated, and in the archetypical love-as-mechanic, repetition is integral in every in-game relationship as the key to courtship. In fact, the archetypical courtship is in totality the repeated performance of specific actions in the “right” way. For *Fire Emblem*, the player repeatedly pairs the intended couple in combat so they might break through the enemy ranks together, thus raising their own Support ranks with each other. The *Persona* games require players to choose how to spend their in-game time, so as long as the player chooses the right timeframe to spend, in which the love-object is “available” for spending time with the player character, then that relationship (in the games’ terms, the Social Link) will succeed, climbing from Social Link Rank 1 to Rank 10. In the *Harvest Moon* series, player characters give material goods to the love-object, who has a scripted set of liked and disliked goods. As the player character continues to regularly give the love-object his/her favorite goods, the interactions between the two characters become more amorous, and the love-object’s “heart levels” rise along a given scale until reaching maximum. Usually during this time the player character needs to make adjustments to their farm and farmhouse in order to accommodate a spouse and family.

When the courtship succeeds, there is a moment that love is declared, leading either to dating (*Persona* games) or marriage (*Fire Emblem and Harvest Moon*). This marriage is an end goal of sorts, as there are rarely scenes and conversations between characters after their declaration, and those scenes that do exist suggest that all is well in their perpetual garden of love. In *Harvest Moon*, the beloved character is in large part defined by their relationship with the player character, moving from bachelor/ette, spouse, and finally to the other parent of the player character’s child. *Fire Emblem* labels characters as bound to one another, marking the beloved’s name in the same space that marks the character’s statistics as used for deciding their role and power in battle. During certain scenes amongst the Social Links of *Persona 3* and *Persona 4*, the player character can enter a relationship with characters of the opposite gender. Indeed, the player character can enter multiple relationships. In *Persona 4*, this can be done with no mechanical consequences (i.e. losing Social Link points), but *Persona 3* does allow Social
Links to drop rather than rise if the beloveds discover each others’ relationships, but this too can be remedied (2). Thus, the player characters in these games are bound to some extent to the love-object once love is declared, but not to the same extent that the love-object becomes a facet of the player character’s existence rather than any independent existence.

Since love is a mechanic in these case studies, there is a greater mechanical use for love in each game’s system of rules, and in all three cases that greater use is tied to the games’ primarily dynamic modes. In *Fire Emblem* and the *Persona* games, this is strength and efficiency in battle; in *Harvest Moon*, this is running your farm into perpetuity. Thus, love-as-mechanic provides the means in each game to the best and fullest experience of the game’s key dynamic systems. The children from the future of *Fire Emblem*’s main characters are amongst the most powerful units of the game, and the children in *Harvest Moon* continue the legacy begun by the main player character as the latter ages and eventually dies with this heir in place. For the main characters of the *Persona* games, their inner strength is somewhat literally boosted by each friendship or love, as higher Social Links with each character result in better battle statistics (e.g. strength, magic, and defensive power) for the player character’s Personas, or the collectible beings that manifest the power to fight evil. Furthermore, love (eros) does not achieve anything more mechanically powerful than friendship (*philia*) does (Cassin, 2014, pp. 602-605).

**For the Love of Sartre**

When these case studies and the surrounding archetype are put into conversation with Jean-Paul Sartre’s *Being and Nothingness* (1993), serious problems and tensions in love-as-mechanic emerge. In Part III, Chapter 3, “Concrete Relations With Others,” Sartre discusses how love structures the interactions (physical and metaphysical) between the lover and the beloved, or the self and the Other. The relations laid out in Section I, “First Attitude Toward Others: Love, Language, Masochism,” around the subjective freedoms of the self and the Other as engaged by “the look” is most useful for my purposes (pp. 365-372). Here Sartre dives into the problem posed by love, namely that there is conflict between the lover’s retaining the freedom to be a being-for-itself, a consciousness (for a person is fundamentally not a being-in-itself or an essence) and that lover’s attempt to sublimate and possess the beloved’s own freedom, by means of the beloved’s freely chosen allowance of this. Were this possible and the ideal of love reached, then the lover (the self) becomes transcendent, safely, and ultimately free/conscious. The problem, Sartre continues, is that the Other is also a being-for-itself, whose consciousness and subjectivity posits the original self as an object, thus alienating his/her freedom (p. 375). Now the ideal of love is shown to be impossible, since the attempt to sublimate the freedom of the lover/beloved is circular, and thus both lovers’ freedoms are alienated (p. 376). The question that I will pose in relation to love-as-mechanic in games, then, is how the work of love would change when freedom is unequal, when the beloved can be reduced to a being-in-itself, for the beloved has no agency or consciousness of its own? That the archetype of my case studies’ love-as-mechanic allows an unproblemalized experience of love is a metaphysical problem of power dynamics, especially when enacted repeatedly for the player, as will be shown in my close readings of the case studies and their archetypical construction.

Sartre’s conceptualization of choice in relation to others is the choice of the beloved, that the self is the one who is to be “freely chosen as the beloved.” To be so is to assimilate the beloved’s freedom, or, in other terms, the ability to make choices. But in the archetypical love-as-mechanic, the choice is always that of the self, the player-character. The only look (objectifying, reductive gaze) that is present is that of the player towards the love-objects. In this way, the player does indeed “escape the look of the beloved,” or at least is met with “a look with another structure,” which allows the player to transcend the status of “a ‘this’ among other ‘thisses’” (p. 369). This passage has fascinating implications for the medium of gaming, as the player’s presence and interaction is the contingent upon which the gameworld relies. Although the written code of the game is present regardless of the player, the gameworld and the characters within are only rendered and only perform their functions when the player chooses to engage them. In this sense, “the world must be revealed in terms of” the player. Sartre continues, “In fact to the extent that the upsurge [i.e. the meeting of consciousness and the world] of freedom makes a world exist, [the player] must be, as the limiting-condition of this upsurge, the very condition of the upsurge of a world.” Here I have replaced the referent “I” with the player, the self that is involved when a game is undertaken, but the meaning is merely contextualized rather than modified. The choice of the player in not only choosing a love-object but indeed in choosing to play a game at all creates the world within, including the love-object, which is ultimately a being-in-itself, which little complexity outside of a predetermined, prewritten, and preanimated personality, even in the case of seemingly life-like/plausible characters.

In all of these games, it is guaranteed that if all requirements have been met, the love-object will be successfully courted, or in Sartre’s words, seduced. In Sartre’s figuration, seduction is a response to the beloved’s look, which “apprehends the lover as one Other-as-object among others” and is thus able to transcend and use the Other, or the original self (p. 371). But as discussed above, the beloved in my case studies cannot have a look and can only
be subject to the player’s look. Thus, the love-object is just that—the “Other-as-object.” Whereas in Sartre’s discussion the process of seduction is meant to bring nothingness into the consciousness of the Other and recognizable fullness into the consciousness of the self, as the self “present[s] the world to the beloved and […] constitute[s] itself as the necessary intermediary between [the beloved] and the world” through acts that are “infinitely varied examples of [the self’s] power over the world (money, position, ‘connections,’ etc.)” (p. 372). This correlates with the presentation of objects or the decision to spend time in one place rather than another that effectively makes the player character’s beloved “feel”—or, better yet, trigger prewritten and preanimated expressions of feeling—special in the eyes, the look, of the player character. Through the repeated actions of courtship within love-as-mechanic, the player is held above the game characters, or in Sartre’s terms, “through these different procedures [the self] propose[s] itself as unsurpassable” (p. 372). Although normally this would not have value without being authorized by the freedom of the Other, even if made to be nothingness, in the love-as-mechanic archetype, the freedom of the Other does not exist, and there is no resistance to the self’s proposal of its “plenitude of absolute being” (p. 372). Thus, the player character’s courtship must succeed, for there is no resistance to it.

As noted above, that courtship leads inevitably to a declaration of love and a binding of two characters, sometimes as a marriage. This binding is, for the most part, unbreakable, as it does not need further attention to continue. Instead, love-as-mechanic is soon shifted from the site of work to the site of reward; it achieves its maximum status long before other struggles are resolved, becoming a tool to leverage towards those struggles rather than itself being a site of work, tension, and navigation of the self and the Other. Love here is thus indestructible, as there is no “deception and a reference to infinity” that comes from love as the relation between two being-for-themselves, nor can the Other ever render the self as a love-object, and there is no other agent to disrupt love “as an absolute axis of reference” and to shame the self by making the self relative (p. 377). This is a love that rewards without the consequences of work, insecurity, or shame, which would seem to be the perfection of love’s ideals. However, it only that embodies that perfection for the one, the self, the player/player character who is able to assimilate the Other, who has no agency and consciousness or even bodily presence. This would be a problem indeed for Sartre’s metaphysics. When the self “experiences himself in the face of the Other as pure transcendence,” as the player does, the result is a need to use the love-object as simply an object while also seeking to validate the self’s transcendence through the non-existent transcendence of the Other (p. 399). This paradox leads to the use of sadistic methods to resolve it via the effort to incarnate the Other through violence, and this incarnation “by force” must be already the appropriation and utilization of the Other” (p. 399).

Conclusions

This seems to be a dire result of an archetype that, when again particularized in the originating games, is surrounded with uplifting, sweet, and otherwise extremely positive textual, visual, and aural discourses of love. Yet, as mentioned above, it is crucial to the study of games to plumb their arguments beyond their narratives and audiovisual presentations. Mechanics and their resulting dynamics are what a player feels when playing a game, and oftentimes those feelings are connected to those of agency and capability, which can inspire the motivation to continue through the tasks presented in a game. In many cases, the player can gain incredible power within that gameworld, which may be able to ignite longer-lasting feelings of power, even superiority and exclusivity. These are then connected to the violent actions players perform in many games and the violent actions people perform in real-world situations, thus landing games a sordid reputation within mainstream media discourses. Yet, for the work done on explicit violence in games, there is much less done on structural violence in games, the violence latent in performances of actions and situations other than inflictions of physical harm and, as shown, have the potential to become ultimately much more problematic.

For games to progress as a medium, it is fruitful to recognize mechanical archetypes as stereotypical, and therefore easily designed and read/played, systems that may be the source of issues still unsolved by more innovative approaches to narrative and audiovisual art in games. The mechanics of love and love-as-mechanic could be a particularly beneficial place for further research into design tropes so that love in games, even if a source of conflict, is not a source of power that is answerable only to and by violence. Less immediately dire but just as important in the long term, critical and reflective design, such as that discussed and modeled by Mary Flanagan (2009), is also the way towards better and more diverse representations of experiences in games and thus a more inclusive games landscape, and perhaps even more inclusive game communities.

Endnotes

(1) The role of the creators and the forces acting upon their choices are interesting subjects, but these sociocultural aspects are outside of the scope of the current study.

(2) This information has been gathered from various forms and wikis about the games, as I am unfortunately not able to access these scenes for the purposes of this paper.
References


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Any% No Sketch Glitch: Speedrunning to Expand the Well Play of Final Fantasy VI

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Abstract: This paper seeks to look at expanding the idea of “well play” in a community that gathers around a game and redefines the goals of the game for themselves in competition. Focusing specifically on Final Fantasy VI (FFVI), we can see that the practice of speedrunning reflects deep gaming literacies, the commitment to community goals and norms, the creation of new games out of the elements of existing ones, and a transition from casual to serious leisure activity. Speedrunning FFVI reflects redefinitions of the boundaries of what we consider the games we put under study, as well as the role of “well play” in our understanding of them.

Introduction

Historically, the “Well Played” format has focused on the ways we can understand the “well play” of a single game through an analysis of its design and how players experience it. Understanding different kinds of “well play” have thus been secondary issues for this community, and often sidelined in favor of discussions of the gaming artifact and the designed nature of it. In this paper, we wish to shift this discussion somewhat, and look at a type of well play that spans hundreds of games, systems, and genres: The “speedrun.” A speedrun is a form of play where the player attempts to complete the game, from beginning to end, in as short a time as possible using various tricks, glitches in the game, and efficiency tactics.

In speedrunning Final Fantasy VI (FFVI) (Square, 1994), we can see an expansion of well play if you will, that illustrates a dedication to learning through productive failure (Kapur, 2008) and a commitment to “serious leisure” (Taylor, 2012). The social task of speedrunning is one wherein players compete to take apart a ‘well’ designed game, and remake competitive play experiences from it. As players fail productively and in a persistent social context, they illustrate that members of a game’s participatory culture (Jenkins, 2006) are able to redefine what counts as ‘well play,’ and can give us a window into how gaming literacy evolves in a productive, appropriative social context. Speedrunning also gives a window into a group of players that value competition and collaboration equally as part of the learning process. As we will show through an analysis of speedrunning in FFVI, speedrunning captures an exciting tension between the designer(s)’s original presumed intent and the active engagement of game players as well as the movement from a casual pastime to a serious leisure activity that for some even becomes a primary vocation.

A note for the reader on the use of first person and the joint-authored nature of this piece. “I” will refer to the first author (Cook) and their experiences playing, watching, and learning how to speedrun FFVI. The second author (Duncan) contributed to the piece by contextualizing the experiences of Cook in a broader landscape of research and the relevance of these experiences.

Final Fantasy VI

Final Fantasy VI is a game that I have been playing since its US release in 1994. I was totally enthralled by the storyline that was far beyond the story of any games I had played to that point, which had mostly consisted of simple goals such as; save Princess Peach (Super Mario Bros.), or defeat the evil wizard, Werdna (Wizardry). In FFVI, the game starts with the play in control of Terra, a Magitek soldier of the empire searching for a magical being called an esper in the town of Narshe. The town resists fighting you every step of the way. Finally when Terra and her two soldier mook (low level soldier) companions reach the esper, the soldiers are killed while Terra interacts with the esper in an unknown manner. She wakes up in a house in the town, where she is helped to escape by a treasure hunter Locke. From there the story spans into a rebellion versus the empire saga, with the player’s party traversing the world in order to save it. The part that sealed the deal in terms of the game’s longevity and significance for me was that after beating the Atma Weapon on the Floating Continent, one did not get to face Kefka, the presumed final boss, but instead has to run from him as he upsets the balance of the world and destroys most of it with fire and lasers. The second half of the game focuses on one’s band of companions trying to find each other in order to take one last fight to Kefka, even with the world in ruins around them.
While *Final Fantasy VI* is neither the first game to be speedrun, nor is it the most often speedrun, it serves as a useful game to look at with speedrunning in mind. It offers many categories of runs that showcase different features of the game and different understandings of various mechanics and glitches. Furthermore, *FFVI* offers insights into how games are routed, and how the community works together to not only push the limits of the game, but to form a deep understanding of how and why various glitches, bugs, and sequence breaks work at a technical level. This allows the runner to apply knowledge of one bug in a different situation because of the technical understanding that is not present in some other games. As a long time player, I was at least familiar with some of the programming issues with the game. As will become significant for this analysis, I was aware of a significant glitch around the skill “Sketch,” that I had never explored since it had the possibility of erasing my save files. The transition from being an expert-casual player to one who is dipping into the world of speedrunning is marked by my changing understanding of the game. I went from knowing that there are certain bugs in the game, to understanding the bugs at a technical level and being able to exploit those bugs in ways that are advantageous to my play.

**Learning to Run FFVI**

Two years ago, a friend turned me on to an online charity event “Awesome Games Done Quick” (AGDQ; https://gamesdonequick.com/), and Summer Games Done Quick (SGDQ; see Figure 1, below). During these events, speedrunners run their games live in order to raise donations for charity. Games Done Quick’s mission is to bring together high level speedrunners to raise money for the Prevent Cancer Foundation and Doctors Without Borders. I had never encountered speedrunning, and had not yet experienced communities of speedrunners with personalities running the games. I saw that they were running *FFVI* as the capstone game for the event and watched the entirety of the six hour run. The thought that the game could be beaten in six hours was a completely alien idea to me, and as a consequence, I started watching the *FFVI* speedrunners on their Twitch.tv channels and studying how they could beat the game in such a short amount of time.

![Figure 1: A screen capture from the YouTube broadcast of the SDGQ 2014 finale game, FFVI. The runners are known as “Essentia” (second from the left) and “Puwxexil” (third from the left). (Image taken from https://www.youtube.com/watch?v=JsZELoI33T4).](https://www.youtube.com/watch?v=JsZELoI33T4)

While watching, I noticed several practices that speedrunners participate in that may help them push games to their limits. First, they clearly collaborate with each other, sharing notes, having open practice sessions where they invite each other to watch, and giving each other advice. Second, they often try to experiment with new strategies, new routes through the game, and new ways to use glitches within the game. They rely upon shared knowledge about the mechanics and details of the game, which allows them to understand how to best use the various exploits and glitches within the game. These clearly overlap, but also present distinctly different community practices, activities, and resources that inform the learning of how to speedrun *FFVI*. Finally, at the highest levels of speedrunning there is competition between runners that serves to push the runners to perform at their highest levels; it does not display, in my experience, many of the toxic aspects that I have found in other competitive environments.

These speedrunners view the game differently, no longer is the game a simple form of leisure or escape, it is now more akin to serious leisure that T.L. Taylor discusses in her 2012 book about the professionalization of E-Sports.
While speedrunning has not achieved the general recognition or professionalization of E-Sports many of the practices are similar. A game like Final Fantasy VI becomes more than just a game, it is a way for some people to make a living, and it is a venue for competition. The game becomes less a game, and more a series of challenges that need to be overcome as quickly, and more importantly, safely, as possible. Speedrunners show similar levels of dedication to professional E-Sport athletes, in that they practice for hours each week, and are dedicated to honing their craft.

I decided to try my hand at speedrunning FFVI, and, as of this writing, I have yet to complete a full run of the game. I have failed dozens and dozens of times, with each failure teaching me something new. As Kapur (2008) posits, each failure has been productive and taught me something new and added to my skills and prepared me to handle other situations that arose later in the game. In Kapur’s (2008) study he found that those students who had been given ill structured problems to begin with had greater persistence on later ill structured problems than did students who just received well-structured problems. The speedrun itself is certainly an ill structured problem when compared to regular play of the game — according to Kapur, the more one works on ill structured problems, the more strategies and more success one has in further ill structured problems. While there is a linear storyline that must be followed in FFVI, there are many aspects that are skipped, avoided, or otherwise ignored by speedrunners. When learning this run, I have relied heavily upon videos of runs from other more experienced runners, as well as written notes that elucidate specific equipment and magic choices.

The first time I attempted a run, I failed on the very first battle, but did not realize I had failed for at least 20 minutes. For the first few battles, the goal is to have Terra gain all of the experience from the battle. One does this by exploiting the runaway mechanic and having the two soldier mooks in the party run away. These battles are basically un-losable, however, if one does not win in the correct way, the rest of the run is affected. When I failed at this, I didn’t think about how much that one mistake would snowball into wasting a significant amount of time about fifteen minutes later in the run when I was not able to kill certain enemies because I was at too low of a level. I had not even considered the impact of a battle that I had not given conscious thought to since the first time I had played the game. For each battle, there is a set amount of experience points that are distributed evenly among all of the party members still alive and in the battle when it ends. There is a way to get the two mooks to run away from the battle leaving Terra alone to get the full amount of experience points. I started to look at the game itself differently. No longer was it just one of my favorite games that I could play on autopilot for simple enjoyment and nostalgia. Now it was a challenge that I had to overcome. I came to understand the game in a deeper and more complex way. Now battles were a conscious decision to fight or not. Do I need the experience points or should I save the time? Do I really need to take the minute it would take to go into town and shop for the new armor or should I skip it? When should I go into the menu to make changes? All of these were things that had never been an important part of my play before, but now are essential.

I reset the game. The next time I reached the first battles, I tried to use the runaway mechanic, and failed. I reset again. I took a moment to watch a video of a run before I went back to make another attempt. The third time, I successfully ran away properly and Terra gained the experience points she needed. This moment showed me that there are reasons behind certain choices that I didn’t fully understand at first and my failures helped me to understand the runaway mechanic to a depth I had never achieved before. After the initial stumbling blocks around the first three battles, I hit fairly smooth sailing for about two hours. I was not on a particularly good pace, nor was I embarrassing myself. I even had a couple of people watching me stream on Twitch.tv. I started to slip back into my old mindset of complacency. I know this game; I have this under control; I am about to fail again.

The next major boss, a battle against two cranes, was coming up, and I feared that I was going to fail again. This battle requires performing a trick to manipulate a set of spinning slot reels to get a certain combination (7-7-7), which kills all of the enemies on screen instantly called Joker Doom. This was a trick that I had the declarative knowledge to understand (had seen performed many times) and ostensibly knew how to perform, but had never done so. To the shock of no one at all, I failed again and had to reset as the cranes killed me before I had a chance to try the trick again. I tried this battle ten times that day before I decided to stop, realizing I needed to practice this one particular trick many times.

What was beginning to change for me was my depth of understanding within the game. No longer would being a casual player who could play through the game automatically be enough. I needed to understand the game and how the various systems within the game interact with each other. For example, understanding that (7-7-7) would kill the enemies and that if I used a certain item in battle that I could set up the trick was enough. I needed now to know why it worked. Using the echo screen in battle advanced the random number seed in the game by 28, which was the number that is needed to allow Joker Doom to happen. However failing at the slots advances the random number seed as well. Now I need to understand what seed I am on, how to manipulate that seed and why certain actions are performed if the trick is missed. My understanding moved from I can tell someone how to do this trick,
to I can perform this trick and explain the systems behind it as to why it works.

It is not simply adequate to have some abstract understanding of the game, or some static gaming literacy and knowledge to be a successful speedrunner. It takes a deeper understanding of the mechanics of the game that are often hidden or otherwise obscured. Nowhere in the game is it explained that Terra’s level has an impact on the level of the next characters to join your party, it just happens. Nowhere in the game it the random number seed explained or even visible normally. Speedrunners need to experiment and fail often to figure out these hidden rules of the game in order to be successful. Not only do they experiment but they also look deeper into the code and systems behind the game to see the interactions and how they can be exploited.

The Sketch Glitch

As an example of understanding FFVI's systems, within the game there are four times when the cast of characters is broken up into more than one group that the players can switch between to complete the dungeon, or guard their leader. Switching between parties in the game is instant, and can be triggered as a character is moving from one tile on the map to another. However, when one combines this with the fact that certain tiles are coded to trigger certain events (such as boss battles or cut scenes), one can skip those events, or walk through non-player characters by switching groups as one is moving onto the trigger tile. When one switches back to the party on the trigger, the trigger does not fire as it is coded to fire upon entry of the tile, not upon standing on it or exiting the tile. This combination of an understanding of how characters move along the map tiles along with the understanding of how certain tiles are triggers for events came together for the community recently and allowed for two major bosses to be skipped that previously were thought to be unskippable.

And so, we can see that one of the most critical elements of a speedrun is the sophisticated use of exploits, glitches, bugs, and mistakes that made it into the final game. These can be capitalizing on the interaction of multiple gaming systems (as in the above example), as well as the exploitation of outright bugs in the game. When I played FFVI as a child, I read in Nintendo Power and other gaming magazines that one should not use the ability Sketch because it could break the game and erase my save files — certainly, the worst fate for a kid who has dedicated hours upon hours to the game! However, in the era of game emulators, players of FFVI have honed their understanding of this glitch through repeated safe failure finding the ways that previously disastrous glitches could serve a useful purpose for players attempting to speedrun the game.

In particular, the Sketch glitch has served an interesting role, revealing both the ways that glitches can be used to help redefine paths through a speedrun, but also how they illustrate collaborative community practices in doing so. Speedrunners have taken the Sketch glitch and spent a great deal of time and effort cracking it open. As a glitch is an uncorrected bug wherein the game executes code that it was not intended to, this can lead to a variety of situations including hard locking or freezing, “soft locking” where the game is stuck and cannot go on but the player can still interact with the game, or other unintended consequences. It is the unintended consequences that are most exploited by speedrunners. For instance, in FFVI, using the skill Sketch, an effective speedrunning approach is to insert a certain spell in the 28th slot of the magic menu that causes the game to execute code that can fill your inventory, or transport you to different locations within the game. With careful manipulation, this glitch can bring a player past several dungeons and bosses, saving a great deal of time on a potential speedrun. Using emulators, players were able to test the glitch dozens of times, changing one aspect at a time in order to determine what aspects of the game affect the glitch, then shared the results online with other runners. There are dozens of trial and error moments that helped to determine that it was, in fact, exactly the 28th slot of the magic menu that impacted the glitch, not the 15th item, fourth item, or any other item one’s inventory or another factor—a bizarrely specific glitch, but one that led to significant impact on the FFVI running community. This is perhaps the most differently well form of play within the FFVI speedrunning community. The runners are taking a glitch that for many people ruined their casual play experience and using their understanding of it to improve their own play.

In speedrunning communities there are several categories for running. These come from a deep understanding of the game and community debate and discussion about what should and should not be allowed for a given run. Since some glitches or bugs so fundamentally change the gameplay experience and route through the game they have crafted different categories of speedrun. For FFVI, these include runs that allow or disallow the Sketch glitch and require different amounts of completion of the game. Any% is a category where the runner completes the game however they can, getting what they need along the way, and there is no restriction on how much content of the game may be skipped. This is further broken into two categories: With and without the Sketch glitch. Atop this, there are 100% versions where one needs to recruit all characters and gather all of the magical stones called esper. There are also glitchless versions of Any% and 100% runs, which disallow any forms of glitches. This allows for several different possibilities for a run, and allows for choice when it comes to which skills or set of skills will be used.
In Mia Consalvo’s *Cheating: Gaining Advantage in Videogames* (2007), we see that gamers often use knowledge of gaming exploits and “cheats” as ways to broker participation in gaming communities. Gamers employ such knowledge as “gaming capital,” akin to Bourdieu’s social capital. In the community of speedrunners of *FFVI*, the knowledge of cheats, bugs, and glitches is a form of legitimate gaming practice and, we argue, a fascinating example of how these perspectives on gaming can transform our understanding of the game itself. Where is the “game” in the speedrun of *FFVI*? Is the game *Final Fantasy* itself, or the attempt to get a quicker speedrun, or the experimentation that leads to the finding of new glitches? Or is it the social enterprise that drives the entire community of speedrunners to probe, prod, and further break apart the “well played” *Final Fantasy VI* toward new aims?

As the speedrunning community creates categories for competition as long as competitors adhere to those rules, we can see that they self-organize around multiple forms of “differently well play” — completing 100% of the game, completing the game with the Sketch glitch, or completing the game without the Sketch glitch, just to name a few. Speedrunners impact other players and the social community of the game when they find a new trick or a new glitch, and can radically alter the route through a given dungeon or the entire game, and thus redefine what *FFVI* is for multiple groups of players, and multiple skill levels.

And, there are some interesting contrasts with Consalvo’s work here. Specifically, Consalvo (2007) argues that speedrunners “cheat” to achieve time compression, focusing on the goal of the player to simply complete a game in the context of a presumed form of “well play” (defined by the presumable goal of the game, defined by its designer). People play games, in Consalvo’s framework, in order to complete a designed system, and experience “the game” as it was intended to be played by whomever created it. Speedrunners are clearly not exploiting glitches for the same reasons, or at the very least, these forms of time compression have very different social consequences. Speedrunners of *FFVI* are not compressing time to get to the story faster, or to see what happens next — they already know what happens next. They compress time for the express purpose of compressing time in the *secondary game* of the speedrun. They may be “cheating,” in that they are breaking the rules of the game as defined by the game’s designers, completing a game that is designed to be a many hours long epic in only a few hours, or skipping large portions of the game. But, more provocatively, they are breaking the intended and expected rules of playing the game as defined by the designer in order to redefine the goals of the game for their own purposes as a community.

### The Social Context of Speedrunning

Speedrunning can thus be looked at as the product of a deep gaming literacy born out of engagement within a gaming-related community. Zimmerman (2009) refers to gaming literacy as the understanding of systems, play, and design, and clearly these forms of gaming literacy are put into practice by effective speedrunners. The runners of *FFVI* spend time playing the game, but also watching and discussing the game and strategies with each other. They work together — and compete — effectively to further their gaming literacy and the meaning(s) that they construct out of these game activities revolve around how to complete it the fastest within a given category.

Not only do speedrunners work individually to develop their own gaming literacy practices, they share this information with other runners, as well as their viewers who may become runners. Many speedrunners do not see their viewers as simply observers or audience members to interact with (and for some actually a source of income), but as potential fellow runners and future participants. The audience is not simply passively taking in the experience that the runner is showing them, but are actively interacting with the runner and the other audience members. For example, in the winter of 2014, one of the major runners of *Final Fantasy* games, a runner known online as “Puwexil,” hosted an event that was a relay race between four teams to complete three *Final Fantasy* games as quickly as possible (Puwexil, 2014a). During this race, there were many viewers who participated in the stream by watching and talking. Later that year, in the fall, Puwexil hosted another relay race between four teams and the same three games (Puwexil, 2014b). While some of the runners were the same, there was at least one runner who saw the first relay race and decided to take up speedrunning and was able to participate, and do quite well, alongside several current and former world record holders.

How they evince gaming literacy is shown by the speedrun itself. *FFVI* is a game designed to be played over many play sessions and many days and to take tens of hours. The speedrunners are playing with the rules and expectations of the game, and turning them on their head. By finding the most efficient ways to go through each dungeon, and defeat each boss and in some cases, avoid them entirely, they are playing the game in ways that were never anticipated.

Finally, we should note that speedrunners exhibit game design literacy in how they construct various categories for their runs. Since these are all user defined categories they have to choose what constitutes completing the game, and when to start the timer as well as what bugs or glitches can and cannot be exploited within the run. In a way
they are creating a new game for each category of run. There are big differences in gameplay, both in terms of how long, and in terms of what parts of the game are experienced between an Any% run and a 100% run, to the point that they are nearly different games. When a new glitch or bug is found the community determines what category the glitch should feature in. Will it be allowed in established categories or does it change things enough that it gets its own run category? This is how distinctions between Any% No Sketch, and Any% Sketch came about and there is the possibility that new categories will be created in the future.

The community of speedrunners around FFVI supports each other in their productive failure efforts. Not only are runs that are going well streamed online for an audience, but also practice runs, and a great number of failed runs as well. The audience has come to expect that sometimes the runner fails, and that this is acceptable and a part of the learning process. Runners watch each other, both as a way to learn and try to refine their own practice, but to also support their fellow runners during their productive failure. Sometimes, it is the audience who is interacting with the runner via text chat that will point out aspects the runner may have missed. Not only do they support each other many of them compete with each other for the world records in various games and categories. This is a space where learning and competition coexist peacefully and help to support each other.

Often, when a runner is done streaming for the day, they bring their current viewers and “raid” the stream of another runner to show support. It appears that while there is competition for the record there is also a sense of collaboration to see how far the game itself can be pushed. For example at the end of a recent world record run, the runner TheLCC discussed with his viewers where they should go next. He stated that “once we soft lock the ending we will go there [to watch another stream]” (TheLCC, 2014). Even after setting the world record for FFVI, TheLCC brought his viewers to another runner’s stream as opposed to resting on his laurels or otherwise hoarding his viewers for himself. He shared the popularity of his stream as a world record holder in a popular game with other streamers.

Conclusion

Speedrunning video games is a space where a community has gathered and redefined the very nature of what it means to play these games. This community has set up rules, structures, and competitions to support these goals. They have elevated the game from simple leisure to serious leisure. These players illustrate a large and deep gaming literacy, as well as a commitment to productive failure and collaboration. These players have created a space where not only is competition a factor in the learning community, but it is also an aspect that brings people together. Additionally, competition in these spaces serves as a way to bind the community together, and not to alienate members of the community. Traditionally when one has tried to inject competition into the traditional schooling structure it has served to alienate and disenfranchise students. We argue that traditional schooling approaches can learn a lot from communities such as the speedrunning community where competition is a central binding factor that serves the learners and the participants, instead of alienating them.

References


Abstract: *Rocksmith 2014* is a game that the developers have mentioned as specifically geared towards learning the guitar. This paper covers the experience of playing the game over 60 days for one hour each day, an idea promoted by the developers of the game. The paper discusses how *Rocksmith 2014’s* 60-Day challenge, its variety of play options, well-constructed feedback, and mission system make it a game worth further discussion.

The Path to *Rocksmith 2014*

*Rocksmith 2014* is a sequel to the original *Rocksmith* game meant to teach players how to play the guitar. In *Rocksmith 2014*, players use a real guitar, rather than the plastic peripherals meant to simulate the guitar used by early rhythm games like *Guitar Hero* (Harmonix Music Systems, 2005) and *Rock Band* (Harmonix Music Systems, 2007). Games like *Guitar Hero* were argued by researchers and music educators to hold some promise in being incorporated into music education (Gower & McDowall, 2012), but have also been lambasted by guitar players as oversimplifying and therefore not representing the real experience (Arsenault, 2008). To combat this latter argument, *Rocksmith 2014* and its predecessor *Rocksmith* allow you to plug in any electric guitar or bass into your console and use that as the instrument instead (Ubisoft San Francisco, 2013). By using a real guitar, it seems to be the hope of the developers that the game becomes a viable option for learning guitar. *Rocksmith 2014* prints on their cover and in their promotional literature that the game is the “Fastest way to learn guitar”, which they state is based on national studies (Ubisoft, 2013).

While the original *Rocksmith* had the option to plug in a guitar, mentioning on their website that the game would allow players to “develop real skills and real styles while playing…” (Ubisoft San Francisco, 2011), *Rocksmith 2014* was the first game that made a concerted effort to say that one would learn in the game (Gera, 2013). In Gera’s interview with the Creative Director of *Rocksmith*, Paul Cross, Cross mentions that the original game had a “passionate and active community”, yet Gera writes that the development team for *Rocksmith*, “…was ‘disappointed’ in critical appraisals of the game that stated that *Rocksmith* failed to teach its users to learn guitar…” (2013) To improve on the original game, Gera reports that Cross and the development team made some changes, like removing an overall journey mode, and replacing it with a mission system that gives players three goals to achieve at any one point in time and introducing more constructivist tools like session mode (2013), which is meant to allow the player to play along with other instruments in an unobstructed environment. Based on arguments and claims made by *Rocksmith 2014*, I decided to try and test out the game to see if it could help a complete novice, like myself, learn how to play the guitar.

The 60-Day Challenge

In addition to being a guitar novice, I knew little about *Rocksmith 2014* before purchasing it. The game is available for many systems, and I chose the Xbox 360 version. Upon opening the game and examining its booklets and promotional leaflets, I was struck by its focus on trying to get you to learn and play guitar. In the materials as you open the game, there is a leaflet which is called the 60-Day Challenge, which includes a URL to a webpage providing more details on what they want you to do, which is essentially to play the game for an hour per day. One of the strengths of this type of challenge is that the game’s literature does not say that you must play the game a certain way, in fact they state that they want you to merely play an hour a day, “However you want, whenever you want” (Ubisoft, n.d.). Using their system they claim to have you learn and experience a wide variety of guitar techniques, including barre chords and arpeggios, as well as scales, vibrato and a variety of harmonics. While this is small, I think it is great in that they are relying on merely spending the time playing the game rather than placing stress or onerous demands on focusing on a specific area of the game. This plan aligns well with research on expertise for gaining some proficiency in skills like typing and driving a car, where researchers argue that learners usually achieve a proficiency level with no more than 50 hours (Ericsson, 2006).

In order to then analyze their claim about the 60-day challenge, I decided to participate in the challenge myself. I had no knowledge of playing guitar, but have some previous experience playing both *Rock Band* and *Guitar Hero*. In July of 2014, I began playing the game from Monday to Friday typically, playing for an hour each day. I continued playing the challenge over the course of 13 weeks until October of 2014. In order to help with analyzing the game, I decided to follow a retrospective think aloud format, since I did not want to deter from the gameplay experience (Iacovides, 2009). Therefore, with each 1-hour session on each day that I would play, I would write down field notes...
expressing thoughts that I had before playing the game or times that I would think about the game outside of the gameplay period. After playing for the hour, I would do a post-reflective exercise, in which I would write down my reactions, a summary of what I did, and any data that I could remember while I played. If I found any frustrations or things that I appreciated about the game, I would also write these down as part of my analysis. The analysis that I wrote before and after each hour of gameplay led to a 100+ page document full of notes, observations and reactions on the game.

Examining the part of the document that I wrote at the end of the 60 days, my reflections at the time stated that I felt I had improved my ability to play guitar, but certainly understood my guitar abilities were still quite limited. I had no understanding of sheet music, could not play a song in full on my own and struggled mightily with certain types of chords, like barre chords. Nonetheless, I did feel as though I had learned and become proficient at strumming certain chords and in moving my hand in all sorts of configurations along the neck of the guitar to be able to play at least part of a tune. I felt I could play the chorus of certain songs, like Def Leppard’s “Pour Some Sugar On Me” and Weezer’s “Say It Ain’t so” to the point that I felt they were recognizable. There were also certain songs in the game that I noticed I could keep up with playing the chords they wanted me to play, and I had this confidence that with some practice and using Rocksmith 2014 I could play a version of many songs, which was a large departure from where I started. So even though there are issues with the game, I learned some aspects of playing guitar with Rocksmith 2014, which is a feat. Focusing on the positive, it is important to use the observations made in my analysis document to provide support for elements of the game I found to be a strength. More specifically this paper will explain how the elements of variety, feedback, and suggestions make Rocksmith 2014 a “well-played” game that is worth studying and discussing amongst the educational video game community.

Variety is the Chorus

One of the first things I noticed and wrote about on my first day with the game relates to Rocksmith 2014’s claim of doing a 60-day challenge by playing anything. After having completed the 60 days and learning some guitar, I think they were able to make this claim because of the variety of ways that Rocksmith 2014 allows you to play the game. On the main menu for the game, there are seven different options for the player related to learning about the guitar, with five of them being different modes for the player to take on. The main mode, called “Learn a song”, is the most similar to the early rhythmic games, in which players choose a song, and then begin to strum the guitar in ways that match the song itself. With over 50 songs in their playlist spanning over five decades and over 400 songs available as downloadable content, there is quite a number of songs that one could find. While I do not consider myself as someone who likes rock music, I could easily find a number of songs that I was familiar with and which gave me the desire to want to play them, which aligns with a professional game reviewer’s comment that the 50 songs were “satisfyingly comprehensive” (Ogilvie, 2013).

This variety however, also extends to the many other options that are available from the start, which include a selection of videos under their “Lessons” area, a constructivist-like experience in “session mode”, in which players have the opportunity to experiment and just strum the guitar in a free-flowing like format, and a place where they can experiment with pedal effects in their “Tone Designer” area. Aside from these areas, an area I spent a lot of time in was the “Guitarcade” area, which is a set of 11 mini-games meant to address different techniques used in playing guitar. For example, one mini-game, String Skip Saloon, looks to be inspired by Tapper (Marvin Glass & Associates, 1983) and helps players practice plucking different guitar strings. Some of the mini-games even cover the same guitar concept, like chords. Chords, defined simply, are notes produced by holding multiple strings on the guitar with one hand and strumming those strings with the other. In learning guitar, chords are a difficult topic to master for beginners (Miura, Hirota, Hama, & Yanagida, 2004) when performing a given melody with a guitar, several finger positions are possible, and when beginners are playing, often it is difficult to determine a fingering position. In this paper, the authors propose a method to determine finger positions that minimize the burden on performance and remove a burden on novice guitar players, and then describe “S2T,” a system which outputs these results as tablature. The authors then confirm based on the results of a performance evaluation of S2T that it requires less burden than commercially available systems,”DOI”10.1002/scj.10609”,”ISSN”0882-1666, 1520-684X,”language”en”,”author”:[”family”:Miura”,”given”:Masanobu”],”family”:Hirota”,”given”:Isao”],”family”:Hama”,”given”:Nobuhiko”],”family”:Yanagida”,”given”:Masazo”],”issued”:[”date-parts”:[”2004”,”6”,”15”]],”accessed”:[”date-parts”:[”2015”,”2”,”2”]]}],”schema”:https://github.com/citation-style-language/schema/raw/master/csl-citation.json”}, which makes sense for why Rocksmith 2014 provides multiple mini-games to address this topic. Below are screenshots of two of the games that are meant for practicing chords, Return to Castle Chordead and Star Chords. In Return to Castle Chordead, Rocksmith 2014 uses the approach taken in Typing of the Dead (WOW Entertainment, 2000) in creating a rails-like story game in which players must play an appropriate chord in order to “shoot” various monsters and progress through a story to face a villain. This mini-game also resembles Rock of the Dead (Epicenter Studios, 2010) which used the original Guitar Hero plastic peripherals and had players play notes to advance through the game and story. Figure 1 shows a screenshot from the mini-game where the player is walking...
through a castle level and must play the F5 chord to take down a monster before the monster reaches the player. In the figure, which is in first-person perspective, one notices the neck of the guitar in the lower center of the screen, which is metaphorically the gun used in many light-rail shooters. One also notices that the F5 chord is placed up top and to the right, with a diagram displaying how to play the chord. This diagram is a depiction of the strings and frets needed to strum the correct chord, this diagrammatic representation is used throughout Rocksmith 2014 to discuss what frets and strings to hold to play a specific chord.

![Figure 1: Screenshot from Return to Castle Chordead Mini-Game](image)

While Return to Castle Chordead follows a “damsel in distress” narrative, the narrative in Star Chords has been simplified to shoot enemy spaceships by performing chords placed next to their characters. Star Chords shares the same overall mechanic of having to perform a chord represented on screen and as an enemy in order to progress through the game. However, the enemy which was represented as a monster that charged at you in Return to Castle Chordead is replaced by enemy spaceships that after some time, shoot at your spaceship in Star Chords. Figure 2 provides a screenshot of Star Chords that uses the same chord displayed in Figure 1, but now the diagrammatic representation of the chord that was in the upper right of Figure 1 is in the middle of the Heads up Display for the spaceship in Figure 2, with the F5 label on the enemy highlighted more prominently.

One part of the mechanic that both games do well is that they reward players who memorize what the F5 Chord is, which translates to the symbolic representation used in traditional guitar instruction. Both games promote the memorization of chords by using the same mechanic. When an enemy appears, it first appears just with the symbolic representation of the chord (like F5). If there is a seasoned player who understands how to play the F5 chord, then they would be able to have a head start in eliminating the enemy and achieve a higher score. If a certain amount of time has passed however, Rocksmith 2014’s diagrammatic representation starts to slowly pop up, first highlighting the red bar in the first column, meant to represent holding the E (heaviest) string on the first fret (the fret at the top of the neck of the guitar), followed by the yellow bar and then the blue bar in the third column, representing the A and D strings on the third fret. Both mini-games incentivize players to learn the symbolic representation once they understand the diagrammatic representation used in the game. In addition, both games do a good job of showing only a few chords in the beginning, and gradually adding more variety to the sequence of chords presented.
In looking at the two games, I not only prefer Return to Castle Chordead over Star Chords because it has a stronger narrative, but I also prefer it for the fact that you can practice a certain set of chords, as the game’s short story on rails allows you to progress through the entire story in about 15 minutes, providing a checkpoint system that is completely missing in Star Chords, where you must always begin your spaceship journey from the beginning. Using the MDA model to analyze both games (Hunicke, LeBlanc, & Zubek, 2004) and applying learning goals to that framework, both games exhibit the same learning goal and mechanic of matching enemies to a chord. Nonetheless, the dynamic and aesthetics of each game differ, creating what feels like a different experience in both. This caused me to alternate between the games. Like for example on the 48th day, after playing Star Chords for a while and not passing my high score, I got tired of playing the game yet still wanted to practice chords, so I switched to playing Return to Castle Chordead. While this type of variety is not always feasible in games due to the amount of resources needed to produce both games, it is an important piece to understand the role that aesthetic pieces like story (Jimenez, 2014) and dynamics can have in creating experiences that feel fresh for gamers, yet still allow them to work towards the learning goals set out by the development team.

Amplified Feedback

Another area where Rocksmith 2014 excels is in the feedback given to the users. While the game provides some summative feedback at the end of playing a song, the game also provides frequent feedback to users with each note that they try to play with their guitar. While this is common for rhythm games, one thing that is not as common is providing corrective feedback to the users. Rhythm games often display whether one was late in hitting a note, but Rocksmith 2014 also provides arrows indicating corrective feedback to play the correct note. So for example, if the note the song asked for was on the 12th fret (column) and the player struck the 11th fret, Rocksmith 2014 would have provided arrows to the right of the 11th column to indicate that one needed to go to the right next time. According to researchers, this is important to learners, as they suggest to “[p]rovide corrective feedback that helps the learners see the causes of their mistakes, and how to take corrective action.” (Keller, 1987, p. 5) Rocksmith 2014 does this by indicating which way novice players need to move their hands so that they can play the correct note.

While the immediate feedback given in the game helps the users immediately correct their actions, the game also aggregates that feedback and makes suggestions to players based on that data. Rocksmith 2014 will try to match the complexity and number of notes to how well players have fared under similar circumstances. It does this to the point that even in new songs that you decide to play, Rocksmith 2014 will not start you with the easiest version of the song, but one that matches to your overall mastery and accuracy level. I found this out as I started playing on my 26th day a song that I had not played up to that point. During that session, the game presented certain parts of the new song at a non-beginner level, which I was able to see based on bars placed at the top of the screen that indicate mastery. Each bar represents a small section of the song. Once a player does a good enough job playing all the notes necessary for that section of the song, Rocksmith 2014 continues to challenge players by offering
“Master Mode”, which is a special mode where the notes for the song slowly fade out as you demonstrate proficiency in playing the song (See Figure 3), until the notes completely disappear.

Figure 3: Screenshot from playing a song where Master Mode has been achieved

The techniques implemented in Master Mode can be interpreted in multiple ways based on the literature. In one way, Master Mode can be interpreted as being the vital part of fading in scaffolding and fading techniques (Pea, 2004). Nonetheless, it can also be interpreted via the guidance hypothesis in the feedback literature (Schmidt, Young, Swinnen, & Shapiro, 1989). The guidance hypothesis discusses how it is important for learners to get immediate and substantial feedback when they are acquiring knowledge about the subject matter. In this case, when players new to Rocksmith 2014 are first learning to play guitar, they should receive the substantial feedback that they do on every note. Moreover, the guidance hypothesis also suggests that having that type of feedback when learners are proficient may actually cause those learners to over rely on that feedback, blocking them from learning the material (Schmidt et al., 1989, p. 358). Researchers argue that once players are proficient, the feedback should be delayed. This is similar to what happens in Master Mode. Because the notes disappear, the player cannot rely on the immediacy of the earlier feedback, and must instead rely on their memory of the song. According to the guidance theory, Rocksmith 2014 could have taken it a step further by delaying the feedback even further. This could have been achieved by not providing any information on the notes until the end of the song. This would have provided players with a seamless transition between the game and coming to do a real performance. Nonetheless, in my experience with mastering parts of the song, I noticed that I was already relying on listening to the sounds the guitar was making, rather than the screen as I played the sections of a song I felt comfortable with.

While Rocksmith 2014 provides a wealth of immediate feedback, it also provides good instances of delayed feedback as well. The best instance of this is in the “Rocksmith Recommends” system, which is linked to each song. When a player wishes to learn a song or play a particular song, they tend to go through the list of songs and select one to play. Before the game launches the user into playing the selected song, the user is presented with various options. Part of those options include a “Rocksmith Recommends” system, a set of three suggested activities the game provides to the user based on their last play-through. The recommendation system not only lists the suggested activity, but once one highlights that activity, the game also tells you why it is providing you that suggestion. For instance, one suggestion may be to play a certain mini-game like practicing sliding, because of a prior poor performance in sliding. In this way, Rocksmith 2014 is doing a good job of providing feedback meant to change the quality of performance, which has been termed as formative feedback (Tosti, 1978). If the desire is for people to improve on their performance, Tosti states that such feedback must be given just before the next performance (1978), which aligns exactly with where this feedback is given in Rocksmith 2014. Providing the feedback just before a user jumps into a song becomes the ideal position for those players to then concentrate on using that feedback to improve their performance, researchers claim this position to be “the teachable moment” (Dempsey, Driscoll, & Swindell, 1993). This is a similar path to one I took in one of my favorite songs. In my notes I noticed that in my 19th day of playing and practicing one song heavily, I finally paid attention to the recommendation system for that song and noticed that it wanted me to focus on practicing the chorus of a particular song, so I then spent the
majority of the time practicing the chorus on that day.

**Rocksmith 2014 is my Mentor**

While the feedback presented during each song works well, another aspect of the game that works well is the “Rocksmith Missions” system, which is a set of three missions that are presented on the title screen on the right. The missions presented are varied from working to achieve a new level in a Guitarcade game, to practicing jamming in the session mode, to editing tones in the tone designer or reaching a higher mastery level for a particular song. This mission system is something that was improved upon from the original Rocksmith which provided a single objective (Gera, 2013). By giving you three missions, Rocksmith 2014 is providing you with a choice in achieving the goals they have laid out for you. You can completely ignore the missions, but the game has done a good job of presenting them on the title screen so that when you are deciding what you want to do, the missions provide an unobtrusive goal for you to work on. There were at least six different days out of the 60 on which I played the game where the mission system dictated part of my playtime for that day.

Providing choices has been shown in previous research to increase intrinsic motivation (Cordova & Lepper, 1996). The game has also done an excellent job in balancing the trade-off of wanting to give the user many different goals without overwhelming them, as having too much choice has also been argued to have detrimental effects on motivation (Iyengar & Lepper, 2000). Rocksmith 2014 does an excellent job by always providing three options to the user in terms of missions. Once the player completes one mission, Rocksmith 2014 will provide the user with a new mission to take the place of the old one. In addition, the game also rotates the missions that are given, so that while some may be the same or are recurring, the game provides you with a different set of missions each time you start the full game. This small detail was important for playing this for an extended period of time, as there were times in playing the game where I did not like any of the three missions given. Once I came back to play on another day, Rocksmith 2014 provided me with a different set of missions, which then caused me to pay attention and to try to complete them. The mission system is a simple yet effective idea in that it does not force you to do what it asks, but tries to provide you with an easy set of gentle reminders on what it believes you should try to play, which empowers the learner to choose what they would like to work on.

**Conclusion**

Rocksmith 2014 has become one of the pre-eminent music games that has the simultaneous desire of helping people learn to play guitar. This paper has explored a number of techniques that Rocksmith 2014 uses, namely the variety of content, the adaptive and learning-focused feedback, and the agency it gives its players to provide a viable alternative to taking guitar lessons in learning guitar. While the game is not without a handful of weaknesses and limitations, discussions of those limitations is beyond the scope of this paper. From a well-played standpoint, Rocksmith 2014 is both well done, and well read (Davidson, 2008) since it serves as an excellent next step in creating a model example of a music game that has the potential of providing a meaningful and utilitarian experience for budding guitarists while also serving as an artifact for the learning game community.

**References**


Intergenerational Gaming in *Kerbal Space Program*

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**Abstract:** *Kerbal Space Program* is a detailed, challenging, and engaging simulation game just released in its final 1.0 version. The high fidelity of the simulation along with the breadth and depth of choices make the game interesting and represent a departure from the simplicity of modern mobile simulation games. Other elements of design, including the iterative, turn-based play, and required knowledge make it amenable to intergenerational play by providing roles for the knowledgeable parent and game-skilled child. This Well Played session by a parent and child duo walks through the game play itself and some of the interesting parent-child/child-parent interactions promoted by game play.

**What is *Kerbal Space Program***?

The flight simulator was once a top selling game within the PC gaming industry. It has now largely disappeared, with Microsoft finally bidding adieu to the latest iteration of their *Flight Simulator* line in 2013. So why would a flight simulator that is more complex, less scenic and requires you to assemble your own flight vehicle from parts capture the interest of so many Steam Early Access players? We’re not sure, but we have some ideas, and we’ll explore that in this Well Played session.

The game of interest is *Kerbal Space Program*, a “space program” simulator which recently exited a long Beta on Steam, and is now in version 1.0 (Squad, 2013). *Kerbal Space Program* (*KSP*) is a highly detailed simulation, in which you play the role of a space program director who must build rockets, staff the rockets, and ultimately pilot them with the goal of getting them into orbit, to the “Mun” or beyond. It is also a game that has some ideal elements for intergenerational game play.

**The Challenge of Intergenerational Game Play**

Most of the popular literature on gaming for parents focuses on warnings about addiction and violence. The first generation of video gamers has grown up (Eric) and now has children of their own (Oren and his sister, Maya). This should provide an opportunity for video games to bring parents and children together, but instead we see a growing divide around this medium.

Some organizations have stepped in to try to fill this gap. The Center for Games and Impact at Arizona State University (Crawford, 2013) has created guides for parents to better understand impactful games that their kids might play, while the Joan Ganz Cooney Center has published some research and more general guidelines (Chiong, 2009) that aim to help parents think about how to play games with their kids. These issues continue to receive popular press (Shapiro, 2013).

While games designed for multiplayer interactions may seem like the obvious choice for such collaborative play (and, truth in advertising, we like to play *World of Warcraft* and other multiplayer games together), single player games may also be the focal point of such interactions. There is an opportunity in such games for cognitive apprenticeship (Brown, Collins & Duguid, 1989), where a parent can model and provide coaching on particular strategies, while the child can similar model other areas of in-game expertise. There is great research supporting the kinds of “in room” interactions between players that can *KSP* exhibits some interesting properties that make it a single player game that is still amenable to collaborative play.

First, the game is inviting. While there is complexity underlying everything that you do in the game, there is also engagement through feedback. While that feedback is occasionally positive, it is often negative. But the feedback loop is tight and engaging, providing the fodder upon which a parent can reflect, and coach their child to do the same.

Second, the game is really complicated. Did we mention that already? The complexity is not arbitrary but rather comes from the detailed physics modeling. The complexity invites participation from multiple participants. But the particulars of the complexity mean that the skills of a knowledgeable parent who might remember something about physics, or even what the rockets that the United States used to launch looked like, can help a child who brings with them proficiency in manipulating the 3D components of the rocket, and some piloting skills. This creates a well-balanced team where the child is both master and apprentice in different roles.
Third, the building stage is iterative and turn-based. There is a lot of opportunity for thought, reflection and input. One player might have the controls to browse through the available parts, while the other player still has many opportunities to critique design, suggest other parts, point to where a part should go, or cite previous data that might inform the current design. The complexity of the space, feedback and lack of time pressure all contribute to this process, as does the balanced failure state mentioned previously. In fact, without this dialog, the game is significantly more challenging. Taking out a new part from the inventory requires explanation and reflection when playing with another player (older or younger). This is an important learning opportunity for both players. The piloting stage is more real time, but still may be slowed down to allow for similar interactions in this stage.

**Failure is Sort of Fun**

The game takes place on the planet Kerbin, an earth-like planet that is inhabited by Kerbals. It has several different modes including a *Sandbox* mode in which you have access to all of the possible parts and unlimited resources, a *Science* mode in which you are given scientific challenges and limited parts and sensors to accomplish those goals, and a *Career* mode in which successfully completed contracts and missions provide resources to build more complex space vehicles and equipment for increasingly challenging missions.

While many games might encourage players to start in a more bounded mode that provides additional structure, leaving the sandbox for later, *KSP* has such a steep learning curve that such constraints are not necessary in the initial phases. Unlimited resources and parts still inevitably lead to a rocket that at best explodes (Figure 1) shortly after launch.

![Figure 1: One of the satisfying explosions in Kerbal Space Program.](image)

Failure is a great way to learn, and an often overlooked design feature of games (Juul, 2013). For many good games, learning comes not only with success but with the oft repeated failure. Persisting through such failure requires (and maybe generates) grit, but games can also soften the blow of failure. The explosions in *KSP* themselves are quite satisfying and provide just enough incentive to try again. In addition to the explosion, however, the Kerbal pilot (Figure 2) is lost (temporarily) in such explosions. While it may not seem like a huge impact to lose a comical, easily replaced character, the attachment to the pilot is not insignificant. In many ways this is the key to the success of *KSP*; the failure state is well designed. Failure provides just enough negative feedback to cause the player to rethink their design and piloting, but enough levity that the failure isn’t devastating.
And that is good, because there is a lot of failure in KSP. The game has an extremely steep learning curve. It turns out that building, launching, piloting and navigating a spacecraft is rocket science, and KSP makes that very clear. An initial challenge might be to build a simple rocket that can fly up a little into the atmosphere, eject the control module with the pilot inside and land safely back on earth. But there are many points of failure in such a plan (Figure 3). Are the fuel tanks heavier than you have lifting power for? Did you remember to put a parachute on top and decouplers between the stages? Are the stages in the correct order? Are the engines the right match for the fuel tanks and sources? Are the aerodynamics sufficient to keep the rocket stable? There are many choices, which make the resulting rockets deeply personal, and equally as challenging to get it right.

Failure also provides a useful context for learning in KSP. Players love to test the boundaries of systems in games—they might try to jump off a cliff, hit their traveling companion, or race to the end ignoring the prompted goals along the way. In KSP such tests lead to important learning. Trying to create the largest explosion on the launch pad means figuring out what fuel tanks provide that potential. Getting a rocket to burn up as it leaves the atmosphere also requires a knowledge of fuel tanks, engines, and knowledge of the weak points to build into your rocket. While success may be slightly more challenging than failure, specific failures require building deep knowledge of the component systems in KSP.
The Devil is in the Details

Launching a rocket doesn’t need to be this challenging. At least launching a simulated rocket doesn’t need to be this challenging. But KSP has opted for a very detailed and accurate simulation of the physics and engineering (with a few exceptions like multi-body orbiting). Many games, even simulation games, opt for low fidelity simulation. KSP has adopted a detailed and accurate physics model, which I’m told (by aeronautics students) is quite lifelike. Getting better at aeronautics (rocket science) seems to make game play easier. This is a desired quality in a game designed for learning (which KSP isn’t explicitly)—getting better at the underlying content should make one better at the game (and also hopefully vice versa).

The details span the physics, the library of parts, and the community that surrounds KSP. One can read up on the different aerodynamic properties, tolerances and propulsion properties of the available components. These are not mere labels, but instead are accounted for (Figure 4) in the simulation. There are supporting tools to help visualize how these properties combine to create a center of mass, thrust and lift.

Once the rocket is assembled it needs to be piloted. If the rocket is well built, the challenge getting it off the ground isn’t too great. But once it is off the ground, getting it into orbit is fairly challenging. Once again the game does not shy away from accuracy introducing terms like apoapsis, periapsis, prograde, and retrograde. These terms may be intimidating, but an experienced player develops a feeling and intuition for what these terms mean, making them less scary if they can get that far.

The game has built in tutorials, but in their current state they are of fairly limited use. There is a very active community that does produce copious materials. There are wikis, tutorial videos, and mods that introduce new parts.

So who would play such a challenging game? Us.

Figure 4: A visualization of the center of mass, thrust and lift on a rocket (left) and detailed information about the properties which combine to create those (right).

Getting Started

We had played some of the early betas of KSP, but as version 1.0 approached we picked up the system again to play with a more evolved system. As a Steam game, it is available for play on many platforms—Mac, Windows and Linux. We built a Steam Machine (a PC running Steam OS) in the TV room to play games on the big screen. This also means that these games are played in a common household space, not solo in a private space.

Launching the near final version on the Steam Machine for the first time we tried to assemble a rocket from components that we could make sense of—a fuel tank, an engine, a command pod (where the pilot sits), a decoupler (to allow the stages to separate). Some of this knowledge came from previous experience and some came from watching rockets launch. Rocket launches are no longer the public display that they once were 40 years ago. So the idea of the multiple stages of rockets was somewhat foreign to the younger of us and required some coaching.
But the interface prompts for this design, highlighting the sequence of events that your design will produce (see the lower right corner of Figure 4, where events 0-4 are noted ending with the parachute at stage 4).

The first rocket doesn't take too long to assemble once you find your way around the interface navigating pages of fuel tanks, engines, aerodynamic components and structural components. We built a rocket that looked pretty nice in that it looked like an actual rocket. The older of us sat on the couch and guided construction, while the younger of us had the mouse and keyboard to do the actual work (though we did change up this sequence periodically). We counted down towards ignition and launched the rocket. Somewhat to our surprise it took off. It got to about 10,000 meters before we had exhausted the fuel in the tank and ejected the command pod which promptly fell back towards the surface with Bill inside. He didn’t make it, as we had not sequenced the parachute correctly that time and he crashed into the planet’s surface.

We made a few notes to articulate our strategies and took some time to reflect. First, we ought to resequence the parachute deployment. Second, the command pod didn’t go anywhere, so it needed something to power it once the big tank was decoupled. The parachute resequencing was easy. But the tank and engine for the command pod caused some debate. Should it be a small tank and engine? The main tank got us up pretty far and pretty fast. Maybe we just needed a little boost to get out far enough to get into orbit. Or maybe we weren’t that far out at all and we needed a much bigger boost. Would a strong engine and a small tank be sufficient? Or would that simply cause a little blip in our trajectory. These decisions required a lot of discussion, which needed evidence to support them. The older of us tried to come up with as much evidence as we could muster.

To make a long story short, the second, third, and fourth launches showed minimal progress (Figure 6) which provided us ample opportunity to reflect. We got Bill, Bob, Jebediah and the recently introduced (and long overdue) Valentina back to the surface safely a few times, but never made it much higher. That is when the younger of us said, let’s scrap this and build a really big rocket since this little one wasn’t taking us far enough. The older of us could have given a rationale to support why this wouldn’t work, but learning by doing is often a more effective way of teaching and parenting. So the younger of us built a great big rocket with massive engines, tanks and wings. Upon launch it didn’t go anywhere. Some modifications got it as far as breaking apart on the launch pad and exploding in a spectacular fashion, so we stayed with that for a while.

Learning Through Research

As much as one can learn by doing, there also comes a time when that doing can be supported by Just In Time research. We knew that we should go to the Internet to find some resources that might help point us in the right direction. An interesting thing happened at this point. As is often the case while playing KSP in the TV Room, we were accompanied by Maya, who is in third grade. Maya immediately jumped to YouTube to get video tutorials on game play as she has often drawn upon before (copious resources for Minecraft come in this form). But the younger of us (also Maya’s brother) felt this wasn’t the right medium for getting the information that we needed. We needed to be able to scan through information, read about components, and tailor the information to our own needs. Videos (in Oren’s words) just give you an answer without an explanation. Textual and graphical tutorials would be much more useful in this case. Maybe Maya learned that as well.

This is a great moment in any 21st century parent’s life when they realize that their child has developed some fundamental media literacy skills. Indeed we found some textual tutorials that seemed reliable (on a KSP wiki) quite quickly and were able to use that information more easily than if we had to watch a whole video (many of which detailed all of the person’s failures before success, or simply documented the success without any detail on how we could do the same thing). We learned some important things – turn early (don’t wait until you are out of the atmosphere), use multiple stages to get rid of the weight of the tanks after they are done, shoot for about 70,000 meters, which is the low end of orbit, and to get into orbit you need to accelerate prograde as you near the apoapsis. These terms required some research, which the older of us was able to do and reduce to common terms. While this didn’t get us into orbit it got us very close.
Approaching Orbit

For several days we were stuck. We had the basic concepts down, but always seemed to run out of fuel as we approached the apoapsis (peak orbit). This caused us to scrap our designs several times. We played nearly each night and would exchange ideas over breakfast or dinner, and came in with ideas for different designs. How about if we had a giant first stage? We played with that idea for a while. While the older of us was very goal oriented and wanted continual progress, the younger of us was gratified by side goals that we just invented. Could we get the giant rocket to go straight down and crash into the launch pad? Yes. Maya tracked the death and survival of our four Kerbals over the first few days. We lost a lot of them. But some survived.

We did get the giant rocket to go straight up fairly far. And then we noticed something strange. When it got far enough out it exploded. What was causing this explosion? Dialog really helped here. Did it crash into something? Let’s watch closely and look at the map view to see if there is anything that it could crash into. No, it didn’t crash into the Mun. Did it burn up? While it got really hot at one point, the place where it exploded was far from there. That shouldn’t be the cause. Was it air pressure? The older of us helped devise a series of tests and we went through a list of tests and still couldn’t find the cause. Then the younger of us got a bonus afternoon session (time to explore) and tested some more possible causes. It turned out it was the time warp. You can accelerate time in the game, since space travel can take a long time. If you accelerate time, the ship explodes. But if you put time back at the normal pace at about the place it typically explodes, the ship doesn’t explode. The older of us attempted to explain how something like that could happen by saying that this “acceleration” actually skips some steps to make it so fast, and that in turn introduces error which can cause these kinds of things.

With that solved we went back to design, and importantly some additional research that the younger of us continued to do. That informed our design and we made some changes that had more to do with piloting than construction. But this piloting required additional steps. We took turns piloting and reading out the sequences of when to turn, how much to turn, when to use full throttle and when to throttle down. We had a lot of debate about the right speed to hit later in the launch. Would faster get us there faster? It might, but it will burn fuel that much faster. And going too fast introduces friction (which we sometimes saw as the ship nearly burned up) that we want to minimize to use as little fuel as possible. Eventually we found success.
This marked an important milestone and of course posed the next question – how do we get our Kerbals back? This process of design, build, and test (along with research in various forms) is a great way to interact and even allows for differential time spent on the game while both of us still feel a sense of progress and ownership.

Who We Are

Eric Klopfer is a professor and designer of educational games, with a background in simulations. He has researched and developed a variety of Science, Technology, Engineering and Math games, and sees KSP both as a way of bringing interesting detailed simulation games into formal and informal learning environments, and as a way of bringing legitimate adult and child roles into games. Oren Klopfer is a rising seventh grader who is a game player and also likes to dabble in game design. The duo has spoken together previously on a panel at PAX East. We will recreate what it is like to get started in KSP with the fun of failure, success and collaboration.

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Acknowledgments

We’d like to thank Maya Klopfer for her faithful tracking of the fate of our Kerbals and also for some helpful suggestions in the process.
Ingress Well-Played: City as MMO

Elizabeth Lane Lawley, Rochester Institute of Technology

Abstract: This paper describes player experience for Ingress, a geo-local, mobile augmented reality game created by Google’s Niantic Labs. Ingress incorporates aspects of both pervasive, alternate reality (ARG) and massively multiplayer online (MMO) games. However, unlike many ARGs, Ingress is not focused on a specific time-limited period, or linked to a single real-world event or location. And unlike a typical MMO, play in Ingress is geo-spatially limited; players must be physically proximate to game elements in order to interact with them. Using game mechanics similar to those of many MMOs, Ingress provides for a range of gameplay, based both on user play preferences and level of experience and achievement, with a focus on the importance of social, community, and collaborative aspects of the game. Participants in this session are encouraged to install the Ingress application on their iOS or Android phone so that they can participate in a live gameplay session.

Introduction

It is difficult to assign Ingress to a specific genre, since it incorporates aspects of alternate reality games (ARGs), massively multiplayer role playing games (RPGs), mobile augmented reality games, and pervasive games. Developed by Niantic Labs, a team within Google, Ingress was released as a closed invitation-only beta on the Android platform in November of 2012. After a full year in beta, Ingress was made publicly available on Android in November of 2013, and an iOS client was released in July of 2014. While Google has not released specific player numbers, in May of 2013 there were estimates of approximately 500,000 players (Schmidt, 2014), and by September of 2014 a VentureBeat article estimated the number of players worldwide at approximately seven million (Takahashi, 2014). As of the writing of this article, the Google Play store shows over five million downloads for the game software, which does not include downloads by iOS users via iTunes. It is unlikely that all downloads of the game have resulted in long-term active players, but it is definitely the case that the game is actively played in communities across the globe, from large cities to tiny villages.

For most players, the first introduction to the game comes from the website at Ingress.com, which contains only links to download the mobile client, and a video that provides a teaser for the ARG narrative behind the game. The video describes the presence of “portals,” located primarily at artistic and cultural sites, which emit a new form of energy called “exotic matter” (XM). Only with a “scanner device” (a smartphone running the Ingress software), can humans see the presence of these portals. Minimal information is provided to potential players beyond this broad-strokes backstory, and while a link to a tutorial video is buried at the end of the initial video introduction, the relatively small number of views on that video (~320K at the end of February 2015) would indicate that it is not a primary source of information for many players. The design of the main Ingress site, which has no links to other resources, makes it clear that the next expected step is to download the client software.

The New Player Experience

Upon launching the Ingress client software, the player is asked to log in using their Google account; no other login options are allowed. The terms of service for Ingress very clearly limit users to a single account, which must be linked to their Google account. To get full access to inventory space in the software, users must also verify their accounts via email, but basic play is enabled as soon as the user enters their Google credentials.

Once a new player has logged in, they are presented with a series of introductory screens that provide a simple introduction to the underlying game concept, and then require the player to select one of two factions in the game (see Figure 1). The faction descriptions provided are minimal, but players nonetheless must select one knowing that their choice is, as the interface tells them, “final.” In fact, it is possible to change factions after beginning the game, although players are limited to a single faction change, the process takes several weeks, and players switching factions are returned to level 1 status, losing all activity points gained. (“How do I change my faction or my codename?,” n.d.)
My faction choice in *Ingress*, as in most MMOs I have played, was based on my desire to play with a friend (a member of the Enlightened faction), rather than on an assessment of the ideological descriptions provided. An informal survey of *Ingress* players done in early 2013 seems to indicate that I was in the minority in that decision, but it is also possible that as the number of *Ingress* players has increased over the past two years, the influence of existing social ties on faction choice has grown.

Half of players chose a team based on the in-game storyline, and the other half deferred to other more practical determining factors. There seems to be a Nash equilibrium of sorts here, which keeps the two teams on an equal footing (in numerical terms anyway). The 23% of people who purposely chose to join the losing team (locally or globally) have a highly balancing effect. The 15% who chose at random would also contribute to equilibrium. Only the 14% who joined the same side as friends have a destabilizing effect. (Lui, 2013)

The two factions are functionally identical, and the game focuses on a struggle between the two. Players are encouraged to claim locations in the game and defend those locations from attacks and reclamation attempts by players on the opposing faction.

New players receive a brief tutorial in the use of the game software (referred to as a “scanner,” since it scans the local area for portals and XM) (see Figure 2). The tutorial is displayed on top of the live scanner interface, which shows a very simple map of local roads, with the player represented by a triangle on the map, surrounded by a circle representing a 40m radius around the player’s location.
Players can only interact with items that are within the marked circle on the map, including portals, XM, and items that may have been dropped by other players. The initial tutorial walks a player through the process of approaching the nearest portal, tapping it to interact with it, and then “hacking” the portal to receive game supplies. This first hack supplies the user with several resonators (which are used to power up a portal) and XMPs (weapons used to destroy portals controlled by the opposing faction). At that point, the mandatory tutorial is complete, and the user is dropped into the live game world.

There are additional tutorials built into the program, but they are not immediately obvious to a new player; they require the player to access the “OPS” screen, and then scroll the menu until “Training” is revealed. The tutorials walk the player through a series of common game actions, including:

- Collecting XM: This is the energy necessary for all other game actions. XM can be collected by walking near portals or through densely populated areas.
- Neutralizing an enemy portal: Using XMP weapons to destroy resonators on an enemy-controlled portal.
- Capturing a neutralized portal: Placing resonators into slots on an unclaimed portal. Placing one resonator gives you credit for “capturing” the portal, but to fully activate the portal’s play capability, each of its eight slots must be filled with a resonator from your inventory.
- Creating a link between two portals: Hacking a portal will frequently yield a key to that portal. You can link from a portal in range to other portals for which you have the key.
- Creating a control field: Linking three portals into a closed triangle creates an XM control field, and the space within the field is shaded in with the color of your faction. Creating a field results in your faction receiving points for “mind units” (MU) contained within the field, based roughly on the population density of the geographic area the field covers (see Figure 3).

![Figure 3: Control Field Tutorial](image)

There are a number of restrictions on linking that are not immediately obvious to a new player, and that are not discussed in the tutorials; these include the fact that creating a link to a portal consumes the key to that portal, requiring you to hack and collect another key in order to create additional links, the inability for links between portals to intersect at any point, and the inability to link from a portal that is already inside of a control field. These restrictions on creating links tend to generate the most common questions from new players. (“Why can’t I link to this portal?” is a frequent refrain.)

The primary Ingress.com website offers nothing in the way of links to documentation, which leaves users to fend for themselves in terms of learning anything beyond the basic mechanics. However, an informal survey of high-level players in my local metropolitan community, found that very few had viewed official video or written tutorials, and instead had relied primarily on more experienced players to help them learn how to play. This was echoed by players responding to a query in the /r/Ingress subreddit, many of whom said they learned basic play from searching online for resources, but that most of their learning came from peer mentoring in their community. (1)
**Ingress Communities**

While I was aware of the launch of the game in 2012, and its transition out of beta in 2013, I did not begin playing myself until the release of the iOS client in 2014. My first experience with *Ingress* was a frustrating one, as I found that the user interface—even in the tutorial mode—left much to be desired. I knew only one other active player at the time, who was still a relatively low-level player, and while he was able to show me the basics of capturing and linking portals, neither of us had a good sense of the game as a whole, particularly in terms of strategy. As in many MMOs, early play is primarily solo, but as you begin to level up in the game, interaction with other players is both inevitable and necessary. Unlike most MMOs, however, *Ingress* play is geographically bounded, and as a result, communities of players are generally based on location.

Each time a player captures a portal, or creates a control field, that action is reported in the COMMs section of the game software, and is visible to players within the local area. This allows local players to see when a new player becomes active in a region, and to reach out to that player with information about local community activity.

As players in a moderately large city, we were quickly contacted by other players in our faction via the in-game communication channel, and invited to join a G+ community and Google hangout for local Enlightened players. In our metropolitan area, the Enlightened community maintains a G+ site, but it is used primarily for announcements. There are also two G+ hangouts for Enlightened players, which is where most communication takes place. One is open to all players, but is focused on welcoming and mentoring new players while they work their way up to level 8. The other is only for players at level 8 and above. The level 8 distinction is important, because after level 8, progression is based on the acquisition of badges rather than simply activity points (AP). The separate hangout for new players also provides a bit of a proving ground, to help reduce the risk of adding players who might accidentally or intentionally reveal information about planned operations to members of the opposing faction. Both hangouts include a significant amount of “off topic” chatter, which ranges from humor to technical support to personal updates. This organization of the social tools is specific to our community and our faction, however, and each regional area varies in the way that it engages new members and structures ongoing participation. There is also speculation among *Ingress* players that the lack of a strong communication infrastructure within the game is intended to encourage more use of Google’s G+ and Hangout tools.

The role of MMOs as “third places” for both socializing and learning has been explored by a number of researchers (Nicolas Ducheneaut, Moore, & Nickell, 2004; Moore, Hankinson Gathman, & Ducheneaut, 2009; Steinkuehler & Williams, 2006). *Ingress* implements this in an interesting pervasive way, with players meeting and socializing in real-world contexts as well as through online community tools. Additionally, these local *Ingress* communities share a number of similarities with MMO guilds, many of which have strong outside-of-game presences (N. Ducheneaut, Yee, Nickell, & Moore, 2007; Rossi, 2008; Williams et al., 2006). Because *Ingress* is a pervasive game rather than a virtual online world, however, the lines between game and real-world activity are much less distinct.

Pervasive games consciously exploit the ambiguity of expanding beyond the basic boundaries of the contractual magic circle. This often leads to the point where the game interface is completely ambiguous: Any action could be a game action, and any sensory observation by any participant could be seen as part of the game. (Montola, 2005)

This is where *Ingress* diverges from most clearly from virtual world MMO guilds and social spaces—everything from weather forecasts to commuting challenges to vacation plans has a direct impact on gameplay, and is likely to be discussed in the game communities. Traffic jams, for instance, offer opportunities for drivers to hack portals on their route, weather can facilitate or prevent access to portals in remote locations, and vacations offer an opportunity to visit (and hack, and capture) portals in new locations.

**Game Objectives**

The designers of *Ingress* have implemented a number of explicit individual objectives in the game mechanics and elements. For beginning players (up to level 8), the primary emphasis is on accruing activity points (AP). This can be done through hacking enemy portals, capturing and populating portals, and linking and fielding between portals. Once a player reaches level 8, AP is still required for leveling, but it is also necessary for the player to acquire badges, which involve reaching specific numeric goals related to game activities. These include the Explorer and Pioneer badges, obtained by visiting and capturing many different portals, the Purifier badge for destruction of enemy portals, the Builder and Engineer badges for creating and modifying portals, and the Trekker badge which rewards distance walked while playing the game (“Badges,” n.d.) as well as a requirement for levels above 8. Each badge have 5 different tiers, except Founder and event badges: BronzeRead More", "URL": "http://deco-
The goal of increasing players' physical activity underlies much of the game design. The tag line on the initial login screen for the mobile app says “It’s time to move,” and that line appears frequently in official communications to players from Niantic Labs. Players also learn, either from their communities or through trial-and-error, that moving between portals at a speed above ~50 km/hour causes the software to “speed lock,” preventing player action—a strong incentive to play Ingress on foot rather than from a moving vehicle.

Another implicit objective of the game is to familiarize players with local sites of historical or cultural significance; new portal submission requirements (“Candidate Portal criteria,” n.d.) specify that a location must meet one of the following criteria:

- a location with a cool story, a place in history, or educational value
- a cool piece of art or unique architecture
- a hidden gem or hyper-local spot
- a community gathering place
- a point of interest that facilitates discovery/exercise

Ingress players often report becoming more aware of historical and cultural information about their local city or region through their gameplay, as well as finding that they develop a better sense of geography and navigation. However, most Ingress gameplay encourages players to focus on their scanner rather than the world around them, and Ingress players are thus more often gazing at their phones than at the artwork or architecture in front of them. This is something that could potentially be addressed through gameplay mechanics; some efforts on this front are noticeable in the new player-created missions built into the game, which allow mission creators to prompt players to take photographs or answer questions about the portals they encounter (“Create Ingress Missions: the basics,” n.d.).

As players level up, the need to work collaboratively becomes more apparent. Higher-level gear becomes available to players at each level up to 8, and can only be obtained by hacking portals at those higher levels. However, there are limits on the number of high-level resonators that a player can place on a single portal. A level 8+ player can place only a single level 8 and/or level 7 resonator on a portal (as well as two level 6, two level 5, and four level 4). Portal levels are calculated by taking the sum of the values of all resonators, dividing by 8, and rounding down. This means that a level 8 player cannot create a portal higher than level 5, and that creating a level 8 portal requires eight level 8 players to each visit the portal and place a resonator on it. To gather supplies of high-level weapons and resonators, therefore, it is necessary for level 8+ players to coordinate on the capture and populating of portals, often working together to create “farms” of level 8 portals for harvesting of resources. Since there is strong incentive for the opposing faction to destroy those portals, these farms are often short-lived, and thus require collaborative planning to maximize yield.

Understanding this part of the game typically requires either guidance from more experienced players or fairly extensive online research, as it is far from self-explanatory. The first two screens in Figure 4 show the global and regional (cell) MU scores, respectively. Globally, players have estimated that there 24,576 cells, which on average are approximately 21,000 square km in size. The scores are calculated over a 150-hour cycle (a “septicycle”), broken down into five-hour checkpoints. The third screen shows a leaderboard of individual player MU scores within a cell. Only MU currently contained within a faction’s control fields at the five-hour checkpoint are included in the regional and global score. Individual player scores on the leaderboard, however, represent all MU captured during that cycle. For many experienced players, timing the creation of fields to coincide with checkpoints, as well as jockeying for position on the leaderboard, become an important aspect of the game. (“Regional Mind Unit Scoring,” n.d.)
Figure 4: Global and Regional MU Scores

The very uneven global scores shown in the first screen of Figure 4 reflect the results of a large, multi-layered field over much of the Indian subcontinent that was created by Enlightened agents on 28 February 2015 (kheaz, 2015). These large fields are extremely challenging to implement, because the links between portals cannot cross any other links. The operations behind the creation of these fields bear many resemblances to MMO raids, with pre-planning by players before the implementation of the field (to determine optimum anchors for the corners or anchors of the field and recruit players to travel to those locations at the set time), and ongoing real-time communication before and during the actual field creation, because players must remove any blocking links along any side of the planned field before it can be completed.

Unintended Consequences

In addition to the actual gameplay, Ingress has had some interesting unintended consequences, both for players and for communities. One of these is the extent to which the game leads to breaking of laws. An informal survey of Ingress players found that “[a]lmost one in three players have skirted around the law: 16% said they had ‘knowingly broken legal or local regulations in order to play Ingress’ and a further 15% ominously said ‘maybe’.” (Lui, 2013)

It is likely that this lawbreaking involved either use of mobile phones while driving, or trespassing in order to reach portals—ranging from minor transgressions to potentially serious breaches. While the Ingress portal guidelines require that portals not be located on personal private property, they do allow for portals on public lands and commercial private property, and these areas often limit their access. Public parks and cemeteries, for instance, frequently house portals, and also tend to limit access to daylight hours. Portals can also be found in places that require admission fees, such as amusement parks.

In order to reach a range of portals, and particularly in order to create or defend control fields, players may end up in deserted parking lots late at night, or lurking at the edges of commercial or government buildings during off hours. This has led on more than one occasion to players being stopped and questioned, or even arrested, by local law enforcement. (A web search on “Ingress law enforcement” yields a number of stories about encounters between players and police.) This also raises interesting questions about how real world identity aspects such as race, class, and gender can directly and/or indirectly influence a player’s access to game resources.

Conclusion and Directions for Future Inquiry

Ingress, with its unusual combination of pervasive gaming and MMO mechanics, offers a rich environment for those interested in the study of games and learning. This paper provides only a basic description of Ingress mechanics, gameplay, and community. There is fertile ground for deeper inquiry into the game’s influence on players’ physical activity levels, on their knowledge of local history, culture, and geography, and on their engagement in informal peer mentoring. It also raises interesting questions about how merging real-world spaces with gameplay results in issues related to real-world identity and access. This paper attempts only to open the door to greater awareness of the game, and to pave the way for further and more detailed research into a variety of aspects of Ingress play.
Endnotes

(1) An online search in February 2015 for “Ingress tutorials” yielded a growing number of tutorial sites, including an official “Help Center” set of tutorials (https://support.google.com/Ingress/), an unofficial set of graphic tutorials that are widely linked to by local groups (https://plus.google.com/u/0/photos/+AlexaMayer/albums/6069486745282199137), a very active subreddit, (http://reddit.com/r/Ingress), and a popular website called DeCode Ingress (http://decodeIngress.me).

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Finding the beat: Cycles of expertise in rhythm games

Kevin Miklasz, BrainPOP

Abstract: I have experienced an interesting puzzle when playing rhythm games: gameplay on a song usually proceeds from being so complex that I do not even know what I am doing wrong, to being so fluent that I can play the song without conscious effort. Thus, I get better at the game without knowing how that improvement occurs or what it looks like. To better understand the development of my own rhythm game literacy, I downloaded four songs on the popular rhythm game Jukebeat, and recorded all of my gameplay on those four songs over a period of nine months. From this recording I observed how quantifiable measures of my performance and improvement in the positioning of my fingers and compared with my self-perceived gameplay skill. Along with observations and reflection of my gameplay recordings, I also present a theoretical framework for understanding the development of rhythm game literacy.

Introduction

Literacy is a fundamental aspect to learning. Literacy takes many forms, but generally involves interpreting meaning from sensory inputs. The process of interpreting meaning can be quite complex: it often involves more than just knowing definitions, but rather having a situational or systemic knowledge (Gee, 2007). Literacy thus involves "embodied intelligence," or having a well developed understanding of the contextual nature of symbols developed through actions, or embodied experiences. Embodied intelligence is built up from multiple sessions of practicing and reflecting on that practice, or what can be referred to as cycles of expertise (Gee, 2007). Squire goes so far as to describe game literacy as particularly embodied in the interactivity of a game, and thus is most directly represented as performance expertise (Squire, 2008).

Rhythm games are often considered to involve practice with musical literacy. Musical literacy generally involves understanding the timing of notes in meter and beats as described in Lerdahl and Jackendoff’s Generative Theory of Tonal Music (Lerdahl and Jackendoff, 1996). Professionally trained musicians are known to perform better than non-musicians in understanding and interpreting the timing of both visual and auditory signals (Ramsayer et al., 2012). Of additional interest, coupling physical movements to beats have been found to increase musical literacy (Manning & Shutz, 2013), indicating that movement is useful in developing musical expertise and there is a potential use for rhythm games to develop genuine musical literacy. On the other hand, rhythm games do not offer an exact parallel to the way music is performed (Miller, 2009; Arsenault, 2008) and evidence that skills transfer from rhythm games to general musical literacy has not been found (Gaydos, 2010). Emergent timing and event timing are recognized as two distinct skills, the former involving the coordination of fluid and continuous movements and belonging to the realm of the athlete, and the latter involving discrete and regular events and belonging to the realm of the musician (Janzen et al., 2014). In this light, games are more similar to sports than music performances, potentially explaining why attempts to show increases in event-timing musical literacy from gameplay have been unsuccessful. This paper will mostly avoid this tricky issue by recognizing that game-based musical literacy is increasing (i.e. a player’s scores in rhythm games increases over time with practice), and concern itself with understanding how this game-specific literacy develops—whether or not a more generic and transferable music literacy is also developing. In this way, rhythm games are simply treated as a convenient case study for understanding the development of a specific, context-dependant expertise.

For that purpose, rhythm games are a particularly useful case study for several reasons. First, rhythm games have clearly defined cycles of practice, namely replaying songs. Second, the game offers a clear mode of performance to express the mastery gained, thus providing an embedded assessment of mastery (Shute, 2013). Third, a player’s score in a rhythm game can be considered a close analogy to a quantifiable measure of literacy.

This well-played example plans to investigate a simple issue- how does literacy expertise develop over repeated cycles of gameplay? To answer this general question, the author focuses specifically on rhythm games. I have noticed from my gameplay that the development of such literacy seems to be far from a regular, linear process. It involved the development of several, functionally separate literacies, which each seem to develop in jumps and spurts. The end result is that gameplay on a song usually proceeds from being so complex that I do not even know what I am doing wrong (i.e. lack of literacy) to being so fluent that I can play the song without conscious effort (full literacy through embodied intelligence). The transition between these two states happens so subtly that I am not quite sure when and how the transition occurs, nor am I able describe what exactly changed in my gameplay to cause this increase in performance. This well-played session is a conscious investigation into how exactly this unconscious transition from low to high literacy occurs in rhythm games. This is achieved through video recordings
and journaling throughout several months of my mastery of four new songs.

For the GLS presentation, I present the theoretical framework, clips from the actual video recordings of gameplay over time, and a close analysis of my journals and videos. Additionally, I will conduct a live playthrough for the audience of two songs- one in which I have undergone many cycles of practice and developed a high level of song-specific expertise, and one which I will download shortly before GLS and will never have played before. The audience can compare and contrast playthroughs of the two songs to offer any additional insights into how cycles of expertise affect the difference in my gameplay of those songs.

**Methods**

**Author background**

I am relatively experienced in several forms of the rhythm games genre, including Dance Dance Revolution, Elite Beat Agents, Guitar Hero, Rock Band, Osu Stream, and Jukebeat. In all of these games, I progressed from a beginner to some moderate to high level of expertise. This study focuses on Jukebeat which proved one of the easier games to record and analyze, but I believe that the patterns described for Jukebeat likely also hold true for other rhythm games. I can currently pass most songs on Jukebeat at a level 9 difficulty, but have yet to pass any songs on level 10 difficulty. Thus I am at an advanced level of literacy in Jukebeat, but still have room to grow in expertise.

**Description of Jukebeat**

Jukebeat (Konami, 2011) is a freemium game available on the iPad and iPhone. It comes preloaded with three playable songs, but has many “4 song packs” available for purchase through the in game store. Each song has three levels of difficulty, and each level has a further rating from 1-10 allowing for a more absolute metric of difficulty that can compare various songs to each other.

Songs are played on a 4x4 grid of square buttons. Players press one or more of the buttons in sequences as a song plays. A visual cue appears about one second before a player is suppose to strike the button, cueing them into the intended timing (Figure 1). One of three feedback animations occurs after a player hits a button, to indicate whether the player hit the note in perfect, near perfect, or far from perfect timing (Figure 1). Players are not penalized for taps on empty buttons. Notes can occur individually or in groups that must be pressed together. A typical Jukebeat song on a high level of difficulty involves coordinating the movement between 3-4 fingers on each hand.

Like most rhythm games, the point system awards more points for the closer you are to the beat, but also weights the score for each note by your “combo,” or the number of consecutive prior beats hit in perfect or near perfect timing. Thus the score accounts for both individual accuracy on a note, and repeated accuracy across notes. Individual notes are worth different points on different songs, such that the more notes a song has, the less points each note is worth to ensure the maximum possible score on any song is 1,000,000. Thus the system is weighted in such a way that scores between different songs feel comparable. The game also awards a letter grade for various final scores: less than 700,000 is an F, above 700,000 is a C, 800,000 is a B, 850,000 is an A, 900,000 is an S, 950,000 is SS, and 1,000,000 is SSS. Typically the only way to score an SS or higher is to get a full combo on a song.

I rarely get scores above an A on any particular song- at the point where I can regularly achieve A’s on a song, the song tends to lose my interest. I am most engaged and interested in a song when trying to move my score from an F to a B.

**Setup and analysis**

In June 2014, I downloaded four new songs from Jukebeat’s store. These were songs I had never heard nor played before. The songs also captured the range of my current skill levels: three were ranked at level 9, and one was ranked at level 10. Based on my current expertise level, I would expect to master three of the songs and struggle with the final one.

I built a device to record my hands and the screen as I played Jukebeat. I did not use screencapture because I was interested in the motion of my hands and fingers in particular, and if they might show any subtle changes over the cycles of practice. I recorded every playthrough of the four downloaded songs, over a period of nine months. I did play more than just those four songs, but only recorded playthroughs of those songs. I continued my natural play cycles with the game, which usually involved playing the game intensely for a few days to weeks, then putting it down in favor of other games for a few weeks to months, then returning again.
I analyzed several features of my play in the recorded videos. These include easily quantifiable things like total song score and scores during particularly challenging sequences of notes. But it also includes tactile information about which fingers were predominantly used both during the song as a whole and during particularly challenging sequences. I also observed what caused me to miss sequences of beats, whether I was moving my fingers in the wrong positions, or moving them at the wrong timing.

**Theory**

**Categorizing literacies**

In thinking about my gameplay over the years, I believe that there are three primary skills involved in doing well at any rhythm game. The first is literacy, or making sense of stimuli acquired through senses. Second is coordination, which involves translating inputs into outputs. It still involves a sense-making activity, but involves coding inputs from one or more sources into a suitable output, usually muscle movement. “Muscle memory” is another word for this. Third is physical finesse, and involves the physical action required to complete the desired output. Conceptualizing the motion that you would like to take is not the same as actually achieving that motion and the desired end result, which describes the difference between coordination and finesse.

Although these three skills were described based on reflections of my own gameplay, there are clear parallels with the conceptions of musical literacy described in the introduction, particularly in the conception of emergent timing skills of professional athletes (Janzen et al., 2014). Also, Squire’s concept of game literacy as being a performance expertise (Squire, 2008) encompasses all three of these skills as part of a single game literacy, as all are required to exhibit performance in the game.

In rhythm games, I believe that for practical purposes, we are not being stretched to the limits of finesse. Besides Dance Dance Revolution, most rhythm games do not require a vast amount of physical exertion, and do not require movements that the average person is incapable of performing. What we lack is the coordination, or the muscle memory, to execute these movements fast enough, or the literacy required to accurately read visual and audio cues.

**Literacies in Jukebeat**

I will now refer to Jukebeat in particular, though these same literacies would likely apply to most rhythm games. In Jukebeat, there are three primary skills that must be perfected to advance one’s performance: Visual literacy (VL), Tactile Coordination (TC), and Audio Literacy (AL).

1) **Visual literacy** is about being able to make sense of note patterns as they come up. It is the earliest skill learned in the game—you need to be able to understand notes before being able to respond to them. This literacy has different levels of competency- the notes become harder to read at more difficult levels both because there are more notes and because they move faster, requiring you to improve your VL. Once VL is attained at a particular level of difficulty though, it is easily transferred to other songs at that same difficulty level.

2) **Tactile coordination** is the reflexes and finger agility required to respond to particular note patterns. It involves making sense of visual and audio clues to produce muscle movements. TC can actually be viewed as a series of different minute skills, rather than one big skill. Being able to hit different types of sequential patterns requires different motor actions, and therefore each sequence requires its own TC. This is akin to being able to read the letter “A”, but not yet understanding the letter “B.” Additionally, being able to string multiple sequences together is an additional skill, just as being able to recognize the letter “A” is different from being able to read the word “ant.” Understanding where one finger leaves off in one sequence and how to connect it to the first note of the next sequence is an additional level of TC. Based on my experience, TC’s seem to be highly transferable- a discrete TC gained for one sequence in one song readily applies when that same sequence is played in other songs.

3) **Audio literacy** is about being able to read the metrical structure of a song. This is actually one of the last skills needed to play the game well, despite being the one most commonly associated with the game genre. At higher level songs, VL informs where you should move and AL informs when you should move (with your ability to actually move in the desired sequences determined by TC). AL is on the one hand extremely song specific. AL gained for lower levels on one song often travels up to and improves performance on higher levels of that same song. In general though, AL is its own higher-order skills that develops over time across many songs, and can allow you to grok the beats of new songs faster. But, a part of it is always song specific, and your song-specific AL will always improve the more that you practice a particular song, no matter how much of an expert you are.
Cycles of Expertise

Rhythm games offer multiple opportunities for repeated cycles of practice. First, any given song repeats certain sequences of notes throughout the song, which gives you a chance within a song to practice that sequence multiple times. Second, the songs themselves are clearly meant to be replayed, giving the opportunity to repeat that song multiple times. Third, songs at equal difficulty offer opportunity to practice playing at that difficulty in multiple ways, with equally challenging but different note sequences.

From my experience, I would suggest that there are four distinct levels of expertise that a player progresses through the more that they play a rhythm game:

**Level 1:** When you first start playing rhythm games, you really are just practicing VL. You play the songs better when you use your VL to learn both when and where to hit a beat. TC skills are pretty minimal, there are not really even sequences yet, the notes are played so far apart that each motion to hit a beat feels separate from the next motion. TC at this point just involves getting the timing of single notes right. The AL skills are pretty nonexistent and are not really even being practiced. Although notes are being played on a beat, they are being played so slowly that you induce their timing visually more than auditorily.

**Level 2:** Once your VL becomes somewhat advanced, you can progress to the next level of songs, where the idea of sequences, or series of notes played on the half or quarter beat, becomes prominent. This challenges both your VL and TC, as you now need to think about several motions happening in close repetition. Muscle memory of sequences starts to be built, and TC is undergoing the most improvement at this stage (though VL is still becoming more advanced too). At this point, AL is still irrelevant, as the sequences happen in enough isolation from each other that VL still informs the timing of the sequence more than AL, and the sequences are short enough that AL is not needed to keep you on beat.

**Level 3:** Once your TC has mastered basic 3-note sequences, you can progress to songs where sequences become faster and longer. Smaller sequences previously learned must be chained together, in sequences that can be 5-15 notes long. The VL task becomes more challenging, and less about reading individual notes as much as seeing patterns of sequences and letting your muscle memory move from one sequence to the next. You no longer see the notes as individual beats, but you read them visually as sequences. TC is constantly strained, and fingers will actually begin to tire over the course of several songs, building up finesse to some degree. These long repetitions of notes, and the increased speed of the songs and the speed at which the notes pan across the screen, means that it becomes increasingly difficult to infer timing visually. Visual pattern recognition still informs what sequences of muscle movements should be enacted, but audio cues start to inform when those movements should be enacted, and how to remain on beat over a 10-15 note sequence. In my opinion, it is at this level that the game becomes fun, and this is when you begin to really flex your AL.

**Level 4:** In the highest level songs, it is primarily about AL. VL is still continuing to be strained by some especially difficult songs, but for the most part this skill is fully formed and most songs are completely readable. The player has also built an extensive muscle memory library of TC’s, which continues to be added to and challenged by each new level of song. But songs at this level are simply impossible to be played correctly if audio cues are not used to infer beat timing. At this level, it is fully incorporating TC with AL that most determines performance.

From this hypothesized progression of skills, one can see that the main literacy that most influences one’s performance changes as one’s skill level changes, starting with VL, then moving to TC, then to AL. This also means that AL is only practiced in rhythm games in a highly complex way that must be fully integrated with other visual and tactile skills. This is an interesting comparison to most of the musical literacy tests described in the introduction, which test that literacy in a highly simplified, abstract manner (e.g. Ramsayer et al., 2012).

**Hypothesizing from theory**

Based on this theoretical framework, I have several hypotheses about how my performance would progress, depending on which skill is being strained the most in a new song. These hypotheses helped guide how I observed the motion of my fingers in my recordings.

H1: If Audio Literacy is most constraining performance, timing should be off for beats, but fingers should be moving in the correct sequences. This timing should get fixed with time, and be the primary factor behind performance improvement. This improvement is only seen over the number of repeated playthroughs of that song.

H2: If Tactile Coordination is most constraining performance, then one would hit the beats at the right time, but in the wrong positions, or to happen in the right position but always with a delay due to higher processing time to ex-
ECUTE the maneuver. Over time, the positioning and timing should rectify itself as the appropriate muscle memory is built up.

H3: If Visual Literacy is most constraining performance, then there should be trouble inferring both position and timing due to general cognitive overload. Improvement should proceed from random to more purposeful motion. That random motion may or may not be on beat.

**Gameplay Observations and Reflections**

In looking at my gameplay records, several patterns are apparent. First, my performance has increased over time, and the increase has been somewhat linear, though with a lot of variability (Figure 2). The quantifiable increase in whole-song ability is certainly more regular than I expected it to be. Apparently, the feeling of mastery occurs much more suddenly than the measurable score of mastery. I gained mastery in two of the songs (i.e. achieved at least a B level rating), and despite my focused attention on the issue, still found my feeling of mastery to appear subtly and thoroughly nearly all at once, without exactly knowing when and how it occurred.

Second, I have found a particular stumbling block in one of the songs, which has allowed for a very interesting case study. The song featured a kind of note sequence for which my muscle memory was unable to cope. Over time I learned that the sequence needed to be played with my thumb and middle finger, rather than with my index and middle finger (which was my natural tendency when first encountering that song). This forced me to explicitly unlearn a given TL or muscle memory, and relearn a new technique to succeed in the song. Challenging automated routines with new sequences is a vital process in Gee’s cycles of expertise (Gee, 2007), and actually led to a drop in my performance from my initial playthroughs. I perceived my performance improvement as a simple 2-step transition (index+middle finger to thumb+middle finger), but in fact the recordings revealed 5 different finger configurations I employed through the learning process, which was unknown to me before reviewing the recording. Additionally, I did not transition through those sequences in a regular way—although over time the proportion of the more “advanced” configurations used on a song increased, in any given playthough I would employ between 2-4 different configurations at different points throughout the song. It was only after I started achieving the most advanced configuration with some regularity that I gained self-percieved efficacy.

Additionally, I have noticed that while struggling to learn that new sequence, I underperformed in the sequences immediately before and after the troublesome sequence, indicating that the additional mental energy required to correct the sequence was distracting from my ability to correctly play sequences that I could otherwise easily handle. This also caused highly irregular play performances from session to session, with scores fluctuating quite a bit in successive playthroughs (Figure 2). This also strongly indicates a cognitive overload on TC.

Third, I observed for two of the songs that there was a significant segment of the song that I noticeably increased my performance on, and that increase was in a large way contributing to my final score. Yet in both of these songs, it was not apparent to me that either I was struggling so much with this particular sequence, or that such a drastic improvement had occurred on that sequence. The improvement was a combination of improved timing with some novel repositioning of fingers (so a combination of AL and TC). But in both cases my self-perceived efficacy on the song as a whole only occurred after the sequence that I was unaware I was struggling with had been mastered. Reflecting on my own play, I mostly perceived the section as one in which I did adequate on initially, and showed a modest improvement on over time.

The general sense is that my TC was being most constrained by the songs, and I saw a lot of confirmation for H2. There was in some sense a sharp and binary transition through discrete finger configurations, a clear indication of TC issues. But the transitions occurred in a disjointed and gradual progression that involved significant retrogression. I would not suddenly move from configuration 2 to 3, but would in contrast still be employing configuration 2 and 3 in a song while simultaneously perfecting configuration 5. I found that my learning was filled with discrete steps that transitioned gradually over time. My learning and progress also seemed generally misaligned with my self-percieved efficacy. But perhaps this cycle between success and failure, progress and retrogression, is how game literacy expertise does and should develop during repeated cycles of play.
Figures and Tables

Figure 1: An example of my fingers in the midst of gameplay on a song. Beats appear as the colored green and white shades, and must be tapped when the shades fully cover the square. The rainbow circle is the feedback response indicating that a note was recently tapped with perfect timing.

![Figure 1]

Figure 2: A graph of the author’s gameplay performance over time. In this graph, the x axis shows the number of repeated playthroughs of the song, which occurred over a period of 9 months at unequal time intervals.

![Figure 2]

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He Was The Most... Human: Ethical Play in Doki-Doki Universe

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Abstract: Doki-Doki Universe is an adventure game in which players control QT3, a robot charged with the task of better understanding human nature. The narrative context of this game utilizes the modeling principle to teach players about prosocial behavior. Gameplay consists primarily of two systems: object-oriented, fetch-quest puzzles and personality quizzes. Players' ethical agency is limited to dialogue choices and answers to personality questions that do not affect the overall story, but the game aggregates data from player choices in both systems to craft a personality profile which can be reviewed and modified. In this way, the game teaches reflection on empathy, logic, and personality traits. Though the game does not afford players moral agency, the game rules and world are still ethically relevant because they foster reflective practice of prosocial behavior.

Overview of Gameplay

Doki-Doki Universe (HumaNature Studios, 2013) is an adventure game in which the player controls QT3, a robot on a quest to understand humanity and become more “human.” The player is tasked with traveling between different planets in order to acquire objects and deliver them to people in need. Each planet suffers from one particular human flaw, like pride, bullying, or pollution. The game's narrative explicitly frames the play experience as a quest for benevolent self-exploration, and the procedural rhetoric (Bogost, 2007) of the explore-interact-resolve systems is congruent with this story. The game positions the player as a helpful-yet-naïve individual, a perfect role from which to perform identity work (Gee, 2007) concerning interpersonal communication—and the game world is characterized by a series of discrete environments that act as caricatures of important ethical failings in modern society. As the innocent outsider, players are asked to observe, help, and assess the denizens of these flawed planets.

Object-Oriented Interaction

As a genre, adventure games are videogames in which players guide an avatar through a virtual environment with the objective of interacting with non-player characters (NPCs) to obtain items and information about how those items can interact with the player, NPCs, and the environment. Typically, players are forced to obtain these items in predetermined succession, with a sort of bait-and-switch progression. Objects that can facilitate progression to the next environment are withheld by an NPC until their goal is satisfied, that goal usually being the acquisition of an item possessed by another NPC—which, in turn, wants something that can only be obtained by speaking with yet another NPC. In this way, players are forced to speak with all NPCs, use logical induction to understand the correct order of interaction and item acquisition, and only then can players assist all NPCs and obtain the items and information necessary to complete progress in a given environment. Doki-Doki Universe is an adventure game that faithfully adheres to this formula. The only exception is that, unlike most adventure games, the planets (levels) are discrete gameplay segments, which the player is able to visit and exit at any time.

Most adventure games feature multiple-choice dialogue options alongside object-oriented interaction, as a method of communication with NPCs. Though Doki-Doki Universe has a few instances of player-driven dialogue, the primary mode of interaction is conducted with Summonables, collectable objects that are stored in a menu-like repository, which are used to ask NPCs about their likes and dislikes, and to fulfill their requests (see Figure 1). Many objects have overlapping characteristics with other objects, so many Summonables—a rainbow, flower, or peacock—could be used to satisfy an NPC’s request for “something pretty,” for example. This object-oriented mode of interpersonal interaction keeps the game accessible to a broad audience and fosters an embodied perspective in learning problem-solving skills, where players map solutions directly onto objects in the world. Since the game requires players to choose objects which will help people in practice, problem-based thinking is situated in the context of each mission, but can eventually be abstracted as players discover general categories of objects which satisfy similar requests. After completing all of the primary goals of a planet-based level, the player is congratulated and reminded of the lesson—that is, the prominent “human” trait which was keeping the denizens from being happy. The player is then asked to identify which characters exemplify that trait. Answering this question, as with the other dialogue choices, results in a pop-up notification with personality assessment based on the player’s choice.
GesturalGreetings, Character Profiles, and Dialogue Choices

Players are directed to speak to all NPCs in every level. Each NPC offers a greeting, followed by some information about themselves or another NPC. Players are afforded three gestural greetings—bowing, waving, and blowing a kiss—with which to address characters. These gestures are performed by moving the right joystick in different directions. Each NPC has their own greeting preference and offering the correct greeting increases the NPC’s satisfaction rating, while performing the wrong gesture decreases their satisfaction. Once learned, usually by obtaining the information from another NPC, this preference information is available in that NPC’s character profile, which is a repository of character-specific information that can be accessed by pressing a button while selecting that character. These character profiles also include likes, dislikes, and other information relevant to satisfying everyone’s needs and desires (see Figure 2).

Sometimes, dialogue choices are available to the player, but they do not appear every time QQT3 approaches an NPC. When they do appear, there are always icons next to choice, indicating their intention, like a smiley face, question mark, devil-like face, heart, sun, bunny face, or jester face. The circle with a star inside represents honesty. In one situation, the symbol sits next to the dialogue option, “Not a chance. Sorry, but he’s dead.”
Personality Quizzes

In addition to the mission-driven planets, the world map also features asteroids, each of which represents one of several dozen five-question personality quizzes. Each question is simple and indirect. Instead of asking whether you consider yourself extroverted or introverted, the game might ask which planet you want to visit or which alien you would most like to encounter. The choices are all crafted to represent distinct personality differences in relation to the underlying psychological concept (see Figure 3). After completing each quiz, the game interprets the answers and tells the player about his or her personality in general terms. The next several pages of the results screen provide a question-by-question breakdown of the player’s answers, elaborating on the issue at hand in each question and explaining more specifically what the player’s choice reveals about himself or herself (see Figure 4).

The game saves the results of each quiz, but players are free to revisit completed asteroids at any time to review and change their answers. There is no penalty for changing answers, so players have the option to explore alternate answers to read the game’s explanations for each choice. This is useful, since the “answers” to each question are in fact cartoonish drawings that represent abstract concepts, with varying degrees of success—so, if the player...
Expression and Reflection, Not Decision-Making

This game serves as an example of one way in which game designers can craft an experience that fosters empathy and self-reflection, as well as exploration of personality traits and moral issues. Most videogames featuring morality components tend to integrate them into the conversation mechanics. In Doki-Doki Universe, the morality components are built into the characters and environment, while the player acts as an observer with little moral agency. Where a game like Mass Effect (BioWare, 2007) asks players to enact their moral code, Doki-Doki Universe asks players to express their innate preferences and tendencies in an attempt to show the player more about themselves. The flawed planets are not meant to be compelling as moral dilemmas, but as exemplars of moral issues. Instead of showing consequences through consequentialist, cause-and-effect branching narratives, the game’s personality quizzes use players’ intuitive responses to create a detailed personality profile to promote self-reflection.

Affording Ethical Play, But Not Moral Agency

Though the narrative context of Doki-Doki Universe is ethical in nature, the game’s rules do not afford any significant moral agency to players. They might choose the “naughty” response to a question, but while this results in some pop-up feedback about the personality trait revealed in such a choice, the significant actions in the main game, the only means of progression and achievement, are completing the item-driven fetch quests—that is, delivering the correct Summonables to the appropriate NPCs and helping them with their problems. In order to make any progress on the planet-based levels, players have no choice but to fulfill the requirements of the narrative: to guide QT3 on his one-way journey to being a prosocial robot who learns to better understand humanity. Zagal (2012) states that videogames can best encourage reflection on ethics and moral reasoning by creating dilemmas which force players to experience emotional tension, such as guilt or shame, and consider tough practical decisions, ideally in a sandbox environment which allows players to make a range of choices which are presented with ambiguity until the consequences are revealed. In this game, there are no tough decisions, nor are the levels constructed to be anything more than a superficial sandbox in which the player can manipulate only objects, not the ethical behavior of QT3—at least, not to a degree which encourages players to “consider the ramifications of alternative actions” (Zagal, 2012, p. 67). Still, even without moral agency, the game’s content is ethically relevant because the narrative context and systems of play are designed to convey a message of prosocial behavior, and can be used by players to reflect on their own ethical viewpoints.

Procedural Rhetoric: Helping Virtual People

“The representational aspect of a computer game—its visual and narrative elements—is of secondary importance when analyzing the ethics of computer games. Games force behaviors by rules: the meaning of those behaviors, as communicated through the game world to the player, constitutes the ethics of computer games as designed objects” (Sicart, 2009, p. 23). The mechanics of Doki-Doki Universe afford ethical play in context of the narrative but, stripped of its aesthetic shell, the abstraction of this game’s rules and play are simply item acquisition and matching. Through the lens of Koster (2004), which defines a game’s lessons by its rules and systems, the game could be viewed as amoral. However, this perspective is overly reductionist and fails to account for the principles of interpersonal communication—the “meaning of those behaviors”—which bind the otherwise disparate abstract elements of objects and characters. When looking at the rules, behaviors, and emergent narrative through the lens of procedural rhetoric (Bogost, 2007), it becomes apparent that the social nature of the item-matching is inextricably linked to the abstract mechanics of the game. The procedural aspect of play might be described in terms of abstract relationships between objects, but the rhetorical aspect necessitates an understanding and appreciation of the NPCs as pseudo-social agents. Because it is impossible to effectively gain and match items without reading the dialogue and interpreting the needs and desires of the NPCs, the game’s ethical framing cannot be ignored.

Players are embodied agents, bringing their perception of reality to bear on their conceptualization of virtual game environments. Sicart (2009) uses the example of falling in videogames, which we tend to consider a bad idea, unless the game (or genre) indicates otherwise. “This comparison [to the real world] implies that there are actually connections made between the real world and the game world in the mind of the player” (Sicart, 2009, p. 34), which
he argues are on a deeper level than simply connecting the physics of reality to those in a virtual environment. Players also consider themselves embodied beings in the game world, having social agency—and responsibility—in the context of the game narrative. This is consistent with a communication theory known as the "media equation," which states that people naturally personify inanimate objects and that mediated stimuli are treated—on a subconscious level—the same as non-mediated stimuli (Reeves & Nass, 1996). Therefore, there is still prosocial behavior embedded in the rules of the game, even if there is not any strong affordance of moral agency. And, since prosocial behavior is the narrative and procedural focus of the game, the play in Doki-Doki Universe should be considered ethically relevant.

Ethically Relevant Play

What makes a videogame ethically relevant "is not about how we inhabit a world, but how that world allows us to inhabit it" (Sicart, 2009, p. 36). The world of Doki-Doki Universe is as straightforward as its rules, focused entirely on a universe filled with planets of fallible people who would benefit from the good deeds of a helpful robot. Aside from minor transgressions—like choosing to wave in greeting when you know an NPC prefers a bow—the game world and the actions presented to the player do not afford any exploration of strongly antisocial behavior. It is not in spite of this rigidity of rules and the simplicity of the world, but precisely because of such rigidity and seeming unidimensionality, that this game is interesting from an ethical perspective. "Ethically interesting games are those in which the existence of the rules predicts a game world in which ethical values can be deduced from the actual gameplay" (Sicart, 2009, p. 37). The ethical values of Doki-Doki Universe are very easily deduced.

According to Sicart (2009) it is essential in analyzing the ethics of videogames that scholars consider players not as passive audiences, but as empowered users of media who engage with the ethics of the game rules and world. Despite the lack of in-game agency afforded to the player, people are competent, reflexive, naturally ethically-minded beings who are able to interpret the subtext of a game just as well as its explicit narrative—and decoding play is part of the player experience. "Games can have ethical affordances because they are designed and experienced by moral agents immersed in specific cultural situations and times" (Sicart, 2009, p. 41). The player, explicates Sicart, is the missing piece to defining the ethical gameplay of a computer game. It is not enough to analyze the rules of a game to understand its ethical design; the researcher must also account for the ways in which players will interpret the rules, react to them, create new rules, and psychologically process the experience.

In other words, it is not only the writers and readers of Well Played papers who are capable of analyzing Doki-Doki Universe as a game with a prosocial ethical nature. Even the average player is acutely aware of the one-sided moral message in the game and is able to understand that message, while also negotiating the in-game identity with his or her real-world ethical framework.

Identity Work and Reflective Practice

The negotiation of the tripartite identity—the player, the character, and the player-as-character—is what makes Doki-Doki Universe a tool for identity work (Gee, 2007) and transformational play (Barab, Gresalfi, & Ingram-Goble, 2010). Again, the game presents an overtly prosocial narrative, and players must read NPC dialogue and respond to their needs and desires by earning and presenting the correct Summonables to each NPC. In role-playing as a character who listens, empathizes, and helps, the game teaches players how to operate as a purely benevolent social agent. This is a departure from the real world, where even the most prosocial personalities must confront the dilemma of not having enough time or resources to help people as much as they would like—and, unfortunately, these and other extreme circumstances place "good apples" in "bad barrels" and force people to compromise on the ideal of perpetual and universal prosocial morality (Zimbardo, 2007). This is also a unique opportunity in terms of videogame worlds, since most games involve aggressive mechanics—like shooting—or at least selfish goals, like collecting every item in a game world. So, at least in the colorful and simple world of Doki-Doki Universe, players can experience this morally-pure identity, incorporating it into their repertoire of experience while also comparing and contrasting it with their own real-world views and experiences.

There is a tremendous amount of feedback in Doki-Doki Universe, from the "thank you" of an NPC when delivering the correct Summonable, to the results of the personality quizzes. Each NPC has a satisfaction meter which can be affected positively by listening and helping, or negatively, by offering the incorrect greeting or by throwing objects at them. Not only is the constant stream of multilayered feedback a good example of the practice principle, one of the principles of good learning in good game design (Gee, 2007), it affords the player opportunities to learn in the moment and reflect before and after each gameplay session. This game fosters reflective practice (Schön, 1987)—not of moral agency, like in The Walking Dead (Telltale Games, 2012; Rosenberg, 2014)—but, simply, of empathy and logical problem-solving skills. Feedback systems have been designed to alert the player to how NPCs interpret various choices and actions, and to analyze the player's behavior and provide meaningful personality assessments.
Potential Applications for Education

Through each of its systems, *Doki-Doki Universe* addresses empathy and reflection on many levels. The personality quizzes foster self-reflection, while the primary gameplay—problem-solving on planets—has players learning to listen and help others, while still being cognizant of their faults. The environments, the planets themselves, each suffer from one particular flaw in human nature, which is demonstrated by its name, design, and the NPC denizens who personify these flaws. The game’s design addresses individual, interpersonal, and societal ethics—through quizzes, quests, and environments, respectively. As a console game designed for entertainment, prosocial learning is a secondary goal and does not fit neatly into any existent context of formal education. However, teachers might consider using this game in an informal learning session, perhaps in an after-school gaming group, where it could be used as an interactive text in a practicum-type setting, to teach children about empathy, logic, and prosocial behavior. For older players, *Doki-Doki Universe* is an opportunity to be reminded of those lessons and to practice them in a stress-free, winnable context.

Conclusion

Games are inherently ethical because players bring their ethical frameworks to bear on all experiences (Sicart, 2009), but this game explicitly integrates prosocial behavior into its narrative and gameplay, which means that the game isn’t just ethical, it is about prosocial behavior (Bogost, 2007). The game is blatantly moralistic and this is both helpful and limiting when designing a game for ethical play. Since completion of the game is dependent on acting in a prosocial manner, players are not afforded moral agency and the game is therefore not optimally ethical in the way that Zagal (2012) claims games should be ethically compelling. The game presents opportunities for reflection, but player agency is limited to just one type of ethical behavior. However, for this reason, its potential as a tool for self-reflection and reflective practice is greatly enhanced. It has been shown that play in a virtual environment as a prosocial agent increases the likelihood of prosocial behavior in subsequent, real-world tasks (Rosenberg, Baughman, & Bailenson, 2013). The role-play in this game fosters identity work and aligns with the principles of transformational play and *Doki-Doki Universe* should be considered an informal learning context in which players can learn to be more... well, human!

References


Prepare to Suffer with Paul & Mo: Let’s Play as Well Played

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Abstract: This paper explores the premise that a written document alone cannot fully capture and convey what it means for a game to be well-played. It postulates that the Let’s Play (LP) narrated video format is an optimal modality for documenting a well-played video game. The authors explore this idea through their own playthrough and LP of Dark Souls by FromSoftware. In addition, they examine how the LP can serve as a record of learning.

Form Meets Purpose

This paper begins from a simple premise: A Well Played paper like this one is certainly sufficient as a form for exploring and analyzing the meanings found in the experience of (video) game play, but a written document alone cannot fully capture and convey what it means for a game to be well-played. In the case of video games in particular, the last seven years have given rise to a modality of expression that is uniquely suited to the exploration of the concept of a well-played game in the form of the Let’s Play (LP) video. We further argue that in some sense every LP is a representation of a well-played game, and we will explore this concept through the presentation of our own LP in progress of Dark Souls (FromSoftware, 2012). First we will examine some of the particulars of the LP medium, but before that let’s consider the history of the Well Played format in brief as experienced by Moses.

Moses’s first encounter with the Well Played format happened in 2007 at the Games+Learning+Society 3.0 conference. At that conference, Drew Davidson offered the first such session at GLS and the first formal offering in the Well Played format with Well Played: Interpreting Video Games (Davidson, 2007), later to be published as Well Played: Interpreting Prince of Persia: Sands of Time (Davidson, 2008). The Well Played format has since become well established with 3 volumes containing 65 articles published in the Well Played Journal, and live sessions at 4 different academic conferences in 2015 (Davidson, 2014). However, at GLS in 2007, it’s fair to say that the audience hadn’t seen anything quite like a Well Played talk, especially in an academic setting. In particular, a talk that not only included an example of game play but actually revolved around it was revolutionary. It fundamentally changed the nature of the discourse in the conference hall at the Monona Terrace that day by physically situating the talk around the play experience.

While the affordances of the conference setting allow for a particularly intimate engagement with both game and player, the ecosystem of contemporary media that includes video games provides opportunities for sharing the play experience and the player’s perspective. Through sharing video records of play with player narration online, there are unique opportunities for players to express how their playthrough is well-played from their perspective, and potentially to receive commentary and critique from other players on the quality of their particular play experience. With this in mind, let’s consider the Let’s Play medium in brief before exploring the authors’ current experience with this medium as they play through Dark Souls, what the implications of this experience are for the Well Played format, and how an LP provides a particularly intriguing record of learning in the context of a well-played game.

The Rise of Let’s Play

Despite the natural mapping between video game-play and digital video recording, Let’s Play actually started out as text and image based posts on web forums. Although we could not find a definitive account of where and when the format originated exactly, there appears to be consensus that it was popularized on the Something Awful Forums around 2006 (Jong, 2011) using the term Lets Play (abbreviated to LP), and that by 2007 video based LPs began to appear on those forums (Fjællingsdal, 2014). The increase in the ability to both generate and view user created video content that YouTube and later Twitch.tv enable has since cemented video as the primary format for LPs. In order to provide a marker indicating the extent to which the LP genre has proliferated, a search we conducted using the compound term “let’s play” on YouTube in late June of 2015 yielded over 18 million results.

The rise of LP videos as a medium has inevitably led to a corresponding rise in academic inquiry around the phenomenon of LPs. A preliminary review of current work indicates that researchers have taken up the topic of LPs to further an understanding of identity (Jong, 2011), the position of LPs as paratexts (Mukherjee, 2012), the experience they offer their viewers (Glas, 2015), their position in relation to other formats of streamed gameplay (Smith, Obrist, & Wright, 2013), and the opportunities they present to the field of media studies and the practice of game
development in general (Fjællingsdal, 2014). However, none of the work we found explores the two themes that we discuss here of how each LP is fundamentally an attempt from outside the academy at presenting a well-played game, and how the LP can stand as a record of the player’s learning.

Dark Souls: A Proving Ground of Suffering

Having disposed of the matter of historical context surrounding both the Well Played and Let’s Play formats, we can now get down to the exciting part of this inquiry: the experience of a well-played video game. As noted at the start of this paper, the game in question is Dark Souls, by From Software (2012). It has been described by reviewers as “...a thoughtful, atmospheric, and mysterious role-playing adventure that challenges your mind and your mettle.” (VanOrd, 2011), “...vicious and unforgiving in the challenge it presents.” (Zimmerman, 2011), and, “...Groundhog Day but in the ruins of a fantasy realm...an exercise in self-abuse and language lessons, the eventual player commentary an inventive catalogue of insults and blasphemy...Zelda in Hell.” (Smith, 2012). In short, Dark Souls is an extremely difficult game.

You might have noticed that the last delightful snippet of reviewer commentary is dated a year after the previous two. This was not simply because Adam Smith at Rock, Paper, Shotgun was late to the party, but because the version of the game he was reviewing (Dark Souls - Prepare to Die Edition) was the version released at a later date for Windows. This is the version of the game that we have played for our LP, or more precisely, the version of the game that Moses has played while Paul has served as host, commentator, peanut gallery, and sometimes guide, having already beaten the game himself. The version of the game has some bearing in regard to the history of each player with the game, and direct implications for this conference session as discussed below under “A Playthrough in Process.”

In terms of game genre and game mechanics, Dark Souls can comfortably be described as a third-person action RPG. The player creates a character at the game’s start that technically has a character class (e.g. fighter, sorcerer, etc.), however unlike in many RPGs the player is not ultimately limited by this initial choice in terms of the capabilities the character can develop. Rather, the player has the opportunity to invest one point into various character statistics at each level.

Souls

Levels in the game are attained through the expenditure of the common currency of Dark Souls, which are the titular souls. With each level attained, the cost of the next level increases, preventing the player from simply optimizing the character by equally distributing points across stats. In addition, it is noteworthy that souls can be spent on other items in the game including durable and expendable items that can be purchased from merchants, training of certain skills by specialized NPCs, and upgrading weapons and armor with blacksmiths.

There are two basic sources for souls in Dark Souls. The most common source is a temporary form of the currency, which is attained through killing enemies. We refer to this source as temporary due to the fact that if the player’s character dies prior to investing these souls, the earned souls are left at the “bloodstain” (i.e., the site of the player’s death), and if the player dies again prior to retrieving their lost power, the accrued souls are lost as well.

Humanity

In addition to souls, Dark Souls has another form of currency called humanity. Humanity comes in two forms in Dark Souls. It can be found as a durable item on some enemies, and it can be attained in a temporary form much like souls by killing certain enemies (this is referred to as “liquid humanity”). Humanity plays a specific role in the game. The player’s character exists in a state of undeath referred to within the game’s lore as “hollowed”. However, while the character is never truly human, it can become externally human by expending the relatively scarce resource of humanity.

Being human in Dark Souls confers certain benefits and carries a specific risk. When human, the multiplayer function of Dark Souls becomes active. This allows players to “invade” one another’s games. When a player’s game is invaded, the state persists either until one of the two players is dead, or until the invading player decides to leave in the event that they give up on attempting to track down the invaded player. The invaded player cannot leave the particular zone they are in so long as the invader is present thereby preventing further progress. In addition to the multiplayer mechanic, being human provides the player with a better chance of getting useful items to randomly drop off of enemies.
Bonfires

Humanity also plays a role in relation to bonfires, another essential mechanic in *Dark Souls*. Each area in *Dark Souls* has a bonfire, which serves as a respawn point for the player. The player doesn’t respawn at the closest bonfire, but rather at the last bonfire they rested at. Certain resources are restored to the character each time a player rests at a bonfire. Specifically, after resting, the character receives a full supply of Estus Flasks, which are the game’s health potions, and also gets a refill on all magic spells the player has gained the ability to cast. However, enemies in the area also respawn when the character rests with the exception of the bosses and mini-bosses, who remain dead after the player has successfully killed them. In addition, a player can expend a humanity in order to “kindle” a bonfire which results in an increase to the number of Estus Flasks restored by resting at that particular bonfire.

Lordran

While there are many aspects of *Dark Souls* that we could easily spend numerous pages describing, including the ostensible goal initially presented to the player (to ring the two Bells of Awakening), there is one final characteristic of the game that is worth mentioning up front before discussing our LP and how this particular play through can be regarded as a well played game. The setting of *Dark Souls*, known as the Kingdom of Lordran, is in many ways a uniquely designed game world. On the one hand, the scaling difficulty of encounters over the course of the game certainly carries its own special quality. However more importantly, as Lordran unfolds, it is a fundamentally connected space. That is to say, as the player progresses further in the game, the various zones are not so much discretely designed levels as they are part of a larger geography. New locations in the game will frequently offer new perspectives on locations the player has been previously, as well as glimpses of the possible locations that lie ahead. In this respect, the process of discovering the Kingdom of Lordran in *Dark Souls* is fundamentally different from the more typical experience of exploration in a game where a new zone or level certainly holds new perils and promises, but also carries with it a feeling of being a fundamentally separate place from the player’s prior location.

A Playful Pairing

In *The Well-Played Game*, Bernie DeKoven addresses the topic of the play community and its essential role in ensuring that a game is well-played. In contrasting a play community and a game community, he writes, “The nature of a play community is such that it embraces the players more than it directs us toward any particular game.” (DeKoven, 2013). Moses and Paul have been part of such a community more or less since they first met in 2007. The community of play they belong to is locally defined, in large part because it embraces both analog and digital games (the former requiring physical co-presence). Its membership has fluctuated over time, and at times it has intersected with other play communities, but it has retained at least three players at its core including Paul and Moses for the duration of its existence. Currently it consists of over a dozen members, although it is rare for all of the active members of the community to play a single game together at the same time.

Embracing players and supporting a mutual enjoyment of whatever games it takes up has been an unspoken rule of this play community, even though neither Moses nor Paul had read DeKoven’s work until roughly a year ago. This has led the community through a wide range of games across an array of platforms. The only genre of games the community hasn’t picked up directly is organized sports, although members of the community do intersect directly with the specific game community of the Mad Rollin’ Dolls flat track roller derby league. All of this is to say that Paul and Moses have always engaged in playful activities together with the sort of intentionality and willing attitude that DeKoven describes, and that their foray into both *Dark Souls* and LPs can be characterized in this manner.

Nested Play Communities

In the context of producing an LP of a single player game, the nature of both playing well and of the play community are fundamentally changed. Playing single player video games does not require active membership in a play community, although as James Paul Gee (2003) asserts, membership in an affinity group where practices of play are shared has long been a hallmark of video game play. In the context of our LP Prepare to Suffer with Paul & Mo, Moses and Paul have entered into a broader affinity space around *Dark Souls* that Moses has previously theorized as a nested community of practice (Wolfenstein, 2011) in that video games, LPs, and *Dark Souls* can all be considered as connected affinity spaces, some of which can be characterized as play communities. Considering both players and audience of an LP as members of a play community certainly squares with DeKoven’s construction of the idea, and furthermore Smith, Obrist, & Wright (2013) have specifically explored both performer and viewer as co-participants in streaming gameplay with each role benefiting from unique incentives.
While we cannot speak to the experience of any of the small number of viewers of our channel who are not us, we can speak to the composite play activity which is recording an LP of a game. There is no doubt that play in the context of an LP consists of both actual gameplay and commentating as Smith, Obrist, & Wright describe. In fact, Paul’s playful engagement with the activity is built almost entirely around engaging in speculative commentary, offering color, and in certain moments offering advice to Moses. However, by both explicit and tacit agreement between us, advice given by Paul has been extremely limited, as part of our mutual consideration of what makes a first playthrough of a game like Dark Souls well-played is severe gating around the player’s knowledge of what lies ahead, and limiting reliance on external sources for strategy and guidance except under relatively extreme conditions.

A Playthrough in Process

For these reasons at current Moses does not know how much of the game still lies ahead. For those familiar with Dark Souls, as of the last LP recording session the character Johnson (currently level 30) has returned to the Northern Undead Asylum where he found the Rusted Iron Ring, but was not prepared to take on the Stray Demon there. He is currently prepared to make a serious attempt at Blight Town. Although he has been largely unsuccessful in prior attempts, but Moses has leveled Johnson up and improved his pyromancy capabilities since the last serious attempt prior to the GLS conference. In addition, Paul and Moses have noted that the time Moses has spent playing Bloodborne (FromSoftware, 2015) has clearly transferred into increased skill in playing Dark Souls. That said, there is no guarantee that Moses will actually finish Dark Souls, as he may potentially quit the game in frustration, or “go hollow” to use the parlance of the broader Dark Souls community. However, Moses has shown perseverance in prior difficult games (Wolfenstein, 2012), and has in no way tired of the repeated deaths of his character Johnson. Paul believes that based on his progress thus far, Moses stands a reasonably good chance of completing the game.

Gating of information is one key characteristic that has gone into Paul and Moses’s consideration of this playthrough as well-played, but it is not the only one. Another essential consideration in the analysis of this particular playthrough of Dark Souls as a well-played game is the pacing of the play sessions. This has varied significantly from the manner in which video games are more commonly approached. Paul has hosted all play sessions, and the saved game that Moses is playing is attached to Paul’s Steam account. As such, we have met exclusively at Paul’s residence (with the exception of the sessions recorded live at GLS 11) and have played by and large once a week, usually on Thursdays. Moses has avoided purchasing a copy of Dark Souls for himself despite his deep excitement about the game, which has provided him with no additional opportunities to practice the game, and no chance of playing past the furthest point we have reached in recording Prepare to Suffer with Paul & Mo. As noted above, due to the release of Bloodborne, Moses has gained an opportunity to practice some of the core skills of the game since both games use a very similar control scheme, but they are also distinct, and the designed challenges of both the levels and boss fights are also by and large unique even if some general principles apply to both (e.g. locked strafing, conserving stamina, etc.).

Drunk Souls

Finally, we would be remiss if we did not note that one regular (although certainly not constant) feature of our local community of play is the consumption of alcoholic beverages, especially craft beer, while gaming. Our engagement with Dark Souls has not strayed from this tradition of our play practice, and while the significant majority of LP sessions have begun in a sober state, beer has consistently been consumed most evenings, and in some instances play has taken place in a mild to moderately intoxicated state. This has led to the impromptu labeling of some LP sessions as “Drunk Souls” when it becomes clear that the play, commentary, or both have become impacted by alcohol consumption. Perhaps needless to say, drinking while learning to play a game can impact both the learning curve and the performance.

A Record of Learning

We began recording “Prepare to Suffer with Paul & Mo” in mid September of 2014. We’ve recorded between one and six episodes on any given evening with a mean of 2.45 recordings. As of the submission of this paper for these proceedings, 36 of the 46 play sessions recorded between the start of the LP and early December have been posted to the “Prepare to Suffer with Paul & Mo” YouTube channel. 10 of the episodes recorded during that time were accidentally recorded without sound, and 1 was recorded without video. While one of the episodes without audio has subsequently been dubbed over and added to the channel, the other nine have been reserved for analysis and potential future use. In addition, Paul and Moses have continued to record LP sessions since then (although the recording schedule has been somewhat hampered due to scheduling), and have a this point recorded more than 96 episodes in total including two episodes recorded at GLS during the Well Played talk, and an additional
four recorded during an evening in late July.

At least prior to GLS 11, we have been the primary audience for our own LP as Paul remarked in one of the earlier episodes, and as we have discussed both when the microphone has been on, and when it has been off on numerous occasions. However, this in no way diminishes one of the key points of this particular paper in considering the value of an LP as a representation of a well-played game in relation to learning. Although we have only barely begun analyzing “the tape” with performance analysis conducted across the first 28 recordings, one thing that has become immediately evident is the manner in which this record serves as an opportunity to chart Moses’s progress in understanding the game systems of Dark Souls in terms of combat mechanics and strategies, the underlying models of the game as expressed through its statistical systems, and the geography and lore of Lordran.

In watching episodes of “Prepare to Suffer with Paul & Mo,” we have observed Moses make clear and distinct progress, and at times regress, over the course of play. Especially early on, the time delimited nature of play sessions contributed directly to back sliding between the end of one evening’s play, and the start of play the following week. In fact, Moses can in some instances be seen to regress and advance in his competency as a player over the course of a given evening, sometimes demonstrating less ability as the night progresses, sometimes improving steadily as the evening proceeds, and in still other instances alternately improving and declining in performance.

**Live at GLS 11**

The session at GLS 11 consisted of three parts. First we provided some minimal background on the topic of Dark Souls and engaged in an abbreviated review of the LP videos on YouTube, tracing Moses’s progress through the game thus far, and highlighting some key moments in his learning as he has negotiated the Kingdom of Lordran. Following this, we conducted a live recording of a new episode of “Prepare to Suffer with Paul & Mo.” To conclude the session, we opened up the room for discussion. Since we accidentally started the session half an hour early, we recorded an additional episode for the LP after our conversation with conference attendees.

In the session, we explored the details of Moses’s progress through Dark Souls up until the current point in the game. Topics discussed included: learning the controls, Dark Souls combat tactics, understanding the weapons system, and development of geographic awareness in Lordran. Particular attention was given to the dynamic of game discovery and what it meant for Paul and Moses to look at this LP as well-played through the lens of DeKoven’s The Well-Played Game, and in the context of their shared experiences with other games. One audience member also asked about more traditional narrative lenses for giving a game a close read. Paul noted that reading the literal narrative of Dark Souls is somewhat complex since there is very little direct exposition in the game, with the story embedded instead in item descriptions, snippets of optional dialogue, and the character of the environment itself. We also provided an example of how Paul provides a soft form of coaching during play, pointing to this sort of game-play as a type of distributed cognitive activity. Paul suggested that Moses explore the area around Firelink Shrine for a potential path back to the Northern Undead Asylum, primarily because the lighting in the theater made it somewhat difficult to make out key details in some of the darker areas in the game like Blight Town, but also because he recognized an opportunity for this form of exploration that Moses might otherwise not have stumbled upon.

**The Suffering Continues**

We have had the opportunity for one additional recording session since GLS 11 but prior to the submission of this proceedings paper. Over the course of that session, Paul provided Moses with a few additional key hints that helped him find his way back to the Northern Undead Asylum, but there was inadequate time and energy that particular evening for a further attempt at Blight Town. However, we intend to resume play and recording at the earliest opportunity as the summer progresses, and neither of us have any intention at this point in time in turning from the challenge of joyously suffering through this play experience.

As an addendum, it is worth noting that our live recording session and conference talk at GLS 11 seems to have had some unanticipated consequences. On the one hand, “Prepare to Suffer with Paul & Mo” went from seven subscribers to 13 after the conference. Individual videos have also seen a spike in viewership at the time of and since the conference in excess of the numbers that the subscription increase might indicate. Perhaps more interestingly, Paul ran into one of the session attendees since the conference and was informed that our session inspired this conference attendee to start a let’s play of their own. We find this last phenomena particularly interesting in that we believe it unlikely that the existence of our LP in its own right would have been likely to inspire anyone to make one of their own. Rather, there seems to have been something transformative about the practice of giving a Well Played talk that reframed what the activity of doing an LP might be like, at least for this individual. We can hardly think of a more gratifying result of playing a game and recording an LP than inspiring others to participate.
in this same playful activity.

**References**


Working Examples
Teaching Bad Apples
Anthony Betrus, SUNY Potsdam
Nate Turcotte, Penn State University
Matt Leifeld, SUNY Potsdam

http://www.workingexamples.org/example/show/712

https://www.thegamecrafter.com/games/teaching-bad-apples

Seed

Tell us about your idea or project. What’s your vision?

Teaching Bad Apples is a game developed in 2014 for current and future teachers. It plays much like Apples to Apples or Cards against Humanity, with each player in turn reading a situation card, followed by the other players choosing their response cards. Each situation, however dramatic or bizarre, is authentic, obtained through crowd-sourcing, social media, and online teacher forums. After many play tests, including feedback from practicing teachers and teacher educators, we concluded that the most effective way to teach people to deal with these dicey situations is to have players provide wildly inappropriate responses to the authentic situations, and then in the debriefing talk about “what you would really do.” Effectively the game teaches by counterexample, and by making light of these situations it breaks down conversation barriers, and then gets into authentic and appropriate reactions.

What problem are you trying to solve and why does it matter?

Teaching Bad Apples, originally named Teach Me To Teach, began as a simple card game meant for teachers, both current and future. It started at a conference, where a few instructional designers got together, and someone brought along a deck of Microsoft product playing cards for show and tell. A spontaneous play session broke out, and each person took turns proposing something hypothetical to teach, while the others matched their product cards with the thing to be taught. While this might sound to the average citizen like something they might encounter in Dante’s 8th circle of hell, it was, surprisingly, and despite the fact that we only had Microsoft cards, actually quite fun. So at the end of the session we concluded that if we can make Microsoft Product cards fun, certainly we can come up with a similar game that is broader, more educational, and more fun. So a prototype was created, followed by multiple iterations of the game, ending up with the finished product one year later.

In this first version of the game, we stuck to the “teaching cards” and “method cards” vision. Most content cards were vanilla, like, “Teach students how to formulate a hypothesis,” or, “Graph a linear equation.” Similarly, most
method cards were equally appropriate and vanilla, like, “Use an instructional video,” or, “Craft a motivational lecture.” After the first playthrough, and just for laughs, we added in a few offbeat cards to the mix, such as a content card that read, “Teach your colleague how to clear porn off his classroom computer,” and a method card that read, “Watch your mother do it.” We even toyed with “wild cards,” that modified what was to be taught, like, “While skydiving from 15,000 feet,” or, “With a ticking bomb next to you with a 1-minute timer.” This spiced up the game, yet potentially at the expense of some educational value.

Fortunately, during an early playthrough, we happened to have at the table a former state teacher of the year, and she was very helpful and supportive. Her suggestion was simple, yet profound: get rid of the boring cards, and keep the fun cards. This turned things upside down for us, and freed up the creative process. We started coming up with more and more outrageous content and method cards, and as we did, we started to realize that many outrageous situations that we had encountered ourselves could not really be classified as “content.” Similarly, the wildly inappropriate methods we were coming up could only, and with a very liberal interpretation, be considered teaching “methods.”

For example, when discussing crazy school situations we each had encountered, one of the teachers was describing a time when she chaperoned a senior trip, and she smelled marijuana coming from a student’s room. We used this example on a card, but it really was more of a “situation” to react to, rather than content to be taught (although as you’ll see below, we ultimately did allow for this to be a “teachable moment” as well). Similarly, some of the tongue-in-cheek method cards we were coming up with to react to these situations, such as, “Lower your expectations,” or, “Watch Reefer Madness with them,” could only loosely be considered teaching methods, and really fell under the broader category of “responses.” From a theoretical point of view, you might say we broadened our scope beyond the traditional field of educational technology, where solutions are often instructional, to performance technology, where problems can be solved in a variety of ways.

So, after a few more playtests (Figures 1, Figure 2), we continued culling the boring cards, while keeping and adding more fun cards. We decided that in order for this to maintain its educational value, the situations needed to be authentic. In a debriefing after one particularly raucous playtest, we looked back and reflected that everyone had a fantastic time, and that spontaneous conversations were happening on an almost continuous basis, with everyone sharing their stories. And while the response cards we played during the session were without question nothing we would ever actually do, we almost always followed up with a, “Well, this is what I really did,” or, “This is what I should have done,” or, “I couldn’t get away with that today; you’d have to do it this way now,” and so on. It worked shockingly well, and in the end this sort of “teach by counterexample” approach stuck.

Figure 1.
Future Plans

It seems that there is a never ending flow of situations that teachers find themselves in, so our first expansion will be additional situations, along with some additional inappropriate responses. We will continue to crowdsourcethe situations, and coming up with inappropriate responses is surprisingly easy, as all you have to do is to write down the inner thoughts and fantasies about what you would want do, if only you could.

In addition to expanding the existing game, when we have shown the game to non-teachers, we often get feedback that this method (authentic situations, followed by counterexample style responses), is a suitable for a wide variety of other professions. One example in particular involved athletic counselors in a Division 1 college football program, where they are now creating a parallel game that helps their players explore ethically difficult situations, and how they should respond to them. Situations like, “A young co-ed admirer is aware that you are likely to be taken in next year’s NFL draft, and she wants you to get her pregnant,” are followed with response cards that explore all of the things the player definitely should NOT do, and then a discussion of what they really should do.

Bloom

You did it, your project has bloomed! How did it turn out? Tell us about your final product or result.

So far, so good. Our long development process and multiple iterations seems to have paid off. Everybody who plays it really likes it, and sees both the entertainment and educational value. Our team (Nathaniel Turcotte, Matt Leifeld, and myself) is looking to market the game, as well as develop an expansion pack and a mobile app next.

What conclusions can you make and why do they matter?

Keys were:

- The scenarios need to authentic, so the core of the game is “real.”
- The responses to the scenarios need to be outlandish, to make it fun.
- If you want learning to occur, a simple debriefing that asks the question, “What would you really do?” is all that is needed after each hand.

Tell us about some of your successes. What can the WEx community learn from them?

1. Iterations are critical.
2. Don’t get married to your original idea; our game morphed multiple times.
3. Teamwork is important, we had a good core team working together and for each other.
4. Listen to your playtesters’ feedback; they were critical.
5. Never stop having fun with it, and be enthusiastic about what you make. How YOU perceive the game will rub off on others.

What were some of your big challenges and how did you handle them?

The biggest challenge was how to have fun and make it educational. By teaching through counterexample, we think we have come up with a formula that works.

Reflecting back, what did you learn along the way? What would you do differently?

We would have not been so afraid to make it “fun first” from the outset. We got there, eventually, after much wheel-spinning. Once we “let it go” and went for all out fun, we found the learning followed.

So what’s next? How are you making sure your work reaches people and is adopted?

This is where we are hoping to network and develop partnerships.

Looking forward, what kind of impact do you think your work will have? How might it continue to evolve?

We hope it will be used in schools of education around the country to arm pre-service teachers with foreknowledge of some of the crazy scenarios they will encounter as teachers. And we really hope teachers use it, if for nothing else than for off-line fun with colleagues.
The Tenacity project set forth to explore how digital media can foster the self-regulation of attention and to measure how this practice impacts the mind. Doing so required developing an interdisciplinary team of meditation experts and neuroscientists at the Center for Investigating Healthy Minds (Richard Davidson, Director) and game designers and learning scientists at the Games+Learning+Society Center (Constance Steinkuehler and Kurt Squire, Directors). Together we created Tenacity, a breath counting app for the iPad to train the self-regulation of attention. Breath counting is a traditional practice of focused attention meditation. Specifically, focused attention meditation involves voluntarily directing one’s attention towards a specific object for a sustained amount of time and returning attention to the object when distractions divert attention away (Lutz, Slagter, Dunne, & Davidson, 2008).

In Tenacity the player is instructed to focus specifically on their breath, counting each exhale by tapping the touch screen with one finger for the first four breaths and tapping with two fingers for the fifth. This breath cycle (tapping to count five breaths) is represented back to the player on the screen with visual feedback for each tap and accuracy feedback at the end of a breath cycle. Utilizing the audiovisual capabilities of the iPad, players can complete the
breath counting exercise in their choice of 7 scenario levels for a variable amount of time (5, 10, 15, or 20 minutes) and variable levels of difficulty (count to 5, 10, 15, or 20 breaths) (see Figure 1). These scenario levels include a tutorial level, two positive reward levels and four distractor levels. Tutorials levels provide instructional support for how to play Tenacity. Positive reward levels (Greek Ruins & Egyptian Ruins) present the player with flowers that slowly grow from the ground when the player accurately completes a breath cycle. In distractor levels (High Altitude, Low Altitude, Near Earth and Outer Space) audiovisual stimuli fly across the screen at predetermined time intervals independent of the player’s actions. These positive rewards and distractions provide manipulations of interest for assessing how gamification elements may affect behavior in the practice of focused attention meditation.

Figure 1: Tenacity menu screen (left) and Greek Ruins scenario screen shot (right).

What problem are you trying to solve and why does it matter

Recent research has shown that increasing self-regulation skills is associated with a wide array of beneficial outcomes. Above and beyond the impact of intelligence and socioeconomic status, attributes of self-control measured in childhood are significant predictors of greater physical health and financial stability, and reduced substance abuse and criminal activity in adulthood (Moffit et al, 2011). Thus, efforts to increase skills of self-regulation, especially in childhood, hold the potential to have a positive impact on many dimensions of wellbeing. Furthermore, neuroscience research has shown that training interventions using traditional attention regulation strategies such as meditation or modern approaches such as games, can enhance skills of self regulation and these changes are associated with measurable differences in attention networks of the brain. In light of these findings the Tenacity project was created to extend the empirical understanding of how these interventions impact mental well being by creating a training app based on mindfulness meditation practices for children and adults to cultivate their self-regulation of attention capacities.

Many digital products are advertised for their cognitive benefits or brain-based design, however these products often lack the theoretical foundation and empirical evidence necessary to support these claims. These marketing strategies can mislead parents and children while diminishing the standard for research-based products. In contrast, the Tenacity project exemplifies a higher standard of research and development where neuroscience theory, methodology, and data are fundamental elements of the iterative design process. User testing can provide great insights for developing a clean and engaging game, but knowing how design choices affect the mental health of the user requires identifying behavioral changes and measuring the underlying neural mechanisms through careful experimentation. Neuroscience thus provides robust techniques for research and development teams to determine if and how their products lead to their desired effects. However, very few projects have successfully carried out this interdisciplinary practice. To this end, the Tenacity project is exploring the exciting space where user game play is combined with neuroscience research to inform the iterative design of games for impact.

The nature of this interdisciplinary work is exciting and groundbreaking, but creating an engaging digital experience that stays true to the practice of meditation comes with its own challenges. Unlike most games and digital applications, the goal of meditation is not easily mapped to standard "win" states common to games. Practicing mindfulness is, in a way, orthogonal to the idea of earning a high score or beating a boss monster. Rather, the goal here is to let go of the win state itself and instead become more self-aware and thus master not the game system but your own mind. As such, designing Tenacity is an effort to solve this design challenge.

What are your goals and how will you know if you’ve achieved them?
At the heart of the Tenacity project is the goal of creating a powerful experience grounded in rigorous empirical research to improve mental wellbeing and the self-regulation of attention. Meeting this goal required developing an interdisciplinary team to integrate neuroscience, meditation, and game design. Motivations and concerns can diverge across these fields bringing challenges to solve through collaboration and compromise. Thus, from a methodological perspective our goal is to create an effective team that appreciates each other’s individual goals in the process of working together. For instance, from a design perspective the goal is to represent attention training through an engaging experience that users enjoy. From a meditation expert's perspective the design must also stay true to the traditional practices of mindfulness. From a research perspective the goal is to discern if and how focused attention training with the app leads to behavioral and neural changes through experimental control and a reliable treatment. During the iterative process of research and design our team has evolved to understand how the goals of designers, meditation experts, and researchers should be balanced to promote the successful training of focused attention.

We can measure the quality of the user’s experience by examining changes in performance inside and outside the game and the mind. If Tenacity indeed trains focused attention, we expect to see this in the gameplay data. A simple measure of attention is the player’s success during a breath cycle. We predict that with successful training, individuals should become more accurate overall and be able to sustain their attention for more accurate breath cycles in a row. Likewise, we predict that individuals should become less susceptible to distractions and accuracy in the presence of distractions should increase as individuals learn to efficiently return their attention back onto their breathing as a point of focus.

More importantly, our goal is for the benefits of training with Tenacity to transfer towards demands of attention outside of the app. Whether the player is a student, a teacher, a construction worker, or a nurse, attention is a domain-general ability underlying countless tasks in the world. The ability to focus attention inwards enables individuals to become aware of their mental and physical states, thus supporting the regulation of emotion and interpersonal communication. Evaluating our progress towards this goal requires external measures of attention and the underlying cognitive mechanisms. Together with Dr. Richie Davidson and researchers at the Center for Investigating Healthy Minds, we invited adolescents in the Madison area to enroll in a pre-post fMRI study. Before and after a two week play session, players completed experimental tasks inside and outside of the scanner. These tasks took the form of standardized tests and computer-based experiments completed during an fMRI scan. As with gameplay data, we predict that a successful self-regulation of attention app should promote long-term improvements in these external measures along with biological changes in brain structure, function, and connectivity associated with attention and cognitive control.

It is important to note that improving attention is not a short-term achievement gained by a single play session, but rather it is a gradual process relying on consistent effort. Therefore, results from this initial study provide evidence of the emerging effects brought on by training with Tenacity, and only hint at the long-term effects that may develop through persistent engagement. In order to meet these long-term goals, it becomes all the more important to design an engaging, relaxing, and useful application. Individuals interested in meditation can do so without the aid of an iPad. Therefore, in designing the Tenacity interface, our goal is to heighten meditational exercises with scaffolding instructions for beginners, graphic feedback to track progress, settings to increase difficulty, and a selection of content-relevant digital environments for players to engage within. We know that we are on our way to meeting this goal from the positive reaction we have received from some of our players, yet there are still drawbacks that we want to address in order to develop a fun experience that is more widely embraced - particularly for younger kids.

Sprout

What interesting patterns or insights have you discovered?

In our primary assessment of Tenacity, we gave a group of adolescent boys and girls access to the app and asked them use the app for at least 20 minutes a day for two weeks. While most of the teens complied with the instructions, some clearly became disengaged. The Tenacity interface relies heavily on the user to embrace the practice of meditation and truthfully record their breaths, but for some of our adolescent players, this was not the case. Without the internal desire to practice meditation, it is much easier to succeed in the app by simply tapping to win without attending to one’s breath. Thus the achievements designed to reward active participation may have provided off task motivation to game the system. Evidence of these behaviors is most easily seen when breath taps are recorded far more quickly than it is physically possible to breathe. From a research perspective, this tap-to-win strategy generates unreliable data that is difficult to distinguish from genuine breath counting. Recognizing this strategy prompted us to remove breath cycle data points that fell far outside of typical respiration and identify the players who most prominently used this cheating strategy. As a result, we were able to analyze the remaining data with greater confidence that it represented valid breath counting.
Even after this data cleaning, the results did not come out the way we expected. For instance, we expected experience practicing with Tenacity to be associated with greater breath cycle accuracy. While accuracy did increase over the two weeks for a portion of players, accuracy decreased for a complementary number of players, and the rest showed no change. Across the group, breath cycle accuracy was high both before and after training. As a result the group mean accuracy was not significantly higher after the two-week intervention. This was consistent with the data from the distractor levels. Specifically, practicing within distractor levels was not associated with increases in breath cycle accuracy. From these results, we have drawn two conclusions. First, in line with the issue we identified where some players were more interested in tapping to win than practicing the exercises, it is impossible to know which players carried out these cheating strategies but did so in a way that appeared to be valid. Future data collection needs an external observation of player behavior and breathing to validate their in-game performance. Second, and equally important to interpreting our results, breath cycle accuracy was near ceiling during the first 30 minutes of game play. Therefore, if a player’s capacity to self regulate attention increased through practice, comparing breath cycle accuracy before and after training may not be a sensitive enough measure to identify these effects. To address these ceiling effects, it will be important to design more difficult challenges and more distracting distractors. Doing so stands to improve the variability in the data generated from app as a research tool and hopefully increase player interest by introducing a more compelling challenge to master.

Have your initial concepts/designs changed? Why have they changed? Show us how they’re being refined and iterated.

The initial design efforts involved finding the most appropriate representation of breath counting to act as an attention training exercise as well as an engaging digital experience. Practices of focused attention meditation are simple and often carried out with little more than the mind and a point of focus, therefore every element of gamification seemed to disrupt the simplicity that our meditation experts hoped to maintain. Standard design elements that make a game engaging were, over repeated iteration in this project, reined in or stripped out entirely so as to stay true to the main “verb” within the game – self-regulation of one’s attention rather than seduction by a well-designed and “sticky” digital stimulus. Once our builds reached the hands of our adolescent participants, however, engagement was fairly lackluster. Even when we rebranded the builds as “gamified apps” with an achievement system but no core game mechanics per se, our target audience of teen- and tween-agers wanted something more recognizable, engaging, and sticky. Our newest build of Tenacity, now titled Zenjuvo, aims to address these critiques by introducing more challenges and player options that increase difficulty and personalize the experience. For example, in Tenacity players could tap anywhere on the screen to count each breath, whereas in Zenjuvo players must tap on active visual elements on the touch screen (see Figure 2). In the Koi Pond scenario, players count each breath by tapping a Koi fish swimming across the screen, while also monitoring distractors (dragonflies, flowers, or bubbles) to earn achievements. By increasing the ways in which the player directly interacts with the app, we hope to increase the player’s motivation to actively participate in the targeted training exercises. This example illustrates how our initial conservative design approach has broadened to embrace more of the features that we love about games and digital apps. Effective training will still rely on the player’s intrinsic motivation to complete the exercises, but providing a more compelling and fun environment will hopefully invite more individuals to try the app and enjoy the experience.

Figure 2: Zenjuvo menu screen with new challenges and options (left) and Calming Koi Pond scenario screen shot (right).
How will you make sure that this thing you’re creating will be adopted by your audience?

Developing the Tenacity app for the right audience has involved reconceptualizing whom our target audience is. Theoretically, the practice of focused attention meditation can have beneficial effects for all ages. Driven by the goal of providing the greatest impact in an important population, our initial design efforts were directed towards adolescent boys and girls. However, our experience working with this unique population has shown us that warping a mindfulness product to fit a disinterested population is not the most efficient way to create an extraordinary app. For instance, the ideal experience to train the self-regulation of attention may be fundamentally different across ages. Based on our research data with adolescents, we modified Tenacity’s breath-counting exercises in our current build, Zenjuvo, to increase the challenges, enrich the user feedback, and motivate valid participation. These updates stand to enhance the experience for an ideal audience of individuals who are eager to become more mindful. However, these updates may not change how some children and adolescents find mindfulness practices fundamentally disinteresting. Inspiring younger populations to practice focused attention training will likely require a completely new approach that frames the traditional mindfulness exercises within more modern gaming elements such as social media integration, multiplayer competition, or a role playing narrative. Furthermore, we hope that testing Zenjuvo with an adult population will illuminate the elements of our current design that successfully maintain interest and strengthen the app as effective intervention tool.

References


New Game Design Curricula for Underserved Youth in Multiple Settings

Mark Chen, Pepperdine University
Victoria Stay, Pepperdine University

Abstract: This Working Example documents the ongoing effort to introduce narrative-focused game creation to underserved youth across multiple settings in South and Downtown L.A. Becoming expert in playing and making games requires learning processes for recognizing patterns in initially noisy systems, leading to agency within the designed systems and hopefully life in general with the proper scaffolding. Creating games serve as creative outlets for storytelling and sharing voices, leading to empathy. Increasing these two things—agency and empathy—are at the heart of our efforts in collaboration with our partners to reach diverse learners. We introduced learners to a number of game engines, often starting with Twine, a text-based Choose-Your-Own-Adventure style game creator but also including the more advanced 3D game creation engine, Unity 5, and others. Each setting had specific goals and served a particular audience.

Keywords: game design, classroom implementation, game narrative, curriculum & instruction, informal learning

![Diagram of a flowchart]

Figure 1: [http://www.workingexamples.org/example/show/703](http://www.workingexamples.org/example/show/703).

This Working Example documents the processes of finding and recruiting partner schools and organizations, identifying setting-specific needs, developing new game design curricula for each setting, recruiting local game developers to help out, planning event dates, adapting to shifting schedules, reporting to higher-ups in a home institution on activities that are invisible until an event occurs, and managing all of these moving, overlapping pieces… all while relocating to and then making a conscious decision to get around by bus in L.A.

Seed

Tell us about your idea or project. What’s your vision?

The Pepperdine Gameful Design Lab’s ([http://gamefuldesignlab.com/](http://gamefuldesignlab.com/)) mission is to increase learning and engagement by raising gaming literacy among the general populace with particular emphasis on serving those who are historically marginalized by our societal structures.
When we decided on this, our initial idea was to host a game jam weekend for underserved youth in L.A. Our task then was to determine who in L.A. to work with. After several meetings with leaders from a variety of local organizations, we decided to target homeless youth by working with a local non-profit that provides services to youth in homeless shelters. To ensure a successful event, however, we also decided to recruit local game developers to provide feedback and mentoring opportunities for participants. We also decided to work with a local charter school in designing and testing out a mini-unit on game design that we could rework as a one-day workshop for the homeless youth. One connection led to another, and we eventually snowballed into offering multiple game design curriculum support for a variety of formal and informal settings.

**What problem are you trying to solve and why does it matter?**

The Gameful Design Lab focuses on helping players develop a playful attitude towards lifelong learning. This includes instilling an attitude of bravery, a willingness to try and try again, and the wherewithal to be reflective and critical about their own and others’ actions and situations. When we play, we are constantly thinking of how things "should" be and trying things out over and over again for continual improvement. When we play, we aren’t afraid to fail because we know it’s the fastest way to learn. When we play, we are always pushing ourselves to try on new roles and see the world from a different perspective. When we play, we understand. I.e., we see games as leading to agency in life’s systems and as good vehicles for sharing one’s voice. Thus we want to help those most in need to gain gaming literacy.

**Who will your work impact? What do you know about them?**

We are currently working with four different organizations:

- a local nonprofit that provides school services to youth at homeless shelters;
- a local charter school with an emphasis on communications and serving part-time homeschooled youth;
- a local nonprofit that hosts an after-school hackerspace for South L.A. high school students;
- a relatively big charter school network in Southern California.

Each of these settings poses different challenges for introducing game design to the students they serve.

**What challenges might pop up?**

Due to our initial plan on working with homeless, we opted for an easy-to-use text-based game creation tool called Twine. This allows us to concentrate on getting youth stories and voices heard and allow them early successes by minimizing the chances of getting bogged down with coding. The students could concentrate on the structure of their stories and implement ideas rapidly without worrying too much about programming syntax, etc.

Twine, of course, introduces other requirements of its designers. It can be just as intimidating to write prose as it is to program a game object. Thus we decided to work closely with teachers and other educators in each of these settings to provide custom curricula to meet the needs of their particular students.

**Addendum**

The above submission was written in the beginning of 2015. This addendum is a status report and summary of events as of late June 2015, half a year later.

This is the new list of collaborators:

- a local charter school with an emphasis on communications and serving part-time homeschooled youth;
- a local nonprofit that hosts an after-school hackerspace for South L.A. high school students;
- a new group that plans on hosting tabletop game jams in L.A.;
- a relatively big charter school network in Southern California (to follow up on);
- a nonprofit that serves homeless shelters in Santa Monica.
We were all set to work with a local L.A. nonprofit that serves homeless shelters in providing schooling to homeless youth. They were to be our coordinator and conduit for scheduling game jams at South and Downtown L.A. shelters. Unfortunately, the realities of nonprofits often being over capacity and understaffed hit us hard, and we could not schedule any game jams before the school year ended. We did, however, sort of serendipitously manage to connect and collaborate with multiple other institutions and settings during the spring.

In preparation for the game jams for homeless students, we decided that we wanted mentors for the youth and thus reached out to a local indie game collective and several game companies in the area to volunteer. This was relatively successful, and those connections should be stable enough should we eventually hold events that need mentors from industry.

We also partnered up with a local charter school, working with 9th and 10th grade teachers on new game design curricula. The intent was to also recruit from their students peer mentors for the homeless students, who we thought would be middle schoolers. As it happens, the high school had some curricular needs that the teachers were actively seeking to satisfy when we met, and it became clear that new game design units across all of the concurrent 10th grade courses could help address many of their issues.

The English teacher was able to extend a previous short story writing unit with one that had her students create optional scenes and alternate endings for their stories. These were then put together during their CS course using Twine, a text-based game medium. Even the students' chemistry course overlapped, as the teacher introduced students to flowcharts and procedures for conducting experiments, and Twine’s main interface is akin to a flowchart or map of game states. All of this helped reinforce and complement planned curricula. For English and chemistry, the game design built upon concepts covered in the previous units, and, in CS, Twine served as a good introduction to logic, HTML, stylesheets, variable manipulation, etc.

It was obvious that this was something larger than initially planned, that introducing game design to this high school was not just a way to cultivate mentors for the future game jams. We now plan a multi-year study, refining and evaluating game design as integral parts of their existing curricula.

In addition to working with this local high school, the Gameful Design Lab also collaborated with another local non-profit to bring Unity 5 into its afterschool hacker space. A 12-week summer studio is under way where urban high school boys are engaged in app creation and game creation using Unity with intent to publish online and submit games to official distribution platforms.

Right as things were falling apart with the homeless shelters, a new opportunity came up with a new group to hold the L.A. Board Game Jam during a game convention near LAX for convention goers. While not specifically targeted towards the same intended audience, we were able to help sponsor the jam and make connections for future collaborations and mentorships.

Furthermore, during the L.A. Board Game Jam, we met up with someone who works at another nonprofit that happens to serve homeless shelters in Santa Monica! This person has a shared affinity for games, so hopefully this relationship will be a little more stable. We are now planning game jams and game design projects to increase awareness and empathy.

Throughout the spring, probably the most notable lesson we learned is how much time it takes to cultivate relationships and form connections with other groups. Coordinating between groups and trying to serve as the bridge between them is time consuming! (This is magnified by L.A.’s infrastructure as a very unfriendly city for someone who doesn’t own a car.) Also, it pays to cast a wide net and then follow up with anyone that indicates even a modicum of interest, though maybe we felt the power of this more acutely because the Gameful Design Lab was in its inaugural year.

The time it takes to build a network was unfortunately invisible to the Gameful Design Lab’s home institution, and as a consequence we felt a lot of pressure to have something tangible during the year to showcase our efforts. Whether we accomplished this (we participated in a multiple other projects besides the game design for underserved youth one) to the satisfaction of higher ups is yet to be seen, but it’d be a shame to be unsupported in continuing our current projects and capitalizing on all the work that’s gone into making broad network connections.

A copy of the presentation slides is archived at https://goo.gl/u5v2G8.
Alice in Arealand focuses on teaching and assessing geometric measurement, specifically the development of a deep understanding of the concept of area. The key challenge for the game is to simultaneously (a) be engaging, (b) scaffold students through a research-based learning progression, and (c) gather evidence for the creation of assessment models that indicate whether students have mastered the stages of that progression.

Seed

Tell us about your idea or project. What’s your vision?

While recent years have seen the development of excellent games for learning, very often these games are isolated from the rest of classroom activity. Even if a teacher draws on references to the game in a lesson, it is often unclear how the lessons of game play fit into the rest of the curriculum. Certainly data from students’ game play is rarely integrated with data from other student work to inform us about mastery of skills and knowledge.

Alice in Arealand is meant to be one piece of an integrated system of learning and assessment. The activities in the system are theoretically integrated through a common learning progression. This framework that lays out the major stages in the development of the skill will be carried across the game, other digital performance tasks, and in-person classroom activities. The activities will then be quantitatively integrated through data collected from each and aggregated together, leading to estimates of student mastery at each stage of the progression.

What problem are you trying to solve and why does it matter?

Alice in Arealand focuses on teaching and assessing geometric measurement, specifically the understanding of area. Many curricula and classes still focus on teaching the formula area = \text{length} \times \text{width}. However, students miss the significance of what the resulting number indicates, namely the number of square units that can fill the space. New common core math standards emphasize the understanding of area, not just the rote calculation of the formula, but few resources exist with which to teach and reinforce these concepts.

The game specifically targets three main stages in the development of area.

1. Area Unit Iteration—This stage emphasizes the understanding that a space can be filled with smaller unit squares placed end-to-end in non-overlapping fashion.
2. Use of Unit Squares to Measure Area—In this stage, learners perceive 2D shapes as collections of single area units and use those units to reason about area. Area would typically be computed by counting the number of squares in the area.
3. Use of Composites to Measure Area—Learners perceive 2D shapes as collections of area composites and use two-level composites to reason about area. For example, a learner would combine the single squares into rows or columns, and then determining the number of rows or columns needed.

The key challenge for the game is to simultaneously (a) be engaging, (b) scaffold students through the above progression, and (c) gather evidence for the creation of assessment models that indicate whether students have mastered the stages of the progression.

Tell us about the team you have assembled or hope to assemble.

The team was brought together with the understanding that a multidisciplinary approach was crucial to addressing
our challenge. The team includes:

- Experts in the application of Evidence-Centered Design in assessment (particularly the identification and aggregation of evidence from digital environments) from Pearson
- Math education experts who have been involved in the creation of both math curricula and formative assessments from Pearson
- Veteran videogame experts with combined 40+ years of game design experience from GlassLab and Crowell Interactive

The collaboration of these three different approaches would be key to the project and requires substantial work in developing a common language and common conceptions. The process of design of a game that is both a learning and assessment tool requires much push and pull from the three perspectives to deliver on the three pillars of Engagement, Learning, and Assessment.

**Sprout**

**Tell us about your process and how your idea is evolving throughout the project.**

In general, the project followed an Evidence Centered game Design process (ECgD; Mislevy et al., 2014). ECgD seeks to combine the assessment argument development process of ECD with agile development methods common in game development.

Development began with a focus on the concepts to be addressed. With a solid grounding in the stages of the progression, initial tasks were developed in which game mechanics were aligned to the major concepts of each stage. Iterations of development included:

- A first iteration of paper prototypes was tested with a group of learners in an informal environment
- A second round of individual play testing conducted in a usability lab
- A third round of testing was conducted in three classrooms, and
- A fourth round of testing was conducted in six classrooms.

The early rounds focused on ensuring that ideas being generated were engaging for learners and also required use of the desired skills. The latter was accomplished through use of think-aloud protocols, which were monitored for both mathematical reasoning and evidence of engagement.

From an engagement perspective, in the early rounds we had to gain understanding of exactly what the curriculum was going to be, and where it fit into the larger arc of mathematics. The game designers approached the problem as they would a media based brand such as Indiana Jones or NASCAR, with constraints particular to such. In the case of Indiana Jones for example, clearly there would need to be fisticuffs and puzzle solving. In the case of the geometry curriculum, we would need to have students work with geometric shapes. No fisticuffs, but definitely puzzles. Then we needed to develop a progression of interactions that would match the learning progression and ask the students to exercise their understanding of those concepts.

Once we had some sense of the kinds of activities, we thought about how to wrap that learning progression inside a narrative that gave meaning to the activities. Using narrative to engage learners is a tactic as old as Aesop. At first, we planned to have the player imagine themselves to be present in the world, taking part in the adventure much as a reader of a storybook feels immersed in the imaginary world.

**What are some of your initial concepts or designs? We’d love to see them.**

Initial designs began with tangrams, given that the main component of the tangram task is to decompose shapes into component parts. We found the concept of Tangrams to be a great storytelling device that required the player to think in terms of geometric shapes (Figure 1). Each Tangram would be the solution to some situation that blocked game progress, so the player would be rewarded by being clever, creating interesting constructions, and unlocking the next area of gameplay. We also hoped to change the way the players viewed the world around them, seeing geometry at work in the real world objects all around them.
In order to bring in additional stages, we also started to develop the idea of an economy of shapes. Players began with a set inventory of larger shapes and then could “trade” for smaller shapes by stating the correct number of smaller shapes they should receive. So, a player could trade in a 3x3 square for individual square units by indicating they should get 9 1x1 squares in return.

Have your initial concepts/designs changed? Why have they changed? Show us how they’re being refined and iterated.

We tested this initial idea with a paper prototype (created by cutting a LOT of shapes!). In listening to students and the facilitator, it became clear that the concepts we were targeting were most apparent when the facilitator was working with the player to conduct a trade. While the composition and decomposition of the shape was engaging, it was not eliciting the concepts of area units and composition with square units that the trading encouraged.

We discussed examples of stories that had solving puzzles at their core. Doctor Doolittle and Alice in Wonderland were two models that came up repeatedly. We decided to combine the best parts of both of those, with a pinch of Wizard of Oz thrown in.

The world was designed to be a flat 2D universe, with the built in limits of such. The inhabitants of that world would be bound to a flat plane, but our player, being from a 3D world, could view their world and take actions that the flat folk could not. This concept bestowed “super powers” on our players, who could use their knowledge of Geometry to solve the flat world’s problems.

The choice of Alice as the protagonist was based on our desire to give the student someone they could relate to, and to create a sense of “helping a friend”. This would hopefully inspire them to pay closer attention and think harder about solving the challenges that blocked their friend’s progress. Help that only they, as smart people from a 3D world, could deliver.

We knew we would need to allow players to perform transformative actions such as gluing pieces together to construct larger compound shapes. We wanted to keep the fantastical nature of the world, and so created living creatures called “Goggles” (for their goggle eyes). Each Goggle has a personality, and does one kind of Action (Figure 3).

- Gluumi was a sad blob who could glue shapes together
- Esploda was an excitable bundle of dynamite who blew compound shapes back into single units.
Multy came along later, as a nerdy multiplication symbol who made copies of shapes.

And finally, we added Flat Cat as a kind of Cheshire Cat companion for Alice. We needed to have another voice in the game to give feedback to the player, and to help push the story. His role turned into (like R2D2 or Alfred the butler) the humorous sidekick to Alice’s straight man, who also knows more than he is saying.

Next began work on detailed design where the push and pull between learning, assessment, and engagement demands can become difficult. A key insight for the game designer was that focusing solutions on using the targeted concepts is important, as learning the concept is the goal, not simply completing the challenge in any way possible.

The mechanism developed to get from the idea of combining individual square units to combining rows and columns was the Goggle Multy. Multy makes copies of the shape indicated by a player. The idea is that a less-advanced player would use Multy to make copies of individual squares and combine them while a more-advanced player would combine a few individual squares into a row or column and then copy that. In this way, evidence, which requires observing player choice, could be gathered from game play actions.

Play testing revealed that, from an evidence perspective, this worked. 48 students played the level depicted below. 8 of them combined the four squares and then multiplied them twice, indicating understanding of using composites to reason about area. 21 players made eight individual copies and then combined the individual squares. The remainder did a combination of these approaches (which we might interpret as behavior indicating they were beginning to develop the concept of composites for area but had not mastered it yet).

However, it was not clear that players understood they could use Multy on combination shapes. It was possible our evidence was not indicating a lack of math reasoning, but a lack of game play skill. In addition, we were not just interested in creating an assessment, but also a learning environment.
We began discussing how to add a level prior to this level to support the use of Multy on combinations (the first level where Multy appears only required a 1x4 construction) (Figure 5). The team discussed creating a level where Multy was not available for use until a row or column was constructed, then only limited uses of Multy would be available, requiring only the correct number of rows or columns were copied. In addition, the characters for combining and breaking apart would be disabled.

This seemed like a good solution for leading the player to the understanding of the Multy solution aligned to using composites for area and the most efficient solution. However, on further reflection, the game designers realized that without any choice, the game is really not much different than watching a tutorial. The assessment designers realized that without choice there was no evidence to gather. The realization that both approaches had led to the same conclusion was an important moment in the collaboration. From here, the team began revision of the scaffolding of use of Multy.

What interesting patterns or insights have you discovered?

The game consists of a series of small challenges. Over the course of development, we came to a three step pattern for these challenges, as follows:

1. Introduce the new concept in an easy to way in the first level
2. Present a new challenge with some nuance that requires student to use the concept creatively and effectively in the next level
3. Add an additional challenge that requires more mastery of conceptual and direct use of the concept, often adding in complexity via earlier concepts to be used in combination in a third level.

The interaction and design process described in the previous sections is crucial to understanding how games that are learning and assessment tools must be developed. Interestingly, the game and assessment views were often in parallel. Choice is a key component to design and to gathering evidence. Assessment designers want choice that is related to the construct while game designers would not ordinarily be constrained in that way. In the above interaction, initial design gathered good evidence, but the inference from that evidence was not clear because game play and learning was not sufficiently scaffolded. In the search for better support, both the assessment and game designers reached the same conclusion about an overly-constrained solution from the separate perspectives.

After months of work and collaboration, the learning, assessment, and game experts can make suggestions and work out the challenges in a shared language. This representation of all three components has been crucial. It is sometimes tempting for education people to think they can make a game without an experienced game designer or technologists to think they can make a game without content experts. Both groups often fail to consider the creation of assessment models. In the end, all this leads to games that will not ultimately serve the three purposes of Engagement, Learning, and Assessment in a coordinated experience.

References

**Troubled Lands: A Sustainability Game**

Thomas Fennewald, Concordia University

http://www.workingexamples.org/example/show/696

(Note there are 28 slides in the full presentation)

*Troubled Lands* is an open source, 30-minute educational game about sustainability for ages 13 to Adult. It is a simple to learn yet morally provocative social dilemma game that requires players to address competing motivations of self-preservation and group loyalty as players need to apply moral reasoning to address inequalities and conflicts of interests. Many sustainability themes including communal negotiation, governance, inequality, power, and the tragedy of the commons are present in the game.

www.troubledlands.com

**Seed**

Tell us about your idea or project. What’s your vision?

This project aims to develop a sustainability game in which players are likely to engage in moral debate as a result of inequality and conflicts of interests among the players.
What problem are you trying to solve and why does it matter?

Our design problem - How can we make a game that captures:

1. the emotional pull between personal need and desire to help others;
2. inequality;
3. how in real life some, all, or none could fail or succeed;
4. the way real people have goals they must meet that are independent from other players’ goals;
5. how real people and nations share common pool resources;
6. how no one knows for certain exactly how much the environment may be pushed before collapse.

This problem matters because from ecological-political debates to local conflicts, life is filled with cooperative situations—situations that are not fully collaborative nor competitive—in which people must negotiate competing interests and apply moral reasoning to address interpersonal conflicts and issues like sustainability, personal security, and inequality.

What are your goals and how will you know if you’ve achieved them?

Our product aims to bring out moral discussion by capturing the experience of competing motivations. If you have ever wanted to help someone, e.g. wanted to take the time to help a friend but felt the need to attend to your own work, you know this experience of conflicting motivations. This is not only experienced by everyday people, it is also experience by politicians who must decide between personal/local and group interests.

We want to leave players feeling that tension, and to force them to make tough choices as they balance the drive to help others with the drive to promote their own interests. Therefore, a success indicator for this project is that players should find it difficult to decide how to treat one another.

How can our community support you? (e.g. expertise, resources, feedback, etc.)

If this problem interests you, contact tom.fennewald@gmail.com, and get a copy of the game or share it with teachers who can use this in their classrooms or in your research. The game is free.

Sprout

Tell us about your process and how your idea is evolving throughout the project.

The game started off under the name The Farmers. This project has undergone at least 20 versions with multiple social dilemma game and collective action game offshoots and prototypes. The farming theme has stuck but the rules are refined.

What are some of your initial concepts or designs? We’d love to see them.

Figures of two of the previous versions are in the presentation above.

Have your initial concepts/designs changed? Why have they changed? Show us how they’re being refined and iterated.

Several minor elements of the game have been simplified to reduce confusion during play. But the core of the game remains intact. Specifically, some people got confused with the finer points and we have simplified things down.

Instead of rotating order on who goes first now it’s a fixed order; the original rules had simultaneous play, but there is no more making simultaneous choices face down - now its just taking turns sequentially (that's what people did in practice); players didn’t know if they could take the same action several times because actions were printed on cards - now they don’t have cards but a permanent chart of choices; a free point option didn’t forcing players to make tough choices, so now no more free point option. Also 12 rounds was enough for players to get the concepts, so now it’s 12 rounds instead of 15, people got mixed up on a rule that stated 2 people need to work to fix...
the land so now one person can repair the land. The game still yields the same learning goals and basic player experience but 75% of the FAQs and stumbling points are eliminated.

**How might your project scale to provide greater impact?**

We are developing support materials for secondary and university level classrooms in collaboration with teachers and professors. We are also planning to translate into French, Spanish, Chinese and other languages.

**Bloom**

**Tell us about some of your successes. What can the WEx community learn from them?**

Working on the paper prototype and publishing on the work even while in development has helped push the project forward.

**So what's next? How are you making sure your work reaches people and is adopted?**

We are in the process of developing an online game and publishing more about the project - please contact us for details.

**Progress**

**Game Available for Free**

*Tom Fennewald*

*Oct 25, 2014*

Downloadable print and play game available. Email tom.fennewald@gmail.com for materials.
Evaluating Geography as Game Aesthetics for Engagement

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Abstract: There has been a growing interest over aesthetics in games for motivation and engagement of learners. We have previously argued how game aesthetics stimulate learners’ critical thinking skills and proposed that aesthetics be considered for evaluation of digital games. Building further upon the notion we dwell on geography as an aesthetical element of games. Analyzing three distinctive games (a digital game, a board game and a game-based learning environment), we illustrate how geography of a game may reveal the core learning concepts and provide complexities for deeper engagement. It is often difficult for teachers to assess the aesthetic values of games that are not content specific. Our working example offers ways to establish and analyze the pedagogy. Using three different examples we elucidate how the social, cultural and physical landscapes of a game provide a socio-cultural context for the learners to understand the content or subject presented through the game.

Practical and Theoretical Foundation for the Working Example

It has been observed that teachers are often hesitant to use games for teaching, in spite of the awareness that games are effective means of acquiring knowledge and skills, and this is because of the lack of proper pedagogical techniques or learning goals (Kirkland, Ulicsak & Harlington, 2010). One of the major hurdles faced with wider usage of games in classrooms is the lack of understanding of the effects of gaming environments on learning and a corresponding lack of theory and practice for their design and implementation (Shute, Rieber & Van Eck, 2012). Elaborating on the practice of learner centered design and constructivism in digital game-based learning, Shute, Rieber and Van Eck (2012) state how there needs to be a paradigm shift towards learners at play, as in entering a conceptual cognitive or cultural space where play occurs. Besides it has also been seen that construction of engaging activities to advance cognitive development has been a challenge faced by teachers for any kind of content (Terry, Mishra, Henriksen, Wolf & Kereliuk, 2013). We hope our working example contributes towards establishing how aesthetical elements of learning environments, as in game-based learning environments, help foster cognition and deeper understanding of the content.

The context of this study focuses on an understanding of aesthetics from a theoretical, practical and methodological perspective. Aesthetical experiences are known to mobilize cognitive powers either through reflection or analysis (Jay, 2005). Gadamer’s (2012) definition of aesthetic understanding revolves around the notion of play, derived through participation in moments of opening and venture that enable participants to comprehend various ways of the world. Aesthetic experiences, according to Dewey (1984), have a single pervasive quality that makes the experiences memorable, holistic, unified and consummatory. Aesthetic learning experiences in particular are cultivated as reflective, critical and resonant, empowering learners by stimulating their imagination and perception (Eisner, 2005, Greene, 2000). Emphasizing the importance of acknowledging learners as creative and innovative problem solvers, researchers (Dickey, 2015; Harry & Walling, 2013; Kay, 2010) claim how aesthetics can provide guidance for creating immersive, memorable and cohesive learning experiences.

Research in game aesthetics have so far been limited to an aesthetic understanding from a design perspective (Aleven, Myers, Easterday & Ogan, 2011) in connection with the mechanics and dynamics of the game. Game aesthetics in general lacked a definition till Niendenthal (2009) explained it as a sensory phenomena and a representation of various art forms. Aesthetics in games in presently understood as the elements of a game (rules, geography, representation, time and number of players) that bring out the experience of playing the game (Egenfeldt-Nielsen, Smith & Tosca, 2013).

Aesthetics of human computer interactions provides a methodological perspective on the aesthetics of digital game-based learning. Wright, Wallace, and McCarthy (2008) suggest that participant engagement can be holistic, constructivist or a dialogical ontology, emerging through the interactions of the self, others and technology. Squire (2011) has also claimed how art in games or aspects of aesthetics communicate educational concepts because aesthetics motivates players to see patterns in the process. Within learning environments it is also known that aesthetic experiences make the learning immersive, meaningful, coherent and transformative (Parrish, 2009). We have therefore suggested that learning depends on the aesthetic qualities of the gaming environment and that aesthetics in games play a crucial role towards understanding what the game is all about (Gupta & Kim, 2014a).
Recent scholarship on game-based learning reiterate how aesthetics in games are central to how a game is experienced and stresses the importance of its’ role in conjuring and supporting the cognitive complexity (Dickey, 2015). We are also aware that the learning process of a game are revealed through the aesthetic elements, which can also be shaped and reshaped depending upon the player’s choice (Egenfeldt-Nielsen, Smith & Tosca, 2013).

Using the above theoretical constructs to understand the notion of aesthetics in games in conjunction with the aesthetical principles of learning as postulated by Parrish (2009), we suggest that the aesthetic element of geography in games clarifies the problem as in exposes the tension or conflicting information; creates anticipation of consummation and maintains the suspense by gradually enhancing the complication; brings out the patterns, routines and motifs to sustain engagement; makes it meaningful for the learner who is the protagonist in the game; turns the learning experience into a narrative grounded in real life events.

This process is iterative across all game genres be it adventure, role playing, action, strategy, simulations or virtual worlds because geography as an aesthetic element, helps in comprehending the game from a number of perspectives as we explain below. Using a theoretical framework that we have conceptualized, we clarify how this holistic aesthetic experience of gaming by visualizing the geography, helps establish the subject matter or the theme of the game. Other aesthetic elements of the game such as the rules, representation, time and number of players, similarly clarify the game from various other perspectives (Gupta & Kim, 2014a, 2014b). For the purpose of this paper however, we are focusing on geography as an aesthetic element for engagement.

Understanding Geography as an Aesthetic Element

According to Egenfeldt-Nielsen, Smith & Tosca (2013), the geography of any game encapsulates the physical landscape that the learners encounter in the game. From a technical and design perspective Egenfeldt-Nielsen, Smith, and Tosca (2013) explain the geography of a game as its physical dimensions, game space and off-screen space. In understanding geography as an aesthetic element we not only refer to the physical landscape of the game that include all of the above, but extend it to include the social and cultural landscape which incorporate the artistic, political and economic landscapes. For this working example, we explore and analyze the social, cultural and physical geography of three very different games. The three games include a digital game, Global Conflicts: Military Operations (globalconflicts.eu), the board game of chess and a game-based learning environment of a graduate program.

We are choosing three very different games or game-based learning environments to exemplify how geography, as an aesthetic element, has a pervasive quality that makes the gaming or learning experience holistic and unified. The physical, social and political landscapes unify various perspectives of the underlying content of the game, which helps learners or gamers to reflect, synthesize and analyze the situation presented through the game. This experience in itself is aesthetic in nature.

Our theoretical framework, which we call visualization of aesthetics for game-based environments (Gupta, 2014), incorporates principles from visualization theory (Brodlie, Brooke, Chen, Chisnall, Fewings, Hughes, John, Jones, Riding, & Roard, 2005), macro-cognitive model of sense-making (Klein, Moon & Hoffman, 2006) and distributed emotions in the design of learning technologies (Kim & Kim, 2010). It explains how each aesthetic element can be visualized for analysis or production. The principles below explain the iterative process of visualization:

- Learners visualize the aesthetics of the games and extract meaningful information from the data.
- As the learners visualize the information they start making sense of it from a data frame perspective. The frame commences with some data or information and from that perspective other information starts making sense.
- As the learners start making sense of the information, their emotions act as resources for their learning resulting in the cognitive experience of problem solving.
We describe how the geography of each of these games or gaming environments, makes gaming an aesthetic learning experience, as it corresponds to the aesthetical principles of learning and helps the learners to visualize the aesthetics for a deeper understanding and engagement with the game. We are specifically using three games, very different in content, in order to exemplify how we could use geography, as an aesthetic element, to evaluate various types of games and game-based learning environments for engagement and understanding of the core content or discipline. The game *Global Conflicts: Military Operations* (Serious Games Interactive, 2008) deals with the ongoing Israel Palestinian strife and the related issues of democracy, citizenship, human rights, terrorism and poverty which are often abstract and difficult concepts to comprehend. Chess is a board game that focuses on strategy and the third game constitutes a game-based learning environment of a graduate course. The entire course is run as a game with avatars and experience points, as part of the course activities and assessments but we are focusing on the encounter with the physical space of the classroom to compare with the other two games.

**Geography of Global Conflicts: Military Operations**

In *Global Conflicts: Military Operations* the learners take on the role of journalists and are brought closer to a series of problems that occur on account of the on-going conflict between Israel and Palestine.

As a foreign journalist a learner arrives at Israel and meets with a media personnel/editor who provides guidance on how to garner information and report accurately. The meeting takes place outside a café near Jeruzalem. Although it appears to be a normal street side café the sudden arrival of the military trucks beside the cafe introduces the problem (see Figure 1) from a social, cultural, and physical perspective. Through mere observation it becomes clear that the region is in turmoil because of the strong presence of the military (Israel Defence Force) within the city. The almost deserted café also accentuates the instability of the region in terms of the safety of the people and the political conditions prevailing in the country. Thus the learner is directly exposed to the problem that initiates the interest or anticipation to proceed onwards for a better understanding of the problem. Although as a journalist the learner has been briefed about the prevailing conditions in the country, landing in the city brings about a direct encounter with the physical space to figure out what he or she has to do. After the initial meeting with the editor the journalist gets direct orders on the entire operation and has to work with the Israeli Defense Force for security reasons. As the journalist travels with the military across the country he or she develops a deep awareness of the country through the artistic representation of certain specific areas (Abu Dis for example where the military conducts a raid), which contribute towards meaning making of the physical, economic, social, cultural and political landscapes (See Figure 2).

![Figure 1: Screen shot of Café near Jeruzalem](image1)

![Figure 2: Screen shot of raid at Abu Dis](image2)
Abu Dis, a deserted neighbourhood with a few masked people on the streets, provides a clear picture of the economic and cultural situation of the region. As Abu Dis suddenly turns into a hub of activity on account of a military raid with the capture of a potential terrorist, the journalist witnesses the change in perspective of the physical, social and political landscape, which creates and sustains the suspense. At the site of the raid, the journalist’s movements across the physical space and social encounters are determined by the geography. The journalist can only approach the people on the streets since most of the houses have their windows and doors shut. The geography also informs upon the culture. As the journalist physically navigates the area and approaches the people some refuse to converse, or prefer to stay out of the picture while some lodge their complaints. Based on such social interactions under the specific circumstances (See Figure 3) the journalist gets a fair idea about the religious conflict, the economic condition brought about by the conflict etc. It also enables the journalist to make a fair judgment on the responses received, which in turn helps to identify the problem.

The geography also embodies certain rules in the game, which may include controlled movement within the country. Such geographic boundaries speak volume about the social and political situation in the country. For example, it is not safe for journalists to move around and gather information on their own. It is advisable for them to travel with the military and take adequate precautions such as wearing bullet-proof vests while on the job.

In addition, the geography reflects patterns of the political practices through frequent raids of certain areas. The raids help towards understanding the culture of the social communities and the dangers they are exposed to under the given circumstances. Thus geography as an aesthetic element of the game creates a meaningful learning experience helping learners to understand the real issues in order to succeed at investigative reporting.

**Geography of Chess**

Chess is a board game (see Figure 4) that involves two players and is a real time strategy game employing a third person perspective. However chess can also be played in a digital environment with the computer as an opponent. In both versions of the game the chessboard serves as the geography of the game. We have chosen the game of chess because Dewey (1984) illustrates aesthetic experiences by listing games such as chess. And as Dickey (2015) claims, many of the key aspects of Dewey’s (1984) characterization of aesthetic experiences such as flow, unity, consummation and memorability are key facets of contemporary digital games. The geography of chess plays a crucial role in representing the problem because the problem commences with the move of any character.
on the board. The physical space thus embodies the rules that govern how the game is played. A move by a player challenges the opponent to identify the problem and proceed with subsequent moves that adds complexities to the situation, increasing the suspense and anticipation. As the characters of the game as in pawns, rooks, bishop, knights, king and queen are physically moved across the board, the particular arrangement of the characters on the physical space helps to identify the strategy employed by the players. The strategy can change with every move, making it more complex and this complexity is revealed through the specific arrangement or the geographic positioning of the characters on the board. The increasing complexity maintains the suspense and creates anticipation for a check-mate.

The physical space of the board also helps to identify the patterns or routine movements of certain characters such as the rook, which can move across any number of vacant squares either vertically or horizontally. Similarly the bishop can move diagonally across vacant spaces and such movements bring about a change in the perspective and help gauge the strategy employed by the opponent.

The social perspective comes alive through the characters, their roles and powers for capturing the enemy pieces. Based on the learner’s experience of the narrative grounded in real life events it can be argued that the cultural perspective can incorporate both a political and an economic realm for the protagonist learner.

**Geography of a Game-Based Learning Environment**

The sketch below (see Figure 5) represents the physical layout or structure of a class for conducting a graduate program course in digital game-based learning, at a Western Canadian university. The entire course was conducted as a game for a period of two weeks in summer. The course design used game concepts such as experience points (XPs) and multiple battles as learning tasks (Johnson et al. 2014; Sheldon, 2011). The learning tasks included team formation, sharing project plans and developing a game prototype (Kim, in press). As a game, the course thus incorporated developing and articulating design principles for the prototype informed by theories and practices of digital game-based learning, both in the physical space of the classroom as well as through the Google+ community page. We have chosen this example because it is argued that careful use of game design elements can motivate players to solve real world problems (McGonigal, 2011). Besides Linehan, Kirman & Roche (2014) claim that gamified environments can change the behaviour of the players for their benefit. We focus on the geography, as an aesthetical element of the gamified course, to analyze how the physical space of the classroom helped create an unique socio-cultural environment that facilitated clarification of the problem for the learners and contributed towards making the entire learning experience meaningful.

![Figure 5: Rough Sketch of Classroom Layout](image)

The geography of the classroom sheds some light on the social and cultural norms practised by the groups. When in class the learners assumed their own seating positions, which contributed to the team formations and as the team members regrouped based on various other criteria (interests in games, communication, etc) the teams
assumed different positions in the physical space. It was interesting to note that some groups (consisting of avid gamers) took up positions in the front rows and back rows while the centre of the class had learners who were not so comfortable with gaming. It was also seen that a few learners occupied certain desks for facilitating communication with learners who were well versed at gaming. During class time, which also incorporated a scheduled time frame for playing games, there was a lot of movement in the physical space around the gaming equipment on account of help-seeking and help-giving with the games. The aisle or corridor in between the desks was also a centre of activity because the learners moved around and discussed various games or their unique characteristics. The physical geography of the class embodied minimal rules of movement: the focus of attention shifted to where all the gaming equipment were located, with more advanced commercial games when they were introduced. The students were expected to choose to play those games. Thus certain areas of the classroom helped arouse the anticipation for consumption either because the learners had access to the games or because they knew they could seek help towards solving a problem or to clarify their own understanding through group discussions.

The physical geography of the classroom largely facilitated social interaction and community building by shifting the focus of the social interaction to discourse about games interspersed with their personal experiences. Thus their learning experience turned into a narrative grounded in real life events making it aesthetic in nature. The groups made their “moves” based on where and how to do their group work within this space. For example, by using the whiteboard and leaving their brainstormed ideas on it, some groups marked their own space to continue their work in the next class. Such routines or patterns established by the learners themselves helped to sustain the engagement as the group members were aware of their own progress and contributed both individually and collectively.

The geography also revealed aspects of group culture and dynamics. It became obvious during class discussions or gaming activities that some members automatically assumed leadership positions and went around helping the others even if they were from different teams playing different games. Some of these leaders also shared access to games they enjoyed playing personally. Depending on the topic of discussion some learners introduced various other games to their fellow classmates. The level of collaboration and sharing was very evident although one might say that the learners were scoring in the game of learning simultaneously (which would affect their grades) and hence making the effort. However it could still be argued that the close-knit structure of the classroom and environment fostered collaboration and sharing, making it a meaningful aesthetic experience for the learners.

Conclusion and Implications

The aim of this working example is to emphasize the importance of geography as an aesthetical element of games. We have tried to demonstrate through three distinctive games how the geography of a game plays an important role in understanding the content or subject matter of the game. We have also described how geography lends a social and cultural perspective to the content helping the learners comprehend the subject from a socio-cultural point of view. By revealing the core learning concepts the aesthetics of geography promotes deeper engagement and this criteria may assist educators or teachers to assess games for learning.

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Steampunk Rochester
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Abstract: Steampunk Rochester is an interdisciplinary project at the Rochester Institute of Technology that is slated to span over three years with the end goal of creating a crowd contributor-based interactive narrative game. The first iteration involved approximately 75 students from two colleges (Liberal Arts and Computing and Information Sciences) and three departments (English, Visual Culture, Interactive Games and Media) across an academic year. Students recreated the world of Rochester in the 1920s, first in text and then in a prototype “point-and-click adventure” video game accounting for social forces at play that time, including labor struggles, women’s suffrage, racism against immigrants, prohibition, and wealth stratification.

Seed
Tell us about your idea or project. What’s your vision?

The Steampunk Rochester project is intended to be an interdisciplinary project that brings students together to work on a large-scale narrative that is rooted in local history and spans the disciplines of creative writing, visual culture, history, and game design.

In the first semester, students in liberal arts classes used a wiki to collaboratively construct a fictional version of Rochester in 1921, historically accurate in terms of its politics and social pressures, yet infused with the speculative element of retro-futurism in the form of steampunk technology. Using the structural principles of role-playing games (RPG), each wiki entry has a combination of quantitative and qualitative information that creates both internal consistency and a rich possibility for storytelling. Just as RPG sourcebooks provide players a wealth of information to draw upon in their campaigns, students populate their fictions with people, places, and things drawn from the wiki, all of which were created by their peers.

In the second semester, the game design and development students mined the wiki entries and fiction to inspire a “point-and-click adventure” game. They spent several weeks in high-level design discussions, additional historical research and brainstorming to springboard into a design. After working in several small groups, the teams came up with a game in which the player selects a playable character of either a White Russian of ducal-descended or “Nellie Bly”-inspired journalist, or a “wrong side of the tracks” Irish descended photographer with a Steam-Driven prosthetic arm. These characters navigate Mafia, Suffragette, and “Church of Light” factions to determine the source, and effects, of Rochester’s mysterious glowing water. A few of the first semester students enrolled in the second semester class as well.

What problem are you trying to solve and why does it matter?

In the first semester class, the two main educational problems we are tackling with this project are (a) raising students critical sensibilities when it comes to representing fictional worlds and (b) helping them see the storytelling potential in their local histories. These classes foreground critical questions about how worlds operate, paying particular attention to the power imbalances along the lines of gender, race, class, and sexual orientation, and how these social forces influence the decisions made by individuals living in that society at that specific time. The local history element serves as a reminder that such decisions helped shape the world we currently inhabit.

In the second semester production studio class, students also learn that local history can be a rich foundation for the creation of game worlds. They are also learning aspects of transmedia production and its challenges. The new twist here is that they are working with media created by other students, external to their class rather than working with their own original intellectual property or adapting established genre fiction as they so often do.

Tell us about the team you have assembled or hope to assemble.
The currently faculty at RIT involved include:

- Trent Hergenrader, Assistant Professor of English specializing in creative writing, digital writing, and game-based learning.
- Stephen Jacobs, Associate Director of the MAGIC Center, Professor in Interactive Games and Media,
Visiting Scholar for the National Center for the History of Electronic Games.

Jessica Lieberman, Associate Professor, Department of Performing Arts and Visual Culture, specializing in traumatic images and cities as texts.

In addition to the core teaching faculty, Michael Brown, Visiting Professor in the Department of History, delivered a lecture on the history of Rochester during the period 1915-1921, and RIT Archivist Becky Simmons provided students with an interactive display of rich collection institute documents and artifacts from that era.

Sprout

Tell us about your process and how your idea is evolving throughout the project.

During the first semester, the Visual Culture students were enrolled in a course entitled Imag(in)ing Rochester, where they considered the city as a visual text that can be interrogated and studied. The two sections of this course were distinct, as one was upper-level undergraduates and the second was primarily first-year honors students. The upper-level students never really fully latched onto the idea, whereas the first-year students became interested quickly. The archival and historical work they did on the wiki, however, never seemed to fully mesh with historical/speculative work being done in the creative writing course. Connections, when they happened, were interesting and inspiring, but the quantity of wiki entries diluted the quality, making it difficult for the creative writing students to find those connections.

The Creative Writing students started somewhat slowly, not entirely understanding this radically different approach to fiction. They were used to reading stories and writing their own, not doing historical research and talking about social forces at play during this era. Some resisted the notion of creating wiki entries as “creative writing,” but the majority came around as the wiki grew and they developed the metanarrative for the world. By the time they were to the point of creating protagonists for their stories who would be interacting with this world, the majority were very excited to see where the course was going to take them. Engagement remained high throughout the role-playing game sessions, and by the final week, most students reported that the course had been a transformational experience in terms of how they view the fiction writing process.

In the studio class the conceptual design phase went really well. Teams independently came up with final game concepts that shared 85% of the same elements. Working as a class to refine the concept also went well.

Production had its challenges, as it always does. The biggest challenges in this case were coordination of development, especially the writing team. This had a trickledown effect as members of the design team ended up having to step in and do some of the writing team’s work, which in turn hampered communication and cohesion across the board. And, without a team from the art school this time around, the game levels lacked polish. All that said, the class produced a multi-level demo that allowed all of the mechanics to be demonstrated, tested and refined, which met the professor’s goal for the class.


What interesting patterns or insights have you discovered?

Several students in the creative writing class completed a post-class survey to discuss the benefits and challenges in the class, which will help in redesigning the class for the 2015-2016 iteration.

Representative positive comments include:

○ One of the biggest benefits I found with this method was that it allowed more interaction and collaboration between my classmates and I. Whether we were playing together and our characters had to interact and collaborate to get through a situation, or we were writing about the game afterwards, we had to consider not only what goals our own characters wanted to achieve or what actions they would take, but what the other person’s character was trying to do as well. In some cases we ended up working around each other, but it was interesting when we managed to work with each other instead.

○ It really made the project feel personal while still being part of a group. I have never done collaborative writing before and I found it very enjoyable to work my character in with another student’s character, making them all feel equally driving and interesting and clearly with different ways of thinking.
Compared to other classes, this class was an entirely new experience in writing. There was a lot of world building, which I think will be very helpful in the future in regards to my writing. I think this methodology worked great for the class: it was very relaxed and free and allowed us to settle into this new way of writing fairly well.

The class allows those who have a background in table-top gaming, particularly those brave few who GM regularly, to really flourish, and with its blend of historical and fictional elements, has something to offer most every student.

Some representative critical comments include:

- It was a bit too ambiguous in the description and in the beginning nature of the class. Having an example from a previous class should help with this, as well as walking through the steps that class went through (research, picking themes, making items, place, people, always adding to the wiki/whatever...).

- The wiki itself was a new technology to work with that took a bit of getting used to. Not really something that can be improved, but something to allow time for.

- I do wish we had managed more time for critiques and had time to edit previous stories. I know out of class time could be used for that, but I think spending some time in class for more critique follow up would be nice.

- One of the biggest downfalls of the class, unfortunately, was the game itself. While the concept was interesting the game sessions often fell flat. A combination of poor dice mechanics and overly forceful DM storytelling often took too much control from the players/writers and left us feeling cheated. For example, a character who managed several successes in a persuasion roll still had a gun pulled on him. Other times the player/writer would want their character to take a certain action and the DM [the instructor] would essentially forbid it, not due to a failed roll or physical obstacle but seemingly because he had a different outcome in mind. The game, and by the extension the stories, would have been more fun for the players/writers if they had more choice and invested interest in what was going on.

The production studio class’ “final exam” was a final play-through and post-mortem discussion of the process and the game. All of the students said that despite the early stage roughness of the prototype that they would be showing it to peers and future colleagues as a conceptual design they worked on that had promise. Many of them also said that in future iterations of these classes a stronger and/or larger writing team would be key to moving things forward.

Have your initial concepts/designs changed? Why have they changed? Show us how they’re being refined and iterated.

The student comments revealed generally positive reactions to the creative writing course but also identified areas that need better refinement. Sometimes this means adjusting the course mechanics, and other times adjusting student expectations. As the instructor of the creative writing class, here is how I am interpreting the survey feedback and how I plan on adjusting the course for the fall 2015 iteration:

- Students clearly struggled with the open-endedness of the world building session. They were asked to develop some interesting narrative that dealt with major social issues that impacted life for people living in Rochester in the years 1915-1921. After weeks of discussion and negotiation, they finally settled on a few main narrative threads that coalesced around steampunk prosthetics, women’s suffrage and labor struggles, and mafia bootlegging thanks to prohibition. It became a challenge to try and tie characters’ stories together when they could be involved in such disparate activities. In the next iteration of the course, I will work with the other professors to develop a narrower narrative structure for students to latch onto. While we will still focus on wider societal forces, it should be less chaotic if we have the class concentrate their stories on a specific theme, such as emerging technologies of the time or labor struggles.

- We will have the Visual Culture students meet with the creative writing students at least two to three times during the semester and have them work more closely on developing wiki entries, going for fewer high quality entries than a quantity of mediocre ones. The creative writing students said that the signal to noise ratio from the Visual Culture students’ wiki entries was poor, and the Visual Culture students didn’t have a clear idea of how their wiki entries were going to be used. Bringing these students together in a face-to-face setting should help solve this.
Several students reported disliking the “loss of control” and feeling constrained they felt when playing the role-playing game. Since I acted as the gamemaster, I would respond that the game veered strongly toward realism than sensationalism, which is what they’re more used to when playing tabletop or digital RPGs. To address the specific example in the last criticism above, no number of speech checks will convince a bank manager to hand over the keys to the vault; in the scenario described, the student did successfully roll that she’d passed a speech check; this did not automatically resolve the situation for her (which is what happens in a digital RPG, for example), but rather afforded them an opportunity to come up with a good reason why the assassin should not kill the character. My response as the GM was not “good roll but he pulls the gun anyway” but rather “he hesitates and seems willing to hear what you have to say.” When the student could not come up with anything to say, the killer advanced. It was less “I didn’t have any choices to make” but rather “I wasn’t allowed to make the unrealistic choices that would have made things easier.”

Along these same lines regarding “lack of control,” beginning fiction writers often give their characters problems that they’re well-equipped to solve. I mentioned that in this course, I would be giving the characters problems that were going to be difficult, and that the character would often be choosing between “damned if you do, damned if you don’t.” Several students (particularly the ones majoring in game design) saw this as a no-win situation because they were conceptualizing the role-playing game as having a victory condition, when that was never the point—the RPG is an engine for generating interesting fiction based on character choices. Next semester I will make this more explicitly clear from the beginning, and reiterate it before and during the RPG sessions.

As my previous research in using RPGs in creative writing classes strongly suggests, the benefits of using RPG structures and mechanics far outweigh the drawbacks. The logistics of the game sessions however proves to be a sticking point, both from a logistical standpoint in terms of time and space (it was feasible because at the time of the game sessions the course only had 10 students) and that some students also slip into “game mode” and focus more on game mechanics and the desire for heroic storytelling rather than staying rooted in realism and the experiences of average, everyday people. The latter trouble particularly came from game design students, who arguably need to understand that games can provide a diversity of experiences.

I am also planning on using a different RPG system. The one I chose for this iteration, Uber Steampunk RPG, used a steampunk setting, but it heavily foregrounded non-realistic elements including magic. Even though we did not incorporate those aspects, I suspect that this might have influenced how students approached the game sessions in terms of their expectations. For the next iteration, I will use the Fate Core, a flexible system that can be adapted to any genre.

Bloom

Looking forward, what kind of impact do you think your work will have? How might it continue to evolve?

The project has garnered attention across the institute and in the local community as well. The project was featured in a chapter of a forthcoming book, Digital Pedagogy in the Humanities, and an editor of a local Rochester arts and culture magazine saw the course Twitter feed and has expressed interest in running a story on the project.

One longer-term goal is to provide educators at other institutions a framework that they can use for their own historically-based, interdisciplinary projects.

Reflecting back, what did you learn along the way? What would you do differently?

In the next iteration we will be doing more in the fall semester to draw the Visual Culture and Creative Writing students into the same physical space for face-to-face discussions about the project in order to maintain greater coherence among the wiki entries during the world building phase. We will also be adding a new category for wiki entries that describe groups or factions to which characters, both PCs and NPCs, may belong. This is intended to give students a better handle on the different, and sometimes conflicting, motivations a character would have when making decisions. For example, a character affiliated with the suffragettes may be forced to choose between family, job, and political activism.

Other changes include switching from Uber Steampunk RPG to the Fate Core RPG system as a way to reduce some students’ fixation on rules over narrative, and to simplify gameplay. Another change I am mulling over is to incorporate a mechanic from the game Fiasco, whereby all the players need to establish relationships between their character and other PCs. Like with the addition of factions, this is an attempt to establish more lines of tension for
characters, to deepen immersion in the world, and to emphasize the social aspects of the classroom environment.

As far as the Liberal Arts classes go, our plan is to run through the project sequence twice more (being three full academic years) and then reassess what is working well and what needs improvement. The plan for the upcoming academic year is to refine polish and expand the existing narrative content.

As regards the production class, the plan is to move forward to an eventual on-line game with player created content. Year two of the project will focus primarily on picking/modifying and/or developing the right set of tools to move forward. Rather than having the entire class committed to one implementation of the content we will looks at employing pieces of it in different ways s the next step in the design process. This will then pave the way for deploying a player-created content game around the content of the Wiki in our third year.
Phylo: Crowdsourced Biodiversity & Science Trading Card Game

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Phylo (http://Phylogame.org) is an exercise in crowd sourcing, open access, and open game development to create a trading card game (TCG) that makes use of the wonderful, complex, and inspiring things that inform the notion of biodiversity. Beginning as a reaction to the following nugget of information, “Kids know more about Pokémon creatures than they do about real creatures,” this project has grown to broach elements of game based science education, ecological literacy, and hackathon mechanics within the teaching community. Given its flexible and open workflow, Phylo has benefited from the input of many communities of expertise, and many collaborations (both formal and spontaneous) leading to a continually expanding resource that is under constant reiteration.

Seed

Tell us about your idea or project. What's your vision?

Phylo an online initiative aimed at creating a Pokémon card type resource but with content focusing on real creatures on display in full artistic wonder. In particular, the primary conceit is to see what can be produced if we essentially allow the project to evolve through reiterative crowdsourcing contributions. This includes obvious groups of expertise such as having: (a) the scientific community weigh in on the scientific accuracy of such cards; (b) members of the artist/graphic design community to develop and contribute towards aesthetic considerations; and (c) individuals from the gaming community who can participate in the design of interesting game mechanics, as well as offer both play-testing opinions. Furthermore, as in any other crowdsourcing project, whereby reasonable autonomy is given to the community, we would expect other pockets of expertise to contribute as content is created. This would hopefully include members of the teacher community who will participate to see whether these cards have educational merit, as well as other unforeseen groups of expertise that may appear during various stages of reiteration (i.e. intellectual property law, museum culture, etc - see below). As outlined in the opening text of the project’s website, the hope is that this will all occur in a non-commercial-open-access-open-source-because-basically-this-is-good-for-you-your-children-and-your-planet sort of way.

The idea was primarily inspired by a letter published in Science and written by conservationist Andrew Balmford (et al., 2002). Here, Andrew shared his eye opening study that showed that children as young as eight had the remarkable ability to identify and characterize upwards of 120 different Pokémon characters. However, when the same rubric was applied using photos of “real” flora and fauna (animals and plants that lived in the children’s back yards) the results were comparatively poor.

In effect, Andrew asked the conservation community the following: Can we learn engagement strategies from Pokémon, and use those insights to create the same type of enthusiasm for biodiversity and ecology content? With this seed of an idea, my lab then queried whether the notions of crowdsourcing and open access could work towards Andrew’s suggestion. And with his blessing, we have been pursuing this idea since 2010, optimistic that the Internet, its social networking ability, and its often wonderfully active and engaged denizens will deliver something amazing.
What problem are you trying to solve and why does it matter?

In a way, due to the overarching game development model being defined by the act of crowdsourcing, the specific problems being broached are fluid if not undefined. At its core, it is visualized that different communities or deck hosts will attempt to create their own cards/decks in response to a specific problem that is dependent on the localized contexts and desires. However, a few obvious goals can be suggested:

1. That the Phylo project is used as a tool to increase student's ecological literacy, especially in this day of nature deficit tendencies. This is arguably one of the heart and soul agendas of the project, especially given the disconnect between Pokémon and “real life” organism cognition. Around this core goal is the realization of a viable TCG culture, where high quality cards can be collected and traded, if not purchased in similar ways to other well known TCGs.

2. That the Phylo project is used as a classroom resource for student content creation (particularly around science concepts such as organism identification and knowledge acquisition). In effect, taking common learning objectives met by common activities like poster or diorama generation, and using that same media to create a deck of cards.

3. That the Phylo project is used as a classroom resource for student content creation, providing a launching point for DIY game development, and in turn creating opportunities for deeper learning. In other words, classroom decks could be created in house, but with the added objective of turning the deck into a playable game, where mechanics attempt to emulate specific science/biodiversity/environmental concepts.

What challenges might pop up?

A number of foreseen challenges will likely arise. These include the following:

- That the project is reliant on crowdsourcing contributions. This is entirely unpredictable both in terms of quantity of contributions as well as the quality of contributions.

- That due to the unpredictable nature of crowdsourced game development, the project could easily lose focus and direction. As well, progress may be inadvertently defined by popularity of the contributor as oppose to the merits of the contribution.

- That the project requires expertise from various and diverse communities, many of which are not often familiar with interdisciplinary collaborations. As a result, the project needs to ensure that civility is maintained in all interactions.

- That the project aims to adhere to open philosophies, whilst also being respectful of the professional (and often compensatory) nature of contributions being provided. Here, notions of ownership must also be considered in a manner that is fair and yet still provides free access to the educational community at large.

- That concerning the key goal of enhancing ecological literacy in children, it is understood that research rigorously measuring this feature is academically recognized to be very challenging.

Sprout

As a crowdsourced project, by default, Phylo is continually evolving. That being said, this article will briefly describe the three phases in the project’s evolution that together constitute a makeshift “origin story.” For additional details on these three phases, please visit http://Phylogame.org/about

The first phase was a very fast paced stage which involved quick reiteration and large numbers of contributions that all occurred in the first two years (but especially in the first 8 or so months). This essentially resulted in the creation of a card databank, a workable production process, as well as a playable game (that focused on ecosystem building concepts).

The second stage formally entertained the idea of creating high quality purchasable decks. Here, cards produced were less about crowdsourcing, as the bulk of the development work was done in the first phase. Instead, this stage was more about following existing deck production templates, while navigating the nuances involved in decks having the option of revenue generation.
The third stage is quite recent, and largely concerns itself with two main streams of activity. One, where the functionality of the website is enhanced to allow for easier DIY classroom deck generation (by teachers and their students for instance), as well as development of other game mechanics that focus on “process of science” concepts.

Below are some key dates for the first phase. The other two phases are detailed in the “Bloom” section.

January 11, 2010: Here, the “Phylomon” project began in earnest. This date was primarily chosen because 2010 happened to be the United Nations International Year of Biodiversity. Interestingly, it was also decided that my lab (http://bioteach.ubc.ca) would do a “soft” launch – January 11th to be exact and at two places on the web—the Science Creative Quarterly (http://scq.ubc.ca) and The World’s Fair (no longer active). These are both websites that my lab were affiliated with, and at the time both also attracted considerable web traffic—note that the seed item was authored as a pseudo press release with the lab’s institutional letterhead included for formality.

Almost immediately, a number of blogs picked up on the story. And some, being quite high profile catalyzed a number of graphic artists signing up, as well as a number of art submissions. In fact, within the first two weeks, we received many media impressions, including several from high profile websites (Pharyngula, Metafilter, Kottke, MAKE, Brain Pickings, Reddit). Interestingly, from the comments left on these various places, it became clear that gamers wanted a place to hold discussions.

January 29th, 2010: At this time, given the feedback, a free forum was set up, where folks could converge and discuss all things Phylomon. This proved to be an excellent move in that very quickly a community was established. In fact, within a week, there was already much discussion and debate about the artwork, about the logo, about the game itself, and indeed by that first week, we even had some folks go to the trouble of putting up great ideas and some very detailed game rules.

One of the more interesting discussions that came from the forums was the issue of copyright, given that Phylomon was premised on being open access throughout. This initially began with a thread comment where a patent held by Wizards of the Coast (a holding of Hasbro, and owners of Pokémon and Magic TCGs) was shared. This was useful because it provided some information on game mechanics to be avoided. It also brought up the issue of trademark infringement – specifically, the nuance where our project was called Phylomon” which in court could be argued to benefit from implied recognition of the Pokémon brand.

February 25th, 2010: Around this time, the project received a request for an interview from WIRED magazine (the UK version). More importantly, this forced a deadline for producing a reasonable graphic of what the cards might look like. As a result, the forum comments were examined for all feedback on card content, and decisions were made on what metadata and general layout would be presented. Overall, the cards were envisioned as general content holders (kind of like flash cards), which allowed flexibility of game mechanic design.

March to April, 2010: At this point, the UBC’s Office of Learning Technology (and specifically Enej Bajgoric) volunteered to create an open access Wordpress template that essentially would allow easy and dynamic creation of blog posts that essentially looked like cards. In other words, we had ourselves a worthy beta website that doubled as a trading card generation portal. This was officially launched on April 7 and you can check out the website at http://Phylogame.org. This has more or less looked the same since its inception (Figure 1), although extra pieces of functionality have since been added as described in Phase Two and Three in the Bloom section.
Around this time, the aesthetics of the artwork was also more formally broached. This led to interesting discussions over the scientific literacy nature of the images used. Essentially, there was a debate over how realistic the images “should” be, versus how cartoony they “could” be. This discussion was actually quite heated, but fortunately my lab was hosting a high school student science conference (http://www.bioteach.ubc.ca/highschool-conference-2010/) where we took it upon ourselves to ask the students themselves what they thought about this. In the end, responses were varied with diverse preferences delineated. However, the central thing agreed upon by the 100 or so students who filled out the questionnaire was that diverse art was fine, as long as it was “good.” This largely settled the debate nicely, and strategically turned out to be useful because it diversified the type of art we could use. As well, this move introduced concepts around custom decks (i.e. if you prefer cartoony images, you could make your custom deck with just the cards with cartoon images).

April 22, 2010: This dates marks the release of Version 1.1 of the Ecosystem Building game mechanic, as primarily developed by three members of the crowdsourcing game community (Fenrislorsrai, ColinD and Naturalismus). Full details can be found at this link (http://Phylogame.org/ecosystem-building-game/). Note that each reiteration carefully tracks previous editions.

Upon release of these rules, feedback was immediate. Interestingly, from “geek” culture types, the feedback was overwhelmingly positive, whereas from “gaming” culture types, the feedback was overwhelmingly thoughtful, but generally negative and critical of the whole premise and game mechanic (a great example of this can be seen at this link - http://havocjack.blogspot.ca/2010/04/Phylomon-and-fanatics.html). Note that at this point, the game play is still tough to test properly as rules are still largely amorphous and card sets not yet determined.

May to August, 2010: Versions 1.2 to 1.4a of the game rules were released over this timeframe, as well as prototype starter decks. With the version 1.4a in place, the basic elements (cards, rules, and point of access) were available, and the Phylo project more or less hummed along independently for about six months. By March 2011, there were approximately 200 cards available on the site, as well as creation of a few starter decks.

January 27, 2011: The first official collaborative deck was released at this time. This one was a result of my sabbatical at London’s Natural History Museum, although this deck was largely designed as a scavenger hunt deck (i.e. look for the corresponding organisms in the museums vast exhibits). Details can be found at http://Phylogame.org/cards/london-nhm-deck/.

By now (a year into the project), traffic to the website had decreased overall but stabilized at about 1000 visitors (individual IPs) per day. Activity in the forums also dropped considerably, which was understandable given that the bulk of the development work was perceived to have been finished. However, one point of discussion became a recurring theme: that is, how would one be able to “purchase” cards, and not rely on home printing, given that the quality of the cards would only be as good as the printer used.
This set up an interesting stream of discussion that led to the following ideas:

1. That we open the Phylo game to “hosts” who are interested in offering custom host decks. These hosts, for instance, could be organizations such as museums, or environmental non-profits.

2. The project would crowdsource details on a possible mechanism that would allow these hosts to “sell” their cards, possibly even to gain revenue, but that efforts would also be made to ensure that the cards (or a version of the cards) are still available for free on the web. Along the same lines, measures would be put in place to protect the open nature of the game itself, although individual cards could be placed under host/artist copyright.

3. That with the purchasing option in the mix, then efforts would be made to provide reasonable compensation for the artists involved. In effect, this was an attempt to properly reward the gracious contributions by the project’s art community, who arguably represent the most significant crowdsourced contribution in the project (in terms of hours per card provided for instance).

With this matrix in place, the next step was to find a suitable pilot host who could help us produce the “first” high quality purchasable deck (hereafter abbreviated HQ deck). To aid in this, my lab begins to offer “art commission” grants, on the basis of providing $5000 towards payment of art (this at $200 per image, 25 images total), whereupon we find our first candidate–an on campus natural history museum (the Beaty Biodiversity Museum).

May to June 2011: At this time, the website undergoes some tinkering related to general updates required for security (as advised by Wordpress), as well as the addition of a new functionality. This specifically was a section devoted to DIY card production which was designed as a way for classrooms and their teachers to create and store their own cards on the website without these DIY cards mixing in with the curated main Phylo cards. With this in place, my lab worked with a number of elementary school classrooms to help them produce their own “classroom” decks. Examples can be seen at http://Phylogame.org/make/ (section 4). This proved to be a huge hit, but was very labour intensive for the teacher.


Bloom

As of May 2012, HQ decks began appearing in earnest, with the first two being the aforementioned Beaty Biodiversity Museum Deck and a coral themed World Science Festival Deck. Initially, this was quite slow, as it generally required my lab’s assistance (both in terms of consultation and/or in terms of the art commission grant). As well, art commissions from these HQ decks tended to provide most of the new free online content, as oppose to general art donations which represented a marked difference from how the card database expanded during the first 2 years of the project. As these decks began appearing, this activity constituted the second phase of the project.

Overall, the second phase resulted in the publication of a good mix of different decks (and expansion packs), which operated under various different logistical circumstances. For a list of current and in progress decks, please visit the deck section of the Phylo website (http://Phylogame.org/decks/). Altogether, this provided good proof of concept experiences to produce a deck-making template.

This template is represented by a number of documents that include information on both design and assignment of specific cards, as well as overall logistics in production and distribution. For instance, it was determined that for small-scale hosts, using real-time publishing print shops was a good solution (our most used vendor is the U.S. based Game Crafter–http://thegamecrafter). If the host was more amenable to independent distribution means (i.e. they have their own shop or online shop), then they tended to go through a conventional printer, as this was usually much cheaper. This template also provided copies of documents that represented good working examples of appropriate art related contracts.

Recently, the crowdsourced nature of the project has led to two significant developments. This I consider the latest phase in the project: Phase Three.

First, the project was courted by the Genetics Society of America (http://Phylogame.org/heads-up-new-deck-being-worked-on-for-genetics-society-of-america/) to create a custom deck for their upcoming 2016 conferences. This organization provided funding to produce a deck that focused on genetic model organisms. However, as the list of model organisms does not naturally lend themselves to ecosystem building, a new game mechanic was required to be designed by a team of undergraduate and graduate students.
This game mechanic, in effect, focuses on “process of science” concepts. The beta version of this game was completed in October 2014, and has been play tested to great feedback. At this stage, the Phylo site has released this game as a public beta to work out final kinks and the stage is set to begin art commissions in the fall of 2015, with a mind to have the deck ready by early 2016. Because this new game mechanic tested so positively, another deck has been initiated (with funding from the WWEST NSERC. This deck will focus on Women in Science and Engineering (WISE) issues.

Overall, these developments are exciting because they promote the idea that this project could adopt alternate rule sets depending on the learning outcomes desired. For the first three years, the gaming community strongly focused on one rule set, making it work well, but to the detriment of other possible game mechanic ideas. The new GSA and WISE card decks will hopefully enable community participants to think more about designing other ways to use the cards.

Second, due to the great feedback we obtained with our pilot DIY classroom decks, it was clear that the website had to be revamped so that DIY card production was made as simple as possible. Up until this point in time, classroom decks were essentially prepared by the teachers involved. In other words, whilst, students created the media, it was still left to the teacher to assemble the media as a card. Even though the website made this relatively easy (about five to 10 minutes per card), the amount of time required really stacks up when a teacher needs to worry about content from a classroom of students. Therefore, a move was made to make DIY card generation as simple as possible so that a young child could navigate their way through this process.

This new functionality of the website was launched in February 2015, allowing a teacher to have an account that enables administrative control over cards that his/her student creates. So far, a few teacher/student accounts have been provided, as we are slowly beta testing this new feature. It will be interesting to see how the kinks are worked out over the months, as well as hearing back from these teachers as they develop logistics and lesson plans around the resource.

Looking forward, what kind of impact do you think your work will have? How might it continue to evolve?

At this point in time, I believe the project is in a very interesting place. We will soon be releasing a DIY DECK kit, which will hopefully enable more spontaneous production of HQ decks. With this in place, as well as uptake from teachers wanting to use this as a resource, I do think the project is set to continue to do well and expand considerably.

That being said, there are three elements that would be great to see happen:

First, whilst the deliverables of the project have gone beyond my wildest expectations, it would be wonderful to start seeing some research around the project. This could in terms of formal assessment of its utility as a learning tool, in gauging its role as a proponent of ecological literacy, or even in its use as mode to study student game development. None of this has really happened to date, but the project is entirely open to such opportunities. My lab is even keen to co-write proposals should any strategic grant opportunities exist.

Second, currently the Phylo project is more or less a physical game entity, as opposed to a digital game. In a way, this presents itself with a number of advantages (e.g., teachers appear to be more comfortable in creating a physical game, and the students do seem to get a real kick out of the physical tactile nature of the cards they buy, make). That being said, it might be interesting to see whether the project can also exist in a digital format. This obviously requires some major input (especially when viewed through crowdsourcing lenses), but it would still be interesting to see what this might look like. Note, that there have been a few small attempts at this: the primary problem is that the game requires a large tableau space when played, which isn’t well suited for the limited screen real estate of most mobile devices.

Third, at a certain point, I worry that the project might get too “successful” and therefore becomes difficult to moderate or manage. As such, I’ve always thought that the ideal circumstance would be for the project to eventually evolve into a non-profit, where some revenue could be collected from sale of cards to provide salaries to the staff that look after and guide the project.

Quick Links to Explore

Main Website – http://Phylogame.org
Card Archive – http://Phylogame.org/cards
Information on making cards and decks - http://Phylogame.org/make/

List of currently available and in progress decks - http://Phylogame.org/decks/

References

Moravian History Mystery: A Mobile, Digital, Augmented Reality, Game-Based Learning Experience for Young Elementary Students

Julie Oltman, Lehigh University
Thomas C. Hammond, Lehigh University

Abstract: This mixed-methods study explored the use of an augmented reality, location-based, iPad game to enhance the learning experience of young elementary history students. Utilizing the ARIS platform and a design-based research approach, researchers built a customized game experience that was inserted into a school’s traditional second grade curriculum. Students’ flow rates, learning outcomes, and attitudes about gaming were assessed through observation, teacher and student interviews, class-debrief sessions, teacher-created assessment tools, and surveys. Findings indicate that high rates of flow occurred with most students, learning outcomes were positively influenced, and that students generally have a positive attitude about game-based learning. This study also suggests that serious game-based learning for social studies can be successfully implemented in the earliest elementary grades. The researchers conclude with methodological and design recommendations for further game-based learning research within this age group.

Introduction

The national movement toward curriculum standardization and high-stakes testing has taken a toll on social studies instruction in terms of instructional time and energy (Fitchett & Heafner, 2010). Teachers are expending more creative energy and allocating more instructional time on higher priority subjects such as reading and math (Zhao & Hoge, 2005; Lee, 2008). This trend is particularly acute in the early elementary grades. In a study of elementary teachers in Indiana, VanFossen (2005) stated that “cries of ‘back to the basics’ of reading and math, and the implementation of high-stakes state testing, have only served to focus further attention and resources on reading and mathematics as the twin engines driving the elementary school curriculum” (p. 377). Because of this lack of attention to social studies, many teachers have moved away from traditional social studies teaching techniques such as field trips, project work, service learning, or extended research (Ellis, 2007), all of which consume far more instructional time and teacher energy than they feel they can currently afford. Social studies marginalization (Fitchett, Heafner, & Lambert, 2014) discourages time-consuming methods, such as projects or field trips, and encourages transmission-driven methods, such as worksheets and textbooks (Kisiel, 2003; Ransom & Manning, 2013). This approach fails to align with the National Council for the Social Studies’ recommendations for instructional methods (NCSS, 2010), and points toward a generation of disengaged, unprepared citizens.

In parallel with elementary teachers’ declining emphasis on social studies, elementary students also lack engagement with social studies. Zhao and Hoge (2005) observed that students find social studies boring, not relevant to their own lives, and don’t recognize the importance of understanding the world around them. Many of these same students who are disengaged in the classroom, however, are deeply engaged in other activities outside of school such as video games and mobile technologies. Prensky (2006) suggests that the current generation of learners is different from previous students; they are digital natives, and they often find their in-class experience “boring” when compared to the exciting and engaging digital games they experience outside of class. Despite the widespread adoption of mobile technologies by children (NPD Group, 2011), few researchers have deeply analyzed student interactions with mobile devices such as iPads to determine what learning benefit they have, if any (Falloon, 2013).

The 2013 Horizon STEM report identified games as an emerging technology for education. More and more educators are progressively recognizing the potential power of games for learning with regards to motivation and improved learning outcomes. Several researchers have successfully shown that games can improve the learning outcomes of students (Van Eck, 2006; Steinkuehler and King, 2009). Other researchers have successfully demonstrated the motivational affordances of games by studying games’ capacity for inducing a state of flow within learners (Sweetser & Wyeth, 2005; Bressler, 2014). Finally, several researchers have specifically explored game-based learning for history education and have shown that games can increase students’ interest in history, understanding of societal structures, and historical facts and vocabulary (Admiraal et al., 2011; Squire, Giovanetto, Devane, & Durga, 2005; Schrier, 2005).

Flow, as described by Csikszentmihalyi (1990), is a phenomenon within participants’ perception: they are immersed in an active experience and (relatively) inattentive to activities and events outside of their focus. It is characterized as a state of enjoyment and high engagement. It is most likely experienced when an ideal level of challenge meets an ideal level of participant skill. Flow bridges both gaming and learning contexts, as the flow-inducing experience
could be a learning task or a game event. The presence of a flow-state within participants indicates motivation and engagement; and during flow, learning becomes autotelic. Additionally, because flow can result in higher levels of motivation to persist in an activity, it can create more effective learning environments (Chan, 1999; Dickey, 2007).

“Serious games”—games that are complex, require player agency, and often have a social element—present excellent opportunities for educators to provide flow-inducing learning experiences for their students. However, as other researchers have shown with middle-school through adult populations, the level of difficulty must not exceed the skills of the students, technology must not present barriers to play, and children must be allowed to apply social/recreational game culture while playing learning games (Admiraal et al., 2011; Bressler & Bodzin, 2013; Inal & Cagiltay, 2007).

The potential of AR mobile games to create powerful learning experiences in the particular subject of history is significant and important to study. Mobile games allow students to be physically present at historical sites and AR can bring these places to life while providing historical context and meaning. The additional information, possible flow-experience, and interactions between the learner and the history, in situ, can deepen the experience and potentially enhance learning outcomes.

Purpose of this study

The purpose of this study is to explore how an AR iPad game impacts history instruction for young elementary students and their teachers. We will examine the potential of the game to create deep, engaging, and meaningful learning experiences for students. At its core, the intention of this study is to provide a “proof of concept” that this type of AR game based learning experience can be successfully developed with teachers and implemented with this particular age group. Additionally, this study aims to contribute to the literature on research methodology and game design with early elementary learners as little currently exists. For this study, researchers partnered with 2nd grade teachers at a northeastern United States private school located within a historical district. Specifically, the researchers examined:

1. What flow experiences do young elementary students have while playing a mobile digital augmented reality game?
2. What relationship exists between young elementary students’ mobile digital augmented reality game based learning experience and their learning outcomes?
3. What are the attitudes of young elementary students and teachers regarding this type of game based learning?

Methodology

To explore the application of game-based learning to the social studies curriculum, the researchers worked with three second grade classes at a private urban elementary school located in eastern Pennsylvania. This convenience sample consisted of approximately 37 students ages 6-8, along with their classroom teachers. The size of each class was approximately 12 students but some data were not collected due to student absences or failures to complete the unit. This project employs a mixed methods and design based research (DBR) approach (Barab, 2002). A mobile digital AR learning game is a novel instructional strategy for early elementary students; no “best practices” for implementation or design have been established. A mixed methods approach allows the researcher to collect both quantifiable targeted data and rich emergent data and use the qualitative data to triangulate and contextualize quantitative findings (Maxwell, 2010).

The quantitative data for this study came from two research instruments and a teacher-designed end-of-unit assessment. The first instrument, the game attitudes questionnaire (GAQ), was administered prior to the gaming experience. The GAQ assessed students’ attitudes toward gaming both in educational and non-educational environments using a Likert-type scale and also collected demographic information such as gender, age, and ethnicity. Similar to Bressler and Bodzin (2013), our study developed the GAQ by selecting items from the scale developed by Bonanno and Kommers (2008). The final instrument is comprised of 4 items and had a Cronbach’s alpha of .864. The second instrument, a Likert-type scale flow questionnaire (FQ) was given to students immediately after each gaming experience. This FQ has been modified from existing scales (Bressler, 2014) to match the reading level and comprehension of a typical 2nd grade student. The FQ consists of 11 items and had a Cronbach’s alpha of .884. The pre-existing, teacher-created end-of-unit test constituted the primary assessment tool for examining students’ learning outcomes. The test consisted of 23 items, required mostly “fill in the blank” responses, and emphasized fact-recall. During the game development process, some of the post-test content was included in the
game while other content was purposefully excluded. The result was two sub-scales: game-related items (N=11) vs. non-game-related items (N=12). The game-related items received attention during game play (e.g., the year was Bethlehem founded) while the non-game-related items were covered only during the traditional, in-class instruction by the teacher.

The qualitative sources included whole-class de-briefing discussions, interviews with selected students, and teacher comments. Both research instruments were adapted from the literature, but adjusted for the level of our participants: we modified the language to be appropriate for early elementary learners, reviewed the items with external experts, piloted the instruments with elementary students, and then reviewed the final items for internal consistency.

The Game

Although a few different game platforms were considered, the ARIS platform (www.arisgames.org) was chosen due to its inclusion of game-elements and geo-location features as well as its strong user-community support groups. Initial versions of the game were play-tested by small groups of elementary students and elementary teachers and then revised based on feedback and observations. The “build, play-test, revise” cycle produced four beta iterations of the game prior to the final production version.

During gameplay, teams of two or three to complete a series of quests in order to “level up” and earn the rank of “Master Moravian Historian”. Each quest requires players to navigate to a historical location. Using the ARIS platform, the game drew upon the iPad’s GPS capabilities to provide a dynamic display of students’ current location on a satellite image, with interactive text and graphics arising as students arrived at game destinations. This content could be the opportunity to view and converse with a historical character, view a historical document or image, solve a problem, input a typed answer, or collect a virtual item. Players were instructed to take turns being the “navigator” holding the iPad and reading the game content.

Implementation

Gaming is a social experience for children (Inal & Cagiltay, 2007), so to replicate a true gaming experience and to optimize opportunities for peer-scaffolding, students were grouped by their teachers into dyads or triads for game play. Each team was given one iPad and an adult chaperone. Each class had two game sessions less than one week apart to allow them to develop an adequate level of game “skill” to facilitate the potential for a flow experience. The groups were not discouraged from collaborating with each other, as the sharing of game knowledge is a cultural norm of children playing games. Each outdoor segment of game play lasted between 45-60 minutes. At a pre-designated time, chaperones collected the iPads and led their students through the flow questionnaire while still in the field so as to immediately capture the students’ experience. After the outside segment was completed, students returned to the classroom to participate in a post-play debrief session led by the teacher. After all of the classes had completed game play, the teachers completed a short-answer online survey to gather data about their perceptions of the experience. This online survey was shortly followed by a group debrief session involving all three teachers and the researcher. The unit test was given to the students about two months after game play (winter break and many snow days occurred in between) and copies of the test were given to the researcher. Six students were then selected for individual interviews with the researcher and a final teacher group debrief session was conducted.

Results

Flow experience

Students’ in-game flow experiences were measured using a FQ administered at the end of the second day of game play (see Table 1). Analyzing qualitative data provided additional contextual information. Given the overall mean flow score of 4.55 (N=32), we conclude that students experienced high rates of flow during play sessions. Flow scores, observations, field notes, and session transcripts support this finding.
### Table 1: Flow questionnaire results.

<table>
<thead>
<tr>
<th>Class</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>12</td>
<td>4.36</td>
<td>.36</td>
</tr>
<tr>
<td>Class 2</td>
<td>10</td>
<td>4.61</td>
<td>.39</td>
</tr>
<tr>
<td>Class 3</td>
<td>10</td>
<td>4.71</td>
<td>.38</td>
</tr>
<tr>
<td>Overall</td>
<td>32</td>
<td>4.55</td>
<td>.39</td>
</tr>
</tbody>
</table>

Students described losing track of time, feeling challenged but capable, feeling intrinsically motivated, knowing what to do, enjoying the experience immensely, and being rewarded for progress (getting feedback)—all indicative of Csikszentmihalyi’s (1990) characteristics of a flow experience. Many students also expressed an emotional connection to game characters suggesting a truly immersive gaming experience. As one student noted, “Sometimes, I felt like it was so real that I almost wanted to touch it, like shake the person’s hand.” (20-C2D1-13). The researchers and teachers were asked repeatedly by the students to “play again!” Although it seems clear that these students mostly had a positive experience playing this game, the qualitative data also provide some insight as to possible barriers to flow such as trouble seeing the iPad in direct sunlight, trouble understanding geospatial concepts, “glitches” with GPS triggering, and trouble sharing iPad with partner. While these issues were recurring themes, only in one instance did they appear to permanently disrupt the potential of flow. It seemed to this researcher that these students were very forgiving of what they termed “glitches” and were eager to solve them and move forward.

### Learning outcomes

Student learning was measured by a teacher-designed end-of-unit test (see Table 2). Across all three classes, 65% of students performed better on game content than non-game content. Students who performed below 90% on non-game content (N=12) performed an average of 14.6% better on game-related content suggesting that students who may not respond as well to traditional instruction do better with game-based learning. This finding is also supported within the qualitative data. As one teacher relayed, “I have one little boy…that has a difficult time when we have cooperative group work. He usually just kind of falls to the back of the group and lets everybody else do the participating, and he was more involved with [the game] (T1-TD1-171-173). The student referenced scored 13.6% better on game-related content than on non-game related content.

### Table 2: Unit Test Results

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Total Test Avg</th>
<th>Game-related items</th>
<th>Non-game-related items</th>
<th>Difference between Game and non-game</th>
<th>Percentage of students performing better on game-related items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>12</td>
<td>66.7%</td>
<td>71.7%</td>
<td>62.1%</td>
<td>9.6%</td>
<td>81.8%</td>
</tr>
<tr>
<td>Class 2</td>
<td>12</td>
<td>89.4%</td>
<td>95.3%</td>
<td>91.7%</td>
<td>3.5%</td>
<td>50.0%</td>
</tr>
<tr>
<td>Class 3</td>
<td>11</td>
<td>92.9%</td>
<td>95.0%</td>
<td>91.1%</td>
<td>3.9%</td>
<td>63.6%</td>
</tr>
<tr>
<td>Overall</td>
<td>34</td>
<td>83.2%</td>
<td>87.6%</td>
<td>81.9%</td>
<td>5.6%</td>
<td>64.7%</td>
</tr>
</tbody>
</table>

In the post-game debrief and subsequent interviews, students were able to recall historical facts from the game, including names of historical places and figures, and demonstrated an understanding of colonial Moravian society. The students were very eager to participate in the class debrief sessions with many hands were in the air as the teacher led the discussion. During one post-game debrief session a class was discussing a quest where they had to figure out the order in which the Moravian community built their places of worship. This was not a topic they had yet covered in regular class instruction. Students were able to recall, and spell, all three buildings in the correct order (2,13,5-C1D2-19-27).

### Game Attitudes

With an overall mean of 4.45, the game attitudes questionnaire (see Table 3) reveals that prior to playing our game, these students already had a positive opinion of games, felt a high level of self-efficacy towards games, and pos-
sessed a positive attitude toward learning with games.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>I know I could play a game like <em>Club Penguin</em> or <em>Minecraft</em>.</td>
<td>4.19</td>
<td>1.151</td>
<td>37</td>
</tr>
<tr>
<td>I like learning with games.</td>
<td>4.35</td>
<td>1.006</td>
<td>37</td>
</tr>
<tr>
<td>I like playing games.</td>
<td>4.81</td>
<td>.739</td>
<td>37</td>
</tr>
<tr>
<td>I can figure out the best way to play a game by myself.</td>
<td>4.43</td>
<td>1.168</td>
<td>37</td>
</tr>
</tbody>
</table>

Table 3: Game Attitudes Questionnaire Results

Discussion

The results of this study suggest that a carefully designed serious game can be implemented as a successful social studies learning experience for children as young as seven years old. These students were engaged and immersed in the subject of colonial Moravian history, a subject that may not seem relevant to the typical second grader. By bringing these historical figures “to life,” giving agency to the students, and placing history in situ, these students connected with the material that is typically deemed “difficult” to teach. As one teacher noted, «As we were reading through the information, they would make references to things they learned in the game or things they did in the game. I think that’s a little bit empowering for them because they’re like hey, we already know about this. Whereas before, they didn’t know anything until we told them.” (T2-TD1-33)

Methodological implications

As mentioned earlier, a DBR approach allowed the researchers to make in-progress adjustments that appeared to be valuable in producing a positive gaming experience for students and teachers. Given the eclectic nature of games, the lack of GBL research with this population, and the dynamic nature of a real school environment, the responsiveness of DBR gave the researchers the agility in the field required to address the needs of students and teachers within their native environment. This study suggests that a DBR approach may be valuable to other researchers studying games and learning.

Another methodological consideration supported by this study is the practice of allowing participants, especially young students, to have two identical sessions of play, survey, and debrief. The original premise for having students play the game twice was supported by the idea that flow is more likely to be experienced when an ideal level of skill meets an ideal level of challenge. By providing students a “practice” opportunity to play this new game, the participants might be more likely to experience flow during their subsequent play sessions. While the researcher’s observations suggest that this original premise is supported, the data also suggests that having an opportunity to “practice” the survey was additionally valuable. The concept of being “in the zone” may be new to young students and thus the ability to articulate and self-report on this type of mental state may need to be learned.

Game Design Implications

At the outset of this study, it was very important to the researcher that this curriculum-based game “felt like a real game” in order to maximize the potential for a flow experience. Thus, a strong emphasis was placed on fine-tuning the game interface, elements, and design while integrating historical content. It was predicted that a high level of engagement, driven by a true gaming experience, would transfer into the learning process. It would seem that, for this particular group of students, transfer did occur. Throughout the unit, students continued to express excitement for the topic of Moravian history and qualitative evidence suggests that this was due, at least partly, to their GBL experience. The results of this study lead us to make some initial observations and recommendations regarding game design and implementation for this particular population (second graders): (a) Geospatial skills require significant scaffolding. (b) Reading requirements needed to be both grade level and not distracting to game play (even if they were capable of reading something, they did not want to do a lot of reading; they wanted to keep playing!). (c) Video content was not received well in initial testing. Videos were perceived to “take too long”. Students wanted to move on quickly. (d) Certain types of gaming activities were popular and well received such as collecting items, typing codes, and figuring out the right order. (e) Curriculum content needs to be an active part of the game experience and not provided as “additional info.” What they need to learn is what they should also need to complete a quest and not something that adds description to a character interaction or location. (f) Teachers provided valuable insights that guided the researcher’s design process. As this study suggests, if the design process is successful, a flow-experience will emerge out of the confluence of the content area, teaching approach, and gaming experience even for our youngest learners.
References


Working Example: Using Popular Games for Serious Learning
Scot Osterweil, Massachusetts Institute of Technology
Eric Klopfer, Massachusetts Institute of Technology
Carole Urbano, Massachusetts Institute of Technology
Philip Tan, Massachusetts Institute of Technology
Rik Eberhardt, Massachusetts Institute of Technology

Figure 1: Students work together on a game from a previous project.

http://www.workingexamples.org/example/show/707

A team of MIT researchers, in close collaboration with high school humanities teachers, is designing and testing supplemental teaching resources for using games to support learning in the classroom. The images included in the Phases below represent games that have been central to our thinking about games as learning tools, but we hope to keep adding to the project’s ludography!

Seed

Tell us about your idea or project. What’s your vision?

There is a large and growing body of research identifying affordances of games that can support learning. In *What Video Games Have to Teach Us About Learning and Literacy*, linguist and educator James Paul Gee describes how computer and video games are potent learning environments. He observes that games are simulations of complex systems that allow learners to explore through trial and error and at their own pace (Gee, 2003). Building on Gee’s work, Constance Steinkuehler shows that players of social online games display complex forms of distributed cognition, collaborative problem-solving practices, novel literacy practices, scientific habits of mind, computational literacy, and reciprocal apprenticeship. In other words, games give players an opportunity to organize themselves to solve problems together through information sharing, crafting of new tools (in-game tools as well as helpful modifications to the game), and engaging in some basics of scientific thought, including “hypothesis testing and revision and model-based reasoning” (Steinkuehler, 2007).

This research has lent itself to further investigations of games’ potential in STEM (science, technology, engineering, and mathematics) learning. As these domains seem to dominate the current fields of innovation, STEM learning is incredibly important for today’s learners. However, Gee’s work highlights the different manifestations of literacy and the ways to teach it, from navigating language to parsing semiotic meanings to interacting socially
In the American education system, these skills are associated with the humanities, which include the content domains of English, foreign languages, history, and the like. These fields too remain relevant for modern students, and yet they are often neglected or marginalized in discussions around education at all levels. Yet, teachers of the humanities are held to high and shifting standards around these so-called “soft” skills (written and verbal communication; literacy and reading comprehension) and skills also associated with STEM disciplines as approached differently by humanists (investigative systems thinking, critical reasoning, global citizenship).

Our project, sponsored by the Arthur Vining Davis Foundation, seeks to apply games’ capacity for implicitly teaching such skills. Our team seeks to create an adaptable set of curriculum supplement resources around commercially available digital and tabletop/physical (“analog”) games. These resources will be designed for and with high school humanities teachers in the Boston area, using games to which their students are already exposed and may already be playing.

This project will be supported by qualitative research methods and learning science perspectives. The goals of the curriculum resources we aim to develop draws upon games’ learning affordances, including:

- Scaffolding complex systems, allowing learning to build understanding incrementally through trial and error.
- Including opportunities for collaborative learning and team play.
- Modelling hypothesis testing and model-based reasoning.
- Embedding learning in a compelling narrative that engages students and motivates them to persist in the game when faced with challenging obstacles.
- Providing multiple paths for problem solving to accommodate multiple learning styles.
- Providing ongoing feedback and rewards that allow student to continuously monitor their own progress and motivate them to keep trying despite initial failures.

**What problem are you trying to solve and why does it matter?**

Our preliminary research has suggested that high school humanities teachers have been collectively encountering difficulties around the skills discussed above: writing and critical argumentation, verbal presentation, critical analysis, and deeper literacy practices such as discerning authorial intent. Games researchers, such as those cited above, have studied games’ proficiency in fostering many of these skills, which can be further practiced via

teachers' existing pedagogies.

In order to avoid treating teachers as the other “guinea pigs” of learning research, sometimes made as much so as the students themselves, the resources we aim to create are not to prescribe curricula, highly specific activities, or even particular games to teachers for use. Rather than requiring teachers to adapt their curricula around an outside source, this project will tackle pedagogical issues with teachers as full co-designers and authors of curriculum supplements that slot in naturally with teachers’ own styles and goals in ways both individual and scalable. Thus, we intend for the delivered resources to act as guides for teachers to use games in ways that work for their classrooms.

This research is not developing new games to teach the skills outlined above. Although these development projects clearly have their merits and are highly valued at MIT and elsewhere, they are not always feasible in classrooms with time pressures and limited access to particular technologies. Instead, the games already in students’ mediascapes will become valid spaces for explorative coursework, potentially inciting motivation via fandom in some students and offering novel and intriguing ways to interact with games and with learning for students not otherwise interested in games. The project resources will include guides for implementation in both the classroom and the home and/or third spaces, drawing upon what can be uniquely available in these spaces.

Figure 3: Gone Home. (http://www.workingexamples.org/uploads/Image/959)

How does this work relate to what others are doing in the field?

This research follows in the lineage of Kurt Squire’s work in bringing Civilization into world history classrooms (2011). That work itself draws from that of Gee as cited above and the trajectories of others in the game-based learning field (see, for example, Glazer & Hergenrader, 2014).
MIT also has a history with game-based learning via the labs in which the current research is housed, The Education Arcade and the MIT Game Lab, which have created a series of innovative online and mobile games for use in classrooms and informal learning settings. Assessment of these projects shows that they have the best learning outcomes when they are embedded in the right “social envelope” – i.e., a social context that includes adult involvement, collaborative play, and integration with classroom learning. Selected highlights of the work done in these labs aimed at creating this optimal “social envelope” include the following:

1. In 2009, the Education Arcade partnered with Maryland Public Television and four public school districts in Maryland to test the learning impact of *Lure of the Labyrinth*, a state-of-the-art video game that provides engaging opportunities to work through core mathematical concepts. While the pilot focused on adoption by teachers in four districts that mandated participation, we discovered that a far greater number of teachers beyond these four districts spontaneously and enthusiastically adopted the game after hearing about its impact from their colleagues. This experience provides persuasive evidence of teacher interest in adopting any new tool that sparks student interest and supports learning. *Lure of the Labyrinth* has built-in teacher materials, providing guidance for introducing students to the game and using it in the classroom. These resources supported spontaneous adoption by giving teachers confidence that they could use the game effectively.

2. In the spring of 2011, the Education Arcade partnered with the Smithsonian Institution to create a new learning genre: the curated alternate reality game. Funded by NSF, Vanished was designed as an informal (out-of-school) learning experience; therefore, outreach did not target teachers. Nevertheless, we found that the best learning outcomes among the 6,000 middle-schoolers who played Vanished were associated with students who were introduced to this science mystery game by teachers and were encouraged to reflect on their game experiences in the classroom. Teacher response to the game was enthusiastic, and they noted remarkable learning outcomes – particularly among students who had shown little interest in or aptitude for science prior to playing the game.

3. In the spring of 2012, the Education Arcade conducted a nationwide competition wherein teams of math students played *Lure of the Labyrinth*, competing for prizes based on many categories including total points, learning gains, and best teacher-generated strategies for curriculum integration. Building on our experience with Vanished and the original *Labyrinth* pilot, our outreach strategy targeted teachers directly, with impressive results. Nearly 14,000 students across the country were enrolled by their teachers to participate in the competition, and these teachers provided a wealth of positive feedback. Teachers were supported by the professional development materials included on the *Labyrinth* website.
How can our community support you? (e.g. expertise, resources, feedback, etc.)

We know that the game-based learning scene houses a myriad of perspectives and wonderful support structures, so we are looking to the Working Examples and GLS communities to help us shape our side of the co-design, both in our ability to connect to and produce game-based learning research and in our ability to work with teachers constructively. Since Using Popular Games for Serious Learning is still in its early stages, we hope to collect feedback, critiques, and suggestions around the research literature (e.g. previous studies we may have missed), approaches to co-designing curricula and related teaching materials, qualitative work with teachers and in schools, experiences of piloting and implementing/scaling game-based learning in classrooms, and building a list of resources (including games) for teachers to draw upon as they adapt our resources to their curricula. We appreciated the discussions we had at the GLS Conference and hope to continue these over the course of the project, as a truly collaborative effort between our team of researchers and teachers and the communities of practice of both.

Figure 5: Assassin’s Creed. (http://www.workingexamples.org/uploads/Image/966)

Tell us about the team you have assembled or hope to assemble.

Our team includes Principal Investigators, staff, and research assistants of The Education Arcade and the MIT Game Lab, working in collaboration with high school classroom teachers in a Boston area public school system.

Principal Investigator Scot Osterweil is the Creative Director of the Education Arcade and a research director in the MIT Comparative Media Studies Program. He is also a founding member and Creative Director of the Learning Games Network, where he leads the Gates Foundation’s Language Learning Initiative (ESL). Co-PI Eric Klopfer is the Scheller Career Development Professor of Science Education and Educational Technology at MIT, as well as the Director of the MIT Teacher Education Program and the Director of The Education Arcade.

Carole Urbano manages the communications and outreach for The Education Arcade and acts as liaison between school systems and MIT learning researchers.

Philip Tan is a research scientist at the MIT Game Lab and was the executive director for the US operations of the Singapore-MIT GAMBIT Game Lab, a game research initiative.

Rik Eberhardt is the Studio Manager for the MIT Game Lab, an instructor for two MIT Game Lab classes on game production, and has served as a mentor and director for multiple game development projects.

The team’s research assistants are Kyrie Caldwell, a graduate student in MIT’s Comparative Media Studies program, and Jesse Sell, a recent alumnus of the program. They are interested respectively in gendered semiotics of games and other play experiences and broadcast and spectatorship models in professional video gaming.
We are also working with a team of eight humanities teachers and numerous administrators across four high schools in a Boston area school district.

Figure 6: The Last Express. (http://www.workingexamples.org/uploads/Image/967)

Sprout

Tell us about your process and how your idea is evolving throughout the project.

The planning stage consisted of logistical and conceptual work, including recruitment of the team of teachers and our own brainstorming around types of games to use, goals and models of the resources, use cases, and critical approaches to games, both as part of the recruitment process and to prototype the deliverables. We hold weekly meetings in which we check in on logistical aspects and iterate upon previous ideas.

Importantly, our work has been impacted by interviews conducted with semi-local teachers of high school humanities, which specified particular skills that students have had difficulty in learning and performing. A first team meeting with administrators of the target school district was also helpful in testing the waters for teacher interest and likely adoption, as well as a general climate of the student body and district policies. We have also constructed and distributed a survey for secondary school teachers in the humanities to further inform our boundaries in terms of accessible technology, classroom time, current practices around and personal knowledge of games, etc. We also hope to test materials and ideas as frequently as possible, starting with an exploratory test conducted in the classroom of one of our co-designing teachers.

As the project is closely tied to teacher input and co-design, we want to continue this flexible and reflexive process of collecting data and iterating, hopefully including feedback and contributions as we begin working with teachers.
Have your initial concepts/designs changed? Why have they changed? Show us how they're being refined and iterated.

We were able to share the first stages of this project at the Games+Learning+Society Conference in 2015. The conference came soon after the project's classroom debut, which gave us the opportunity to work through that pilot for and with the GLS community. In this first classroom test, we used *Rome: Total War* as an interactive text in a Latin classroom, framed in a role-play setting in which two revolving students acted as consuls to the rest of the class's Senate. Especially in regard to this test, one key thread in the feedback from GLS raised a concern for the innovation of our approach, particularly in terms of which games and analytical styles would be at the basis of the resources we aim to create.

We have been considering the connection between content and skills, namely that the affordances of games include more than content delivery, and as a part of existing classrooms and curricula, these games may better serve skill development and practice, for instance. Although always a key part of our project, it has become clear to us that the piloting process and resulting teachers' supplemental materials will need to focus on promoting creative uses of games outside of their content and the content covered in classrooms, leaving ample space and yet providing sufficient guidance for teachers to connect these games to lessons through not only content, but more importantly the skills valued in humanities education, such as critical thinking, various kinds of literacy, persuasive argumentation, problem solving, systems thinking, social emotional skills, etc.

How will you make sure that this thing you’re creating will be adopted by your audience?

One of the foundational aspects of this project is its co-design process, incorporating teacher feedback at every stage. Thus, we began with the use of qualitative data from teachers in shaping our initial approach, which will be presented with our co-designing and piloting teachers. We plan to support, accommodate, and collaborate around teachers' and district needs throughout the design process via:

- Regular meetings with our teacher advisors.
- Meetings with curriculum coordinators.
- Presentations and demonstrations at participating schools to cultivate interest in game-based learning.
- Visits to participating classrooms.
- Distribution of regular project updates to decision-makers within both districts.
When we do pilot the program further, we will be drawing upon data and analysis derived from the following:

- Surveys and structured interviews with participating teachers and administrators.
- Classroom observation to document teacher fidelity to the recommendations and techniques presented in the professional development and curriculum materials as well as student response.
- Focus groups with students.
- Pre- and post-tests to assess student learning outcomes, both in terms of concept mastery and development of deeper learning skills such as critical thinking, problem solving, effective communication, collaboration, and learning to learn.
- Analysis of data generated by game play—i.e., qualitative evaluation of student posts in game forums, time spent playing different aspects of the selected games, and game progress.
- Correlation of game-generated data with survey, test, observation, and interview results.

**How might your project scale to provide greater impact?**

In our initial research, we noted that some teachers are already experimenting with use of popular games as learning tools on their own initiative. For example, in the January 8, 2013 issue of eSchool News, an online publication for educators, the lead article describes how some teachers are using popular games to help students develop skills “from writing and physics to teamwork and problem solving.” While teacher interest is confirmed by such reports, it is also clear that systematic development of curriculum materials and assessment of learning outcomes based on use of popular games—a critical component for supporting effective adoption—is not occurring.

Thus, this project does not aim to just insert commercial-game-based learning in the curricula of those teachers who co-design and pilot with us. Instead, through that co-design process, we will focus on developing teacher professional development and curriculum resources that support the educational use of popular commercial games in ways that are built to adapt to teachers’ individual situations (and overarching ones, such as the country-wide Common Core curriculum standards) for the effective adoption of existing games for classroom learning.

Our main concerns in scaling this work revolve around access to technology (including quantity of devices and the power/ability of the hardware), teachers’ professional development and classroom time, curricula flexibility, pedagogical need and use, game types/genres and varying levels of accessibility therein, and related issues that may arise. The preliminary data collection and that from actual classroom implementation will be key in designing more flexibility, and therefore scalability, into the supplemental resources to be produced.

**Bloom**

**Looking forward, what kind of impact do you think your work will have? How might it continue to evolve?**

As mentioned elsewhere, Using Popular Games in Serious Learning is still in its early stages, and has not yet begun to bloom. However, our team will continue updating the online Working Example where possible as we co-design with teachers and pilot in classrooms.

**References**


Acknowledgments

We would like to acknowledge the Arthur Vining Davis Foundations for support of this project.
Design students need to learn ethnographic skills for user-centered design. We want them to learn that in an interview there are different kinds of questions that can lead to different kind of responses. To do this, we are designing a video game to allow a situated learning experience through the dynamics between people, content, and context. In this game the following concepts are being applied: Transformational Play (Barab, 2010), Player Experience Need of Satisfaction (Rigby & Ryan, 2011) and the 36 learning principles of learning (Gee, 2003).

Seed

Tell us about your idea or project. What's your vision?

Based on situated learning theories, we want to make a transformational videogame in which people, content and context can give value to educational experiences.

We see virtual environments as an ideal resource with multiple affordances for situated learning spaces inside the traditional school system and as an opportunity for researchers to study the importance of the integration of the information into daily activities of the student.

For the design of this game we are applying transformational play concepts when students commit with learning levels (Barab, 2010), Player Experience Need of Satisfaction (Rigby & Ryan, 2011) and the 36 learning principles of learning (Gee, 2003).

What problem are you trying to solve and why does it matter?

The problem is that design students are not making an empathic connection with the final user. The user is a basic condition for any experience design; he has to be present in two stages of the process: the first so they can be emphatic of his needs; second when he can evaluate the object or service created.

For the first part, designers need to know and apply different qualitative investigation techniques like a diary, observation and interview, just to name the most common ones. The main goal of this process is to obtain significant information, with this we mean sufficient and with quality, so they can be able to work with real concepts created
after an organization of intelligent perceptions (Noel & Frascara, 2012).

The problem with the lack of empathy is that without this cognitive and emotional skill, is very difficult for a designer to do a good job, especially when the most of the problems they need to solve are related to human experiences.

**What are your goals and how will you know if you’ve achieved them?**

The main goal is to design, develop and evaluate a educational videogame to increase the learning motivation of designers, using as a pedagogical frame situated learning theory through: Gee’s (2003) videogames learning design principles, Rigby & Ryan (2011) player experience needs of satisfaction and transformational play (2010).

The particular goals of this study are:

- to create a videogame prototype based on the established methodology;
- to evaluate the usability, learning and motivation of the prototype with design students;
- to establish the needs of the team work for the development of further prototype levels and the development of videogames for learning based on the same theoretical framework model.

For the *first particular goal*, the three theoretical models will be reviewed to find their similarities and points of convergence and use the model to design the learning experience.

For the *second particular goal*, the learning experience will be evaluated through a qualitative study with and emphasis in the observation of the experience. As a result we will have all the data related to decisions and attitudes taken by the students during the gaming experience. Also, before the experience a survey will be applied to know information related to their gaming experiences, and after the experience another survey and an interview will be applied to know how the student felt during the experience. The model to evaluate if the main goal was achieved is still in process.

After all the experiences, hopefully the information gathered will help to establish the technical, economical and people affordances needs to convene a team for further similar projects.

**Who will your work impact? What do you know about them?**

The final users of this game are interaction design students. They are between 18 and 21 years approximately. Most of them had grown up playing videogames and that's why they have a strong connection with that theme. They are very interested in producing videogames, but they are not clear of the difficulty it takes.

An important consideration is that the students are amazed by the way this digital products made them feel but they are not conscious of the amount of work that is required to produce them. We think that a videogame can be a good way to engage them but we are curious to know if the high exposure of this interactive experiences can demand specific stimulating affordances.

**Tell us about the team you have assembled or hope to assemble.**

Initially this project was a PhD proposal with only two people working in the design: me, Roberto Razo as student and researcher, and Antonio Santos as the academic advisor who guided all the theoretical part of the investigation.

For the video game production, we will be supported with a video game company that is emerging with very professional interesting projects named Bromio.

Recently a strategic and innovation designer student is working in the project as an assistant researcher.

**Sprout**

**Tell us about your process and how your idea is evolving throughout the project.**

Initially the videogame was based on transformational play theory with the idea to develop a virtual experience based on the different engagement levels: *procedural*, *conceptual*, *consequential*, and *critical*. A Transformational Game is not exclusive of a virtual environment as long as the engagement levels are achieved and it can be implemented in a classroom or any other place. So because the idea was to implement this theory in a videogame,
the design model needed to take into account why video games as medium can be so motivating to the player.

*Glued to Games* (Rigby & Ryan, 2011) is a book that presents the Player Experience Needs of Satisfaction (PENS) as a very important concept that we thought it needed to be consider for the design of our game. They present this needs as the reason why the videogames are so engaging to some people: *need for competence, need for autonomy, and need for relatedness*. So every well designed game have to cover this needs considering the human factor that make us spend so much time engaged to this interactive spaces.

Also for the final design model, the 36 learning principles of learning (Gee, 2003) are considered as the principal guide to reach the educational goals of the proposal.

So the design model of this project was based on three big concepts:

1. Transformational Play Theory (Barab, 2010).
3. 36 principles of learning (Gee).

The following table (*Spanish*) shows how they are related:


**What are some of your initial concepts or designs? We’d love to see them.**

![Initial Visual Concepts](http://www.workingexamples.org/uploads/File/837)

**Figure 1: Initial Visual Concepts.**

**Have your initial concepts/designs changed? Why have they changed? Show us how they’re being refined and iterated.**

The story of the game is about a character that needs to obtain information through interviewing different people in a place that was recently adopted by another civilization. We select some specific recommendations, based on literature, to obtain better results with each interview and it consists with what and how experts ask, included in the following list: (a) what, when, where, who instead of how, why; (b) last instance instead of typical instance; (c) compare and contrast instead of criticize; (d) encourage stories; (e) avoid asking binary questions; (f) don’t suggest answers to your questions.
Also in the game the following interview flow will be encouraged:

![Interview for Empathy](Plattner, 2010).

**The call of hero:** For this game, the main purpose of the character in the story is to help the Designer Master to create a flag, ideally to make an emphatic connection between two cultures. The Flag Master is an old man that makes marvelous designs that had changed the history of many places, the problem is that he is so old that he can’t walk and hear very well any more; for this reason, you as his apprentice need to gather all the information he needs for creating this object. This way the master is going to interpret all this data and transform it to visual object, the flag.

**How might your project scale to provide greater impact?**

Currently we are working on the first prototype for the PhD dissertation, but there are plans for scale the prototype for a greater impact in the students.

**Playable Digital Prototype - Level 1:**

Goal of the player is to gather information for the Master. To do this he needs to make 8 interviews in which he have to choose what questions to ask from a multiple option (three questions each). The questions will be based on the previous Master recommendations and depending which ones they choose, they will achieve a more or less level of empathy. The empathy level in each interview will decide if the final flag design will consider aspects of both cultures and will define the consequence of the final result.

**Procedural Engagement:** The system (the Master) will give the player the recommendation of which questions to make. Based on a visual diagram, the player must seek for the center of a three circles: the external one is the context, the middle one is the action and the one of the center is the emotions.

**Conceptual Engagement:** The player has the opportunity to choose which question to make based on the Master recommendations, which represent the best practice.

**Critical Engagement:** Depending on what kind of information you gather, eventually the Flag will have a different design and different outcomes, which affects somehow the context in which the game is taking part.

**Playable Digital Prototype - Level 2:**

In this version after the first Level is completed, the Master dies but he leaves the resources of how to make a good flag around the village so the player have to find them first. While he gather all the recommendations, a pool of elements which represent the different kind of questions he can make, will be display in an interface in which they can design and check the interview before they make it. This interface will represent a way to communicate with the Design Master who is already dead. In this version of the game there are not going to choose from a multiple option but instead they will need to find the resources to design a good interview that gives them the best possible
answers.

Also because it will be no Master Designer to make the flag, another section of the game will appear in which the player will be able to design of the flag. For each well done interview the designer will receive resources (materials) to create a flag and at the same time, the information received will help him to know which of this elements and symbolism will help them to reach their final goal which is to support an ideological and cultural conquest through this banner.

**Procedural Engagement:** The context will have the information that he needs to make the interviews, also the characters will give the resources for the flag design depending of the quality of the interview.

**Conceptual Engagement:** The player will have an interface, which represents a spiritual communication with the Master, this will allow him to design and see the different results between the different options of questions.

**Critical Engagement:** Depending what kind of questions you make, the interview will have different results, depending on the quality of the interview the player will receive different materials and depending the materials, it will be a different result in the flag which affects somehow the context in which the game is taking part.

**Playable Digital Prototype - Level 3:**

For further phases, the idea is to make a multiplayer game in which every player will play with different characters with their own missions; they will have to apply different ethnographic skills (observation, interview) to complete their task and organize the information (emphatic charts, personas chart) to reach their own goals and finish the game.

**References**


Mobile Movement Mathematics (M3): Discussing Iterative (re)Design of a Digital Tablet Tutor-Game for Learning Fractions

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Abstract: Researchers developed Iteration-1 (i1) of a digital tablet tutor-game exploring the impact of narratives (strong (S) vs. weak (W)) and gestural mechanics (conceptual (C) vs. deictic (D)) on players’ understanding of mathematical fractions. Tutor-log data revealed that students using conceptual gestures were significantly more accurate at estimating and denominating fractions than students using deictic gestures and a possible interaction between narrative and gesture. We discuss how these findings, combined with observational notes, student exit surveys and clinical interviews informed revisions for the redesign of assets, mechanics, pedagogy (instructions/scaffolding/feedback) and narrative for Iteration 2 (i2).

Introduction

How do narrative and gesture impact learning on digital-tablet tutor-games? Learning, in its native state, is situated in contexts (Lave, 1988; Brown, Collins & Duguid, 1989; Anderson, Reder, & Simon, 1996; Schwartz & Bransford, 1999) and emerges from the experiences that learners identify with and take an active role to “recognize the value of concepts as tools useful for understanding and solving problems central to the context in which one is embodied…” (Barab, Sadler, Heiselt, Hickey, & Zuiker, 2007). Digital-tablets are virtual portals that leverage the visual, auditory and haptic channels of perception (Baddeley, 1986; Richer, AuBuschon & Cowan, 2010) and afford (Gibson, 1977) developers, educators and learners opportunities to situate experiences (Lesh, 1981; 1985) in game-like problem spaces and ground experiences (Barsalou, 2008) by utilizing the physicality of the gestural mechanics to embody concepts (Riconcente, 2011; Alibali & Nathan, 2012; Segal, Tversky & Black, 2014, Kang, Tversky, Black, 2014; Vitale, Swart & Black, 2014). The challenge in tutor-game research is controlling for the impact of manipulations and making adequate comparisons (Chi, 2014).

For narrative, Jiminez (2014) created a fractions game that assessed the impact of story using a single game architecture to create three variations that differed in asset depiction and story-level. This allowed Jiminez to control for all other factors and attribute the positive correlation between gain scores, story and enjoyment. For M3, we investigate whether narrative facilitates learning and mental model construction (Black, Turner & Bower, 1979) by creating a personally meaningful project (Papert, 1972) that fosters intrinsic interests and motivation (Cordova & Lepper, 1996; Prensky, 2001) or, if it simply adds to cognitive load (Sweller, 1988) as a seductive detail (Harp & Mayer, 1998; Adams, Mayer, MacNamara, Koenig, & Wainess, 2012)?

For gesture, Segal et al. (2014) also created multiple variations of a single tutor-game architecture to determine that learners performed better at simple arithmetic using functionally enactive and conceptually congruent gestures compared to static and identifying gestures. However, Byrge & Goldstone (2011) found better transfer of physics concepts (e.g., momentum) when gestures were transformed and incongruent (i.e., swipe right to move left). These different findings highlight the multidimensionality and functionality of gestures (McNeill, 1992) and the need to clarify what constitutes a beneficial intrinsic link between game mechanics and curricular concepts (Habgood & Ainsworth, 2011).

The current study, Mobile Movement Mathematics (M3), uses design-based research (DBR) to develop a tablet-based tutor-game for learning mathematical fractions and investigated two research questions: (a) How will situating learning using a narrative arc (characters, setting, plot) impact learning and motivation compared to a weak non-narrative structure? (b) How will conceptually enactive gestures impact performance and learning compared to pointing gestures? Crafting curriculum and designing contexts in an applied field like education, according to Brown (1992), must consider many research agendas in order to adequately capture learning. Thus, the current study presents performance data from the game-tutor, formal assessments, researcher observations, survey data and clinical interviews to quantify and qualify the impact of the game, its narrative, gestures and assets on student learning and to inform the redesign of M3 from i1 to i2.
Designing the Game: Iteration 1 (i1)

Fractions begin with fractures; the metaphors of mathematical thinking are grounded in our actions (Lakoff & Núñez, 2001). For example, the simple act of sharing an apple, splitting it in two equal parts underlies humans’ Number Sense (Dehaene, 1997; Norton & Wilkins, 2009). The natural abilities to estimate, meter magnitude, apportion and compare objects are all essential for fracturing. The curriculum for the M3 tutor-game is contoured around this situated embodied approach: Five levels with 5 fractions in each level. In Part 1, players estimate, de-nominate and numerate fractions by fracturing objects (i.e., an enerchi bar – a hybrid between a rectangular area model and number line). In Part 2, players determine equivalency between the previously 5 constructed fractions by ordering them from least to greatest: First along a horizontal axis left to right (magnification), then vertically bottom to top (verification) (Figure 1).

Developing Gestural Mechanics

Gestures represent ways for learners to reactivate (simulate) the perceptual states associated with underlying concepts and strategies (Goldin-Meadow, 1999). For example, Goldin-Meadow, Cook and Mitchell (2009) demonstrated that a pairing gesture (i.e., two fingers to identify two numbers as a pairing) facilitated elementary students strategies for arithmetic problems and how gestures as abstractions are rooted in relation to the body. Alibali and Nathan (2012) documented how gestures represent structure, orientation, action and correspondence in fractions learning. For i1, the tactile gestural interface of the digital tablet serves as a bridge between action and concept.

Echoing Hostetter’s and Alibali’s (2008) Gestures as Simulated Action, the tutor compares deictic gestures (i.e., pointing) that index the environment, to conceptual gestures (metaphorical / enactive / symbolic) that embody simulated actions for fractions (Figure 2). The gestural mechanics for M3 come from an exploratory study by Swart et al. (2014) that observed students fracturing objects, sets, containers and distances and used their actions as the bases for M3’s gestural mechanics. We hypothesized that conceptual gesturers would show better performance and learning than deictic gestures.
Developing Narrative

Developing an effective narrative invests the audience in the continuity of the characters, locations, objects, actions and themes and invests them into the plot’s trajectory (Graesser, Singer & Trabasso, 1994). The integration between the microstructure (details) and the macrostructure (abstractions) is especially important when building an interactive narrative if the details are the access points to concepts. Designers must situate players in problem spaces that foster mental model constructions (Johnson-Laird, 1980). Since narrative has been shown to help learners formulate coherent scripts into schemas and chunk them into coherent mental models (Black, Turner & Bower, 1979), investing players’ in the narrative will hopefully motivate their exploration of the problem space and encourage their practicing the procedures for creating and comparing fractions that leads to discovery learning (Brown, Collins & Duguid, 1989). Figure 3 shows the two narratives for comparison. The strong narrative is based on the television series Cyberchase and titled, Fix the Climatron. In the game-tutor, the player embarks with the agent, Jackie to a fictional land called Penguia to defeat the evil villain Hacker by energizing the enerchi bars that activate the HERObots. The weak narrative is titled Fractioneers! It is the same tutor-game but without characters, settings, story or explicit context. We hypothesized that a strong narrative will improve student performance, motivation and engagement better than the weak narrative.

Testing Iteration 1

After developing i1, researchers tested seventy-two students from grades 3 (n3 = 24), 4 (n 4=22) & 5 (n 5=26) grades (NTTL=72; x̄ age=10.31 years [1.64], 67% female) at an afterschool program in Harlem, New York City. In a mixed-methods 2x2 randomized factorial with repeated measures, students were assigned to play one of the 4 tutor environments (SC, n=17), (SD, n=18), (WC n=19), (WD, n=18). Each student completed a total of 3 one-hour sessions that included pre/post direct assessment using the rectangular area model from the game tutor to assess estimation, denomination, numeration and equivalency between fractions; pre/post transfer assessment using rectangular area models, shapes, collections, number lines, numerical fractions, equivalency, arithmetic, and word problems to assess estimation, denomination, numeration, equivalency (including ratio, proportion, scale), addition, subtraction and multiplication); log data from tutor play (estimation error, denomination-parts error, numeration error); written exit surveys (likert and free-response items assessing manipulation of narratives and gestures, comprehension, self-efficacy, motivation, engagement, persistence, preferences and concept learning) and pull-outs for video-recorded clinical interview pullouts. Two groups of 10 students each day (5/condition) extended over multiple weeks and portions of tutor play were also video-recorded.
Quantitative Data

Repeated measures ANOVA of pre-post assessments revealed that the tutor-game overall is effective at improving learners understanding of fractions with significant learning gains across all conditions for both the direct assessment ($F_{(1, 71)} = 48.9$, p< .001, $\eta_p^2 = .408$) as well as the transfer assessment ($F_{(1,71)} = 57.51$, p< .001, $\eta_p^2 = .448$). Moreover, there was a significant positive correlation between the direct content and transfer assessments ($r = .774$, n=38, p< .01), thereby confirming a strong relationship between the tutor content and more general fractions concepts and principles.

Tutor-Log Data: Estimation. Estimation error was lower for conceptual gestures than for deictic gesture users across strong and weak narrative. Means for groups C and D were 23.04 and 24.1: the distributions in the two groups differed (Mann–Whitney U = 248, Wilcoxon W= 477, $n_C =26$, $n_D = 20$, p < 0.08) and revealed a trend towards an interaction between gestures and narrative that requires further study. For unit fractions, estimation errors were lower for conceptual gestures than deictic gestures and approaching significance, $\bar{x}_C = 23.04$ and $\bar{x}_D = 24.1$, Mann–Whitney U = 231, Wilcoxon W= 462, $n_C =21$, $n_D = 29$, p < 0.15 and there was a similar trend towards interaction between narrative and gesture.

Tutor-Log Data: Denomination. Student performances denominating wholes into parts were more accurate for conceptual gestures than for deictic gestures. For levels 1 – 3, students using conceptual gestures denominated (i.e., correct number of divisions) with significantly less error than students using deictic gestures $\bar{x}_C = 18.66$ and $\bar{x}_D = 25.24$, Mann–Whitney U = 164.5, Wilcoxon W= 345.5, $n_C =19$, $n_D = 25$, p < 0.10. The number of denominations cuts that students made in error (e.g., 3 slices of the bar, 4 parts, for a denominator of 3) suggests a similar recurrent trend towards an interaction between gesture and narrative. Students were also significantly more accurate denoting unit fractions using conceptual gestures than deictic gestures; $\bar{x}_C = 17.95$ and $\bar{x}_D = 30.97$, Mann–Whitney U = 146, Wilcoxon W= 377, $n_C =21$, $n_D = 29$, p< 0.01.

Qualitative Data

Exit-Surveys: 5-Point Likert Scale. Items found strong indications that students across all conditions were highly motivated to play ($\bar{x}_M = 4.62 [.72]$, enjoyed playing ($\bar{x}_E = 4.59 [.67]$) and that they would persist in playing more levels ($\bar{x}_P = 4.62 [.70]$). Overall, student’s indicated that they liked learning on the iPad ($\bar{x}_L = 4.44 [1.00]$) even though they found the game moderately difficult ($\bar{x}_D = 3.79 [1.11]$). Their self-efficacy judgments for their performance on the game ($\bar{x}_{EF} = 3.90 [.94]$) showed a moderate correlation with difficulty ($r = .479$, N =71, p < .01).

Exit-Surveys: Free Responses. Students’ revealed important aspects about narrative and gesture. When students were asked to describe the game they played, only 12 students out of 37 (32%) mentioned aspects of the narrative (e.g., robots, penguins, Cyberchase). This reinforced the notion that the narrative needed to be strengthened. When students were asked to describe how they made fractions in the game, their descriptions of the fracturing process were more enactive (i.e., embodied) for the conceptual gestures (75%) than the deictic gestures (38%). However, there was overlap between the two conditions in their verbage with words like “cut”, “split” and “break”. We hypothesize that while conceptual gestures are more enactive of the processes of fractions, the gestural affordances of the digital tablet, even for the deictic condition, also contributed to an embodied mental model.

Redesigning Iteration 2

ReDesigning Strong Narrative

While 94% of all the students’ reported they “liked” the game and thought it was “fun” or “cool”, their responses also highlighted important points for re-developing the strong narrative. For example, only 32% of the students’ recalling proprietary narrative elements like the climatron highlighted the need for a simpler and more connected narrative. To simplify the narrative in i2, players embarked on a new mission to stop the villain Hacker and his mind machine from subduing the Penguins of Penguia. To reinforce the players’ involvement in the narrative, interstitial scenes were added at the top of each level to perpetuate the narrative and the players’ objective to fracture all the enerchi bars and activate the HERObots to stop Hacker. Another change included replacing the pedagogical agent Jackie with the affably anthropomorphized character Fluff the Penguin. Sixteen of the 37 students in the strong narrative (43%) complained about Jackie and her incessant instructions. Thus, in i2, players in the strong narrative must work with Fluff to save Penguia (Figure 4).
ReDesigning Assets.

Revising the narrative affects every aspect of game design. For example, revisions to the narrative included changing the scenes for Parts 1 & 2. The icy exteriors from i1 were replaced by the interiors of a laboratory to engender the precision associated with mathematics (Figure 5). Moreover, developers designed a device, the *fractivator*, to encapsulate the process for fracturing the enerchi bars. This includes a conduit line that feeds enerchi in and out of the fractivator in Part 1 and transfers it to canisters inside the HERObot for Part 2. Figure 7 reviews many of the redesigned elements between i1 and i2, including backgrounds and assets for gestures, curriculum, game-play, instructions, feedback and scaffolding.

ReDesigning FrActivities.

In i1, the development team thought it would be prudent for players to deposit the fractured enerchi bar into a receptacle (i.e., to embody the process) and in Part 2, deposit the power cell into the chest of the HERObot. However, these deposit steps proved to be unnecessary *seductive details* (Harp & Mayer, 1998) that detracted from the tutor’s focus on fractions and were thus removed from i2.
ReDesigning Pedagogy/Scaffolding.

In i1, students intentionally received no feedback for their estimates to prevent biasing students’ subsequent attempts to denominate and numerate the fraction. However, tutor play and clinical interviews revealed numbers of students’ expressing inherent desire for feedback. Thus, i2 introduced a new step for students to adjust their original estimate once they had successfully denominated and numerated the fraction. This allows students to compare their original estimate to the actual value to reinforce the connection between the parts-to-whole, the continuous real number on the number line, and its numeric representation (Siegler, Thompson & Schneider, 2011).

In the original development of i1, the process of constructing fractions in Part 1 was to serve as a foundation for sorting fractions from smallest to largest in Part 2. However, observations of tutor-play corroborated the data log that showed students were largely unable to determine equivalency between fractions strictly by number and resorted to a guessing strategy (n= 9 students, 14%, determined equivalence between fractions correctly on 1st Attempt). In the progression of the game, students’ mental models of the magnitude of each fraction were not yet robust enough to determine equivalency solely by number. Thus, for i2, researchers developed a scaffolding mechanism by which students could connect numerical fractions to their area-model depictions. By depressing the magnifier on the canisters in Part 2, students previewed the numerical representation followed its area-model (Figure 6b) to help students devise visualize the correspondence between the size of the enerchi bar and the value of the fraction and make bifurcated comparisons as they put them in order.

ReDesigning Instructions.

In i1, all instructions were delivered audibly via the agent, Jackie (circled in magenta, see Figure 7). If students’ needed to hear the instructions again, they could hit the “?” on the screen. Nonetheless, many players (n=32 students, 44%) still requested help from experimenters to play and conveyed that the instructions at times were unclear. Consequently, instructions in i2 are delivered by a ghost hand (circled in yellow, see Figure 9) that demonstrates the gestural mechanics. Additionally, this makes the tutor more accessible to children with hearing difficulties and ESL learners.

ReDesigning Scaffolding/Feedback.

For i2, all scaffolding and feedback was delivered through visual feedback and SFX and any text was removed. For example, in Part-2, feedback for incorrectly ordering the enerchi bars was revised from turning numbers red to a brief visual depiction of the fraction for comparison (Figure 8). Testing these revisions to i2 will provide important lessons for the design and delivery of scaffolding and feedback.
Figure 8: Scaffolding/Feedback redesigns from i1 to i2.

Future Study

Overall, mixed methods iterative-design experiments are effective ways to create contextually situated embodied experiences of mathematical thinking (Lesh, 1985). The current study presented empirical evidence for the benefit of utilizing gesture and narrative in tutor-game development for digital tablets and discussed many of the issues surrounding effective design, implementation, testing and re-design. In the meantime, researchers look forward to testing the impacts of these revisions on i2 and reporting results in the near future.

References


Secret Societies of the Avant-garde: Designing a Game for Art History

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Abstract: Our design of “Secret Societies of the Avant-garde” (under testing Spring 2015 in a mixed mode course on Twentieth-Century Art) will demonstrate how using a serious game to teach art history not only fosters interactive learning, but models one of the most compelling artistic trends of the post/modern era as well. These models, the mechanics of the adventure game genre (puzzle-driven and informed by a sense of participating in a goal-driven narrative thread), and our knowledge of modern art inform the game’s design. The game has five phases, during which students will play in teams and uncover and interpret artifacts from various art historical movements of the twentieth century. Working together, they will interpret primary and secondary sources including visual objects, letters, and essays, craft cohesive narratives for their objects that situate them within an avant-garde movement, and compete for clues that will help their team overcome obstacles.

Seed: Our Vision for “Secret Societies of the Avant-garde”

Our design of “Secret Societies of the Avant-garde” (under testing Spring 2015 in a mixed mode course on Twentieth-Century Art) will demonstrate how using a serious game to teach art history not only fosters interactive learning, but models one of the most compelling artistic trends of the post/modern era as well. These models, the mechanics of the adventure game genre (puzzle-driven and informed by a sense of participating in a goal-driven narrative thread), and our knowledge of modern art inform the game’s design. The game has five phases, during which students will play in teams and uncover and interpret artifacts from various art historical movements of the twentieth century. Working together, they will interpret primary and secondary sources including visual objects, letters, and essays, craft cohesive narratives for their objects that situate them within an avant-garde movement, and compete for clues that will help their team overcome obstacles. In these ways the game will utilize cooperation and competition to enhance student engagement and invite students to question the continually changing category of experience that comprises the notion of art itself while learning to recognize a core group of images within twentieth-century art and interpret these works within the socio-historical and cultural context of their production.

Creating games that leverage the power of game mechanics to create transformative experiences are at the center of game development movements. As game designers and scholars focus on the ways in which games operate as spaces for exploration, critical thinking, and collaboration, games become increasingly significant as educational tools. The work emerging from the “Games for Change” and serious games communities is particularly helpful in addressing an apparent contradiction between games and educational objectives, as traditionally the idea of “fun” has fallen into a separate space from that of learning. Elsewhere, in the art games and electronic literature communities, game designers as artists are producing provocative works that explore the potential of games as experiential spaces: Zoe Quinn’s Depression Quest places players in the role of the clinically depressed, Anna Anthropy’s Dys4ia is a raw autobiographical exposure of hormone therapy and gender dysphoria, and Jason Nelson’s flash games explore digital poetics. Genres such as electronic literature, a space for digital poetics and narratives with procedural and interactive components; interactive fiction, text-driven games composed with language parsers and object-oriented world models; and new media art further complicate the boundaries between games and other forms of interactive art. We seek to bring these convergent themes to the art history classroom, which has traditionally been a space without the intervention of experimental pedagogy of this kind.

Games are undervalued in art history teaching and learning. At the College Art Conference’s annual meeting in 2014 there was one session on using games in the teaching of art and art history. Even so, the presentations were more interested in employing badges and gamification than in rethinking course delivery. In contrast, “Secret Societies of the Avant-garde” finds the game in the content. Games, play, and interactivity have had a significant role in modern and contemporary art movements including Dada, Surrealism, Fluxus, and Conceptualism. Artists have used play and participatory projects to challenge traditional media, to respond to political upheaval, and to instigate social change. From Cory Arcangel’s video hacks to Theaster Gates’s built environments to Andrea Zittel’s sculptural installations, today’s most compelling artists are blurring the boundaries between reality and hyperreality, between the personal and the societal, and between art and life. Our game's structure is based on the development and organization of twentieth-century art movements, models art historical research methods, and
illustrates historical contingency.

Our team is comprised of an art historian, a games scholar, and two student workers responsible for art history research and the implementation of game mechanics. The art historian, Keri Watson, specializes in modern and contemporary art and theory. Keri Watson has previously taught art history using Reacting to the Past and role-playing game strategies, and this project is in part an effort to bring interactive methods of the type used in small classes up to the scale of large lecture and mixed-mode courses. The games scholar, Anastasia Salter, focuses on narrative and expressive games. She applies lessons from these game genres to classroom challenges, and writes on games, pedagogy and technology in ProfHacker, a blog hosted by the Chronicle of Higher Education. This is the initial team for prototyping and deploying “Secret Societies of the Avant-garde” in Keri Watson’s spring course.

**Sprout: Our Prototype and Process**

During the first phase of the production of the game, we deployed a prototype in the Spring 2014 iteration of Keri Watson’s 20th Century Art History course. Students were broken into teams and engaged in critical thinking and the construction of thematic narrative through examining clues distributed in Webcourses, University of Central Florida’s Canvas online learning platform. The course was delivered as a mixed mode experience, which means most of the student engagement with the game happens online, while the physical component of the course still includes traditional lectures as well as events for the sharing of student research and progress. However, students were first introduced to the narrative through physical letters distributed during the first lecture. Once students received this letter, the game has proceeded through the delivery of messages sent from “The Initiator” on Webcourses to each team. The avatar was designed by student developer Marcelo Laborda and has a painted design to suit the spirit of the game (see figure 1) and a logo for the society (see figure 2).

![Figure 1: The Initiator](image1.png)

![Figure 2: Secret Society Logo](image2.png)

Although this semester’s test only involved a prototype, not a stand-alone interactive system, the game appears to be motivating students to engage deeply with the course’s content. The first deliverables, 800-1000 word response papers in which students identified their objects and crafted cohesive narratives for their movements using the clues as examples, were of a high quality. The teams appear to be working well together and most teams demonstrate active participation on their discussion boards. Only one student out of sixty does not appear to be contributing. Moreover, the students who participated most actively on the online discussion boards are not necessarily the same students who contributed in the face-to-face class meetings, thus the game is engaging more students than a traditional lecture-discussion classroom format. One of the groups had trouble identifying the clues in the first phase, but they also demonstrated the ability to make interesting connections between their objects, because
they are not just “looking up the answers.” By manipulating the images in future phases of deployment, we were able to replicate this experience for other teams.

Our initial concept developed as an alternate reality game, with the online portions of the class mediated not just by Keri Watson as the professor but by a separate figure, “The Initiator,” who would bring students in to a narrative in which they needed to unravel the identity of a secret society of artists and prove themselves worthy to join. Designing the game overview was complicated by the need for deliverables that could be evaluated as a substantial part of progress in the course to clearly link the online activities to the learning objectives of the class. We brainstormed this initial structure to accomplish these goals and implemented it with modifications throughout the semester:

**Phase One**

Announcement to team from Initiator: Should include introduction to the society, a reminder that you are working with your team of pledges, and requirement to work using the discussion forum for phase one and prove your individual and collaborative worth through contributing. Will also include the first clue.

Clues: For first phase, all images will be pretty much unaltered. Materials should be added as pages in webcourses set to become visible on Thursdays, split between weeks based on the final due date. Deliverable: 800-1000 word response to the images with each clue identified, linking them all in a narrative or thematic thread.

**Phase Two**

Announcement to team from Initiator: Should include a reminder that things are going to get more challenging, and a riddle for each team that can be solved using information from at least two of the clues. This riddle will have a one-word answer that unlocks an additional clue, worth bonus points for its incorporation in the deliverable.

Clues: For second phase, some images may be altered. Materials should be added as pages in webcourses set to become visible on Thursdays, split between weeks based on the final due date. Deliverable: 800-1000 word response to the images with each clue identified, linking them all in a narrative or thematic thread. For phase two, including the identifying information and thematic link of the bonus clue (unlocked through the riddle) is worth extra points.

**Phase Three**

Announcement to team from Initiator: Should remind players not to forget the movements that have come before, and include a riddle for each team that can be solved using information from at least two of the clues in addition to a reference from a previous phase. This riddle will have a one-word answer that unlocks an additional clue, worth bonus points for its incorporation in the deliverable.

Clues: For third phase, all images should be altered or obscured. Materials should be added as pages in webcourses set to become visible on Thursdays, split between weeks based on the final due date. Deliverable: 1000 word response to the images with each clue identified, linking them all in a narrative or thematic thread. For phase three, including the identifying information and thematic link of the bonus clue (unlocked through the riddle) is worth extra points.

**Phase Four**

Announcement to team from Initiator: Should remind players not to forget the movements that have come before, and include a riddle for each team that can be solved using information from at least two of the clues in addition to a reference from a previous phase. This riddle will have a one-word answer that unlocks another riddle that points to a work not included as a photo: players must further unlock this riddle to figure out what piece they are missing.

Clues: For fourth phase, all images should be altered or obscured. Materials should be added as pages in webcourses set to become visible on Thursdays, split between weeks based on the final due date. Deliverable: 800-1000 word response to the images with each clue identified, linking them all in a narrative or thematic thread. For phase four, including the identifying information and thematic link of the bonus clue (unlocked through first completing the riddle, then following the second clues to identify the piece) is worth extra points.

**Phase Five**

Announcement to team from Initiator: Should remind players not to forget the movements that have come before, and include a riddle for each team that can be solved using information from at least two of the clues in addition to
a reference from a previous phase. This riddle will have a one-word answer that unlocks another riddle that points to a work not included as a photo: players must further unlock this riddle to figure out what piece they are missing.

Clues: For fourth phase, all images should be altered or obscured. Materials should be added as pages in webcourses set to become visible on Thursdays, split between weeks based on the final due date. Deliverable: A list of all identified works from phase five, in addition to the bonus object if successfully found. A 1000 word thematic description linking significant works from all phases, which will become the foundation for the final exhibit.

Final Phase

For the final phase of the game and initiation into the Secret Society teams must curate digital exhibitions that include works from each stage of the game and construct a thematic thread between the five movements they uncovered.

For later phases, we created videos and some audio files for the clues, rather than just posting image files. We are also bundled the clues rather than releasing them one at a time. In this way we can encourage the teams to make connections, not just identifications. We also planned to implement more changes to deliverables and variations in clue types, but found that student teams were more comfortable if we kept those elements relatively consistent throughout the semester. For future iterations, these changes will enhance the difficulty of the game and increase the amount of teamwork necessary to complete the tasks. In these ways, the phases will ideally become more challenging as the game progresses, thereby keeping players interested. The competitive nature of the game could also be enhanced by allowing more explicit interactions between teams.

In its current iteration the game features 500 clues that fit within fifty avant-garde art movements of the twentieth century. The game is played in five phases with each team of six students working through five artistic movements over the course of the game. Each team receives approximately ten clues per phase and in the final phase of the game they curate a digital exhibition of twentieth-century art that features their clues/objects/movements. The game is scalable in several ways. First, the number of players per team is flexible; one could envision teams of ten students. Second, more movements could be added; there are many movements and submovements that could be added to the game, as the twentieth century has no shortage of artistic experimentation and fragmentation. Third, the movements could be shuffled into different threads, so that teams would have other combinations of movements over the five phases thereby resulting in different final exhibitions. Fourth, more than one team could play with the same clues but still develop different deliverables because the players are different. In this scenario teams with the same clues could compete against one another. Finally, clues could be added and then randomly distributed so that any number of teams could play simultaneously. In this way the game has potential as a multiplayer online game suitable for use in a massive open online course.

Bloom: Reflections and Looking Forward

This example reflects the first prototype of “Secret Societies of the Avant-garde,” which was developed as a constrained game for implementation within a course management system. Ultimately, the course management system proved most limiting to the progression of the game, as the team set-up was very assignment focused and ultimately the Webcourses / Canvas platform did not lend itself to play. While student outcomes in the course were very promising, particularly as represented through the final gallery exhibitions reflecting the thematic unity of each team’s society, we believe that the next iteration needs to provide more space for playful interaction, and particularly allow for both individual and collaborative work while experiencing the practices of art historians.

Building a game of this kind centered on the study of twentieth-century art offers the opportunity to benefit from and expose the playful and game-like practices already embedded in the work under examination. With additional refinement, we believe this game structure can supplement traditional art history pedagogy and allow students to critically engage while using discomfort and uncertainty as motivation for investigation. In future iterations, we intend to enhance the mechanics of problem-solving to ensure that students must move well beyond identification to develop their own narratives of art history while challenging their existing conceptions of genius and clear movement-based universal narratives.

References


Workshops
Reflective Gaming Course: Supporting reflections on the effects of gaming

Rafael Marques de Albuquerque, University of Nottingham (UK)

Abstract: The Reflective Gaming Course was developed to support young people’s reflections on the potential positive and negative effects of playing games, and thus support more informed and reflective gaming practices. The course was empirically investigated in UK secondary schools, and a commented version of the course was discussed in this workshop. Attendees were presented with some aspects of gaming: tangential learning, cognitive gains, problem solving skills, and stereotyped representations of race and gender. They were invited to reflect on whether and how these aspects relate to their own gaming practices. They also heard about how the topics and activities were perceived by young people in the previous empirical studies in schools, such as how young people reacted, their prior perspectives, etc. The workshop concluded with reflections about the potentials of this game education proposal and opened the discussion for attendees’ perspectives.

Introduction

For decades there has been research on the permanent effects of playing digital games on players. It is true that sometimes some of those research findings are reinterpreted and appear in the mass media – such as when journalists provoke panic by associating gaming with shooting tragedies, while others would argue that “games make you smarter”. However, with some exceptions, young people are to some extent alienated from academic discussions about the effects of playing games. There are some proposals – normally theoretical ones – that address this issue, suggesting processes of game education. This workshop offered a summarized version of the Reflective Gaming Course, adapted from a broader research project for the GLS Conference context. Attendees were presented with ideas similar to the ones presented in the Reflective Gaming Course conducted in schools, and were invited to think about the rationale, potential outcomes, and the students’ reactions to the topics and activities. Attendees were also asked to discuss the proposal and relate to their own practices as teachers, researchers, and others.

Workshop Aims

On the one hand, the workshop aimed to invite attendees to reflect on whether their gaming practices relate to the research findings regarding the positive and negative effects of gaming, in order to support more reflective gaming practices. It allowed attendees to construct their own understandings of how the generic idea of effects of gaming relates to their gaming practices in a more concrete perspective. In other words, attendees had an experience in the workshop analogous to the young people who participated in the Reflective Gaming Course in schools. On the other hand, the workshop presented the Reflective Gaming Course with commentaries on previous experiences in order to inspire participants to design their own game education courses in their own contexts, and allowed attendees to discuss the game education proposal that guided the project.

Program

Attendees were told about the topics that were evaluated as more enriching from the original course. Because the original Reflective Gaming Course was approximately four hours long, the topics are presented very briefly in this one hour session.

Course introduction

The workshop opened with an explanation of the game education proposal, contextualized within other proposals in the literature. Game education can be conceptualized in a variety of ways: the proposal presented in this workshop has some similarities with the theoretical proposals of the media educationists Fromme (2012), Partington (2010), Sanford and Madill (2007) and Newman and Oram (2006) in the sense that they consider that the content to be taught includes the effects of gaming beyond the gaming activity itself. Therefore, this game education proposal includes teaching about the effects of games, encouraging young people to reflect about whether and how the claims regarding the effects of gaming relates to their own gaming practices, in order to stimulate critical and reflective gaming practices. This concept brings together two different areas of research: the literature on the effects of gaming and the one on game literacy, which considers that there is something about games that is worth
teaching. This perspective focuses on the agency of players to take informed decisions and influence the effects of their own gaming practices, respecting players’ autonomy. It differs from other perspectives because (a) it does not place game creation as the main activity to develop game literacy, (b) it focuses on the effects of playing that extrapolate the game activity itself (and not in gaming aspects that remain “in the game”), (c) it includes the positive effects of gaming as well as the negative, and (d) it encourages learners to develop their own understandings, opinions and ideal gaming practices, instead of having an ideal model of gaming \textit{a priori}. This conceptual proposal of game education was initially presented in Albuquerque and Ainsworth (2013) and Albuquerque (2014).

Attendees were also asked to identify themselves and reflect on whether and how this proposal relates to their own practices as teachers, researchers, and others. Some examples of other contexts of game education are: teachers educating students in schools, parents educating children at home, or friends educating friends in informal contexts, or media professionals (e.g. journalists) educating their audiences. Amongst the attendees there were several points of view, including teachers, journalists, game designers, game researchers and parents.

Positive effects

The first topics of the original \textit{Reflective Gaming Course} were the positive aspects of gaming. One of them was tangential learning, i.e. searching for more information about an element of a game theme, such as searching for information about the Roman Empire after playing a game set in this context. According to the empirical studies with the \textit{Reflective Gaming Course}, tangential learning was widely experienced by young people prior to the empirical studies. The topic had raised interest of young people and related to a very concrete learning potential associated with games, thus allowing them to share experiences and conceive new possibilities of tangential learning.

The other topics involved cognition and problem solving. Many claims have been made about cognitive gains and problem solving skills that can be developed by playing games. Some studies in this area were mentioned in the workshop, and an exercise from the original course was explained in which young people had to reflect upon the potential cognitive gains of their favorite games, with the challenge of thinking about the contexts of their lives (when not playing games) in which the skills are concretely useful. It aims to develop a critical perspective on such research findings, and also an awareness of the potential cognitive gains of the individual practices of participants. This topic also raised the interest of students in schools, especially because it offers a positive perspective of gaming, which is frequently seen as only negative, harmful, and time wasting. Hence young people perceived this topic as a way to fight negative stigma upon gaming.

Negative effects

The last topics were related to the character representations of games, including gender and racial diversity (or lack of diversity), and the stereotypes convened by some games (as in other media). These issues as well as the kinds of heated discussions it generated in classrooms were considered. The resistance of young boys to be sympathetic with regard to women representation in games, as well as some of problematic ideas about gender that they expressed in course, illustrated the need for further discussion about gender and race in schools, which became evident when the original \textit{Reflective Gaming Course} was offered. The potential outcomes to encourage players to undertake a critical view on games, thus perceiving the problems of representations critically, was discussed in the workshop. It included the idea of players as critical consumers.

Debriefing the course

The last slot was open for questions and comments. Some extra questions were problematized throughout the course according to the discussion flow:

- Is the practice of reflectively playing games likely to generate concrete outcomes to the players?
- If we consider that supporting a more reflective and informed gaming practice is something relevant for players, what are the best contexts in which it could be undertaken?
- If players become more informed and reflective about the games they play, what could be the consequences to the game industry? And to the research about effects of gaming?
- What are the other initiatives of game education that are already being conducted today, which approach is similar to this one?
Presenter

Rafael Marques de Albuquerque presented the workshop. He was in the last year of his PhD in the Learning Sciences Research Institute, at the School of Education of the University of Nottingham (UK). In addition to his studies with the Reflective Gaming Course, he has worked in research projects involving game creation in schools, the usage of commercial games as pedagogical tools, and educational game design. Rafael has a BA in graphic design and MA in design and graphic expression and in both degrees his research focus was on the various relationships between digital games and learning.

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References


Interactive Life Sized 3D Digital Modeling & Simulation: A Case Study in Anatomy and Physiology Education

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Greg Vaughan, Learning Games Network
Kurt Squire, University of Wisconsin-Madison

Abstract: 3D digital simulation and related educational technology represent a relatively new phenomenon in clinical health sciences and STEM education. When such technology is leveraged to prepare students for clinical and science related encounters, it should map back to the curriculum and strive to solve challenges associated with traditional didactic instructional techniques (Bauman & Ralston-Berg, 2014). The AnatomyTable provides an interactive large format 3D touchscreen experience to reinforce anatomy and physiology objectives for veterinary medicine students.

Background

3D digital modeling and simulation is not a new phenomenon and has been used in various experientially driven curricula (Kolb, Kolb, Passarelli, & Sharma, 2014). Advances in technology have the potential to encourage increased interactivity and engagement of and among learners. The project discussed in this paper addresses the design process related to the development of life sized 3D digital modeling and simulation, as well as the pedagogical paradigm shift required to leverage such technology. The AnatomyTable was designed to address the challenges of teaching comparative and veterinary anatomy. While this paper discusses this technology through the lens of comparative and veterinary anatomy, the researchers and designers believe that this type of interactive large format 3D modeling and simulation technology could also be leveraged for a variety of other topics, particularly STEM education. Technology should be integrated within existing curricula with purpose and to solve problems or challenges associated with traditional educational models. To this end content conveyed through the use of novel technology such as digital simulation must map to the objectives found within the curriculum.

Summary of the Project

Teaching anatomy can be particularly challenging and must attend to various ethical and logistical concerns. When using animal models for teaching purposes one must attend to accepted animal welfare standards. In addition, traditional models of anatomy education are limited in terms of access to specimens and the ability to contextually situate anatomy lessons in an applied context (Martinsen & Jukes, 2005). More accessible 2D images or textbooks do not adequately demonstrate the spatial relationship of complex structures, spaces, or orientation (Adams & Wilson, 2011).

AnatomyTable provides a high-fidelity interactive 3D life sized canine model displayed on a large touch screen. This model can be dissected layer by layer and by body system. Students are also able to explore physiological events and complete virtual surgical techniques based on objectives found throughout their curriculum. AnatomyTable also allows faculty to link course notes directly to students interactive experiences in real time. Focus groups were conducted to evaluate acceptance of this technology to support existing curriculum and to glean feedback for AnatomyTable enhancements. The research and design team hypothesized that students would be accepting of the technology.

Theory

The development of AnatomyTable is fundamentally anchored in the concepts of a layered learning approach to clinical education and educational technology implementation. Didactic components of the curriculum are reinforced through scaffolding multimedia educational experiences, while simultaneously providing authentic situated learning opportunities to move students towards eventual clinical practice and competency (Bauman et al., 2014). The layered learning model, Figure 1, illustrates how a multi-medium approach supports educational activities preparing clinicians (human or veterinary) for real world experiences.
The layered learning model recognizes the importance and relevance of traditional facets of education. Digital applications and virtual reality are not seen as replacements for lectures, or reading assignments, but rather as tools to support a transition from the classroom to the clinic. In other words, students still engage traditional didactic preparation, such as lectures, reading assignments to prepare for more interactive components of the educational process. Didactic preparation prepares students for and overlaps with interactive situated learning activities that represent and portray authentic clinical practice.

For the purposes of this project, digital games and simulations represent the AnatomyTable and haptic simulators represent traditional veterinary cadaveric dissection. Students continue to develop content and process knowledge though game-play, which in turn prepares them for supervised learning opportunities with physical simulators or physical specimens (Bauman, 2007; Bauman 2010). Learning that leverages digital interaction and interaction taking place with simulators or specimens prepares students for supervised clinical education in actual clinical environments where students interact with real patients.

**Methods**

A convenience sample of 66 veterinary medical students was recruited to watch a brief demonstration of the AnatomyTable and then spend approximately 20-30 minutes interacting with the AnatomyTable. At the conclusion of the interaction, the students filled out a questionnaire related to their experience. Students completed this process in small groups of approximately 2-5 students at a time. The Ross University School of Veterinary Medicine IRB approved this study and students were provided with informed consent prior to data collection. All data collection was completely voluntary. Students were provided with a $20 gift certificate for the campus coffee shop as an incentive for their participation.

**Results**

A convenience sample of 66 students was surveyed. 95% found AnatomyTable Very Helpful (n=39) or Somewhat Helpful (n=24); with 50 (66%) Very Willing to use it and 14 (21%) Somewhat Willing to use it. Finally, 40 students (61%) were Very Satisfied with AnatomyTable and 14 (21%) Somewhat Satisfied.

Qualitative results form open-ended questions were consistent with quantitative results.

**Discussion**

The researchers believe that the data presented here provides an impetus for the inclusion of high-fidelity large format interactive 3D digital simulation for clinical and STEM education. However, when considering such implementation it is critical to consider not just appeal, but effectiveness and efficiency as well (Ralston-Berg & Lara, 2013). Design processes that ensure innovative technology targeted for educational purposes should be effectively grounded in curricular goals and learning objectives. Further, it is imperative that technology intended to support clinical and STEM education serve to solve problems existing within the curriculum in order to promote greater adoption potential among students. In short, if students do not perceive technology as effective and efficient, it is unlikely to be used (Bauman and Wolfenstein, 2012). AnatomyTable and other like technology encourage active engagement and team problem solving. Team problem solving is a demonstrated effective method for clinical education (Hazel, Heberle, McEwen, & Adams, 2013; Hrynchak & Batty, 2012). While it is thought that students are accepting of the technology presented, teachers and researchers alike should understand that further investigation is required to determine if this sort of digital technology has an effect on learner outcome.
Conclusion

Students in this study were accepting of the educational technology discussed in this paper as a tool to support their existing curriculum. Further, the researchers found that the focus groups and the subjects completed questionnaires provided important feedback for technology and content enhancement.

References


Abstract: Playtesting should be a part of any game design cycle, since most games aren’t good games until they’ve been through multiple iterations of refinement based on player feedback. This workshop allowed conference participants to test out in-development games from other participants, including many student teams from Clark Street Community School, providing that valuable feedback and bringing the featured games closer to being good.

Iterations Are King

Last year’s playtesting session was a huge success (Chen et al. 2014)! We’d like to make it a tradition at GLS, and that started with a sequel. We know that our work improves as we iterate incremental changes for a final product. This is true of academic work such as writing papers (and running workshops) and of game design. Indeed, usually the first prototypes, alpha builds, and drafts of our work start off so broken that it’s often intimidating to share these early versions. Yet it’s only through collecting, synthesizing, reflecting, and acting on feedback from reviewers and playtesters that our work improves. This session provides GLS attendees a space to share in-progress work with other attendees to gain that invaluable feedback.

Workshop Logistics

This workshop provided hands-on experience with game design’s playtesting cycle. Participant-players playtested tabletop and digital games in progress, providing feedback to participant-designers while also learning and reflecting on the playtesting process (see Figure 1).

Figure 1: Playtesting in full swing.

To fit in the one-hour format, the workshop consisted of two 30-minute playtesting cycles, each including time for playing (20-25 min) and time for feedback (5-10 min). Thirty minutes was a rough estimate, however. Some games were much shorter than 20 minutes, allowing for more players to rotate through their playtests. Likewise, some games took longer, and we accommodated designers who wished to hold one long playtest.
The workshop organizers prepared a 2-page handout for design teams to use as their games were played. This included space for notes from in-game observation and then sets of in-game and post-game questions, culled from Fullerton (2014, pp. 295).

The games that were tested came from multiple sources (see Table 1). Two digital games were tested by high school students at Clark Street Community School in Middleton, WI, with whom Filament Games has partnered to teach a game design seminar. Many of the high schoolers are interested in getting into game design & development, and this represented a chance for them to interact with and get feedback from scholars and practitioners in the field. Other games included those featured in the Educational Game Arcade and/or other in-development games by the same designers. We also sent out a general call on the GLS and GamesNetwork listservs, inviting other conference attendees to submit games for the workshop.

<table>
<thead>
<tr>
<th>Game name</th>
<th>Author</th>
<th>Affiliation</th>
<th>Genre</th>
<th>Digital?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snow Mercy!</td>
<td>Doug Maynard</td>
<td>State University of New York at New Patlz</td>
<td>tabletop dice/card</td>
<td>no</td>
</tr>
<tr>
<td>Flora: A Game That Takes Guts</td>
<td>Barry Joseph and Hannah Jaris</td>
<td>American Museum of Natural History</td>
<td>card game</td>
<td>no</td>
</tr>
<tr>
<td>MicroRangers</td>
<td>Barry Joseph and Hannah Jaris</td>
<td>American Museum of Natural History</td>
<td>mobile augmented game</td>
<td>GPS</td>
</tr>
<tr>
<td>Codename: Purple</td>
<td>Owen Gottlieb</td>
<td>RIT</td>
<td>strategy card game</td>
<td>not yet</td>
</tr>
<tr>
<td>Translator's Pickle</td>
<td>Joel Langston</td>
<td>Indiana University South Bend</td>
<td>card game about literary translation</td>
<td>no</td>
</tr>
<tr>
<td>Wastelander</td>
<td>Julian</td>
<td>Clark Street</td>
<td>apocalyptic shooter</td>
<td>yes</td>
</tr>
<tr>
<td>Germ Tower</td>
<td>Tyler and Corey</td>
<td>Clark Street</td>
<td>nasty dungeon crawler shooter</td>
<td>yes</td>
</tr>
<tr>
<td>Codename: WISE beta game</td>
<td>David Ng</td>
<td>University of British Columbia</td>
<td>card game</td>
<td>no</td>
</tr>
<tr>
<td>+PlusOut!!</td>
<td>Brandon Bell</td>
<td>Independent Game Designer</td>
<td>card game with points/numbers</td>
<td>no</td>
</tr>
</tbody>
</table>

Table 1: The final list of games that were tested.

The workshop organizers invited teams that were working on issues with learning goals (rather than basic user interface issues) and that could be explored in just a short amount of time. Designers were also encouraged to welcome moments of frustration and failure with their games. Some groups may have been apprehensive of this if this was the first time their games were shared with the public, but this feeling quickly dissipated in the fast-paced, supportive, chaotic environment.

By the end of the workshop, both participant-players and participant-designers gained experience with the process of rapid playtesting iterations. Other, slower forms of playtesting afford other kinds of feedback, but this rapid format gives us a more manageable chunk / concept / process that we can think about incorporating into our other learning experiences. It also gave invaluable insight for our participant-designers as they seek to improve their games, and it was a lot of (crazy hectic) fun!

References


What Do I Do With All This Data? How To Use The FUN! Tool To Automatically Clean, Analyze, and Visualize Your Digital Data

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Abstract: Digital learning environments, particularly digital games, are becoming more prevalent, and datasets from these environments are becoming larger, but many researchers are still parsing data using spreadsheet software and graduate student labor. The academic community, like the business community, needs tools to automate repetitive processes and to manage the increasing amount of data from these digital learning environments. In this workshop, attendees will learn to use a new tool called the Functional Understanding Navigator! tool, or FUN! tool, to adapt, analyze, and present their digital data.

Introduction

Using data science methodologies to analyze digital learning environments has the potential to impact businesses and schools in big ways (e.g. personalized learning, learning pathway recognition, stealth assessment). The amount of time that workers and students spend in digital learning environments is increasing, resulting in larger, more complex digital datasets. The datasets are exciting, with the potential to reveal previously indistinguishable learning patterns and predict learner outcomes, but also frustrating for researchers with small teams and limited resources. Some problems include:

1. Coordinating research teams consisting of personnel from several departments.
2. Efficiently managing large amounts of data.
3. Securely managing large amounts of data.
4. Reproducing results after several iterations of data cleaning and analyses.

The Functional Understanding Navigator!, or FUN! tool, addresses this pressing need for tools that automate processes to help researchers efficiently clean, analyze, and present data (see Figure 1). Furthermore, the FUN! tool defines a data pipeline to keep data more organized. The tool also logs the history of the data analysis process so the research team can easily trace their steps and reproduce their results.

Figure 1: The FUN! tool has three distinct steps: adapt, analyze, and report data.
Introduction (10 minutes)

The workshop organizers began with an introductory discussion about the current trends and issues in educational data mining and learning analytics. We provided an overview of the type of research questions and data that are most relevant to our methodologies and the tools that are currently available for researchers, which will help contextualize the FUN! tool. We also discuss the importance of building a relationship with developers during the data collection process. Before beginning the hands on exploration, we summarized three key points as to the value of the FUN! Tool: (a) organizes your workflow process from start to finish, (b) records log data of all of your analyses, and (c) provides a platform to share your analyses with others.

Hands on Exploration of the FUN! Tool (40 minutes)

Next the workshop organizers provided a 40-minute hands-on workshop for participants to explore the FUN! Tool using laptops at six stations loaded with the FUN! Tool and practice data. A User Guide was provided to all participants with directions to follow along with during the exploration and to use with their own data. During this session, attendees worked with a sample dataset from the Scratch programming language. Specifically, attendees learned to: (a) modify the adaptor of the FUN! tool (so it can read in their own data), (b) modify the analysis functions (so the tool can select various data pieces and measure various aspects of those data pieces), and (c) modify the reporters (so researchers can read the results).

Discussion (10 minutes)

The workshop concluded with a discussion about how to use the FUN! tool with various datasets. We asked the audience to discuss the value they recognized with use of the FUN! tool. Several people seemed to see the value in using the FUN! Tool to automate processes done routinely and as a way for data scientists to support the work of researchers. The participants were not familiar with Scratch, so they appreciated the discussion of the application of the FUN! tool to another environment that uses log data of moves and board states from a fraction game. This data seemed similar to the data many of the participants worked with and allowed them to see the potential of the FUN! tool processes for use with their own data. We had a discussion of recommended next steps. Some felt the development of a dashboard was important to truly visualize the data. Others felt that more time could be spent on measure development and that the dashboard could be left to individual users and their needs for what should be visualized.

Conclusion

Though automated analysis tools, like the FUN! tool, are already being used in the business sector (see Spark and KNIME), the FUN! tool is part of the first generation of tools to anticipate and address the challenges that will come with the incoming data deluge in education (for other examples see Stenerson, Salmon, Berland, & Squire, 2014 and Werner, McDowell, & Denner, 2013). We envision tools like the FUN! tool, to eventually be used in training environments and classrooms so that instructional designers and teachers can automatically analyze learning environments and make better formative decisions.

References


Acknowledgments

This work is supported by National Science Foundation Grant IIS-1319938. Any opinions, findings, conclusions or recommendations expressed in this material and presentation are those of the authors and do not necessarily reflect positions or policies of these agencies. This material is based upon work supported by and while the author, Taylor Martin, was employed by the National Science Foundation. Any opinion, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.
Building Opportunities for Faculty Adoption of Game-Based Learning Strategies in Higher Education

Megan Mathews, The University of Iowa

Abstract: For the past year, the ITS Office of Teaching, Learning & Technology has centrally supported innovative teaching and learning with a game-based learning (GBL) initiative. Our educational development opportunities yielded surprising and informative advantages and challenges for faculty adoption of GBL. Join us in this interactive session as we share our multifaceted approach to support faculty adoption of GBL in higher education.

Session Description

Last May the ITS Office of Teaching, Learning & Technology's Center for Teaching hosted a day-long institute for faculty exploration of applying game-based learning strategies into the course curriculum. This institute generated interest among the attendees to consider how they can use games or game-based learning in their classrooms and in creating games for classroom use. Faculty continued with their ideas, and were supported through consultations, grant funding awards and additional professional development opportunities. We noticed great success of the GBL initiatives at The University of Iowa, and this session shared what we have learned along the way.

Expected Outcomes, Session Activities, and Plan for Interaction

Session participants gained knowledge and a set of professional development strategies to support faculty adoption of game-based learning on their own campus. They (a) connected with the concept of gaming as an instructional tool, (b) explored and identified resources and collaborators on their own campuses, and (c) became equipped to combat skepticism for using games in the classroom. Learning from The University of Iowa strategies as a starting point, participants developed adaptable faculty development opportunities to meet their own campus goals. Participants left the interactive session with models to support GBL faculty development.

1. Warm-up (5 min. exercise and 5 min. discussion): In small groups, participants played a game to explore applying game design principles to learning objectives.

2. Introduction (5 min.): We summarized and shared examples of how we have supported GBL at The University of Iowa.

3. Reconnected with the concept of gaming as an instructional tool (20 min.), explored first steps for getting started, and identified pain points and barriers.

4. Application (15 min. exercise and 10 min. discussion): Synthesized and designed arguments for using games in the classroom, and developed next steps.

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SHORT PAPERS
Showcase
Introduction

Educational games have many potential benefits, when compared to traditional instructional methods, including increased learner motivation and the encouragement of exploration and risks (Allery, 2014). However, instead of seamlessly integrating learning into the game itself, often educational games take a “chocolate-covered broccoli” approach to learning (Bruckman, 1999). In *Math Baseball*, for example, learners must respond to mathematical equations and based on the correctness of their responses, are rewarded with either a “run” or an “out” accompanied with a change in graphics. The intended learning content has nothing to do with the baseball going on in the background. Furthermore, the engaging aspect of the game does not help the player learn about algebra. The content isn’t made any clearer and the baseball aspect does nothing to change the fact that algebra is algebra, or, broccoli is broccoli. The potential of fun in a game such as *Math Baseball* does not compare well to today’s popular games such as *League of Legends* and *World of Warcraft*.

*Down with Food* works to create a game experience that is both fun and educational by actively involving the learner in all parts of the game. Developed to teach systems thinking, an approach focused on the understanding of how parts of a system influence one another within the whole system, *Down with Food* emphasizes that the individual organs in the digestive system interact within and influence a larger system.

Down with Food Game Components

E-book Chapters

The e-book provides continuous context and explanation to the learner. The learner is kept engaged through careful use of humor, a likeable protagonist, interactive animations, collectables, and voice recording.

The plot starts with Mr. Patron being unable to eat the meal that Dr. Chef, a master cook with a degree in Biology, has prepared. Her friend Zyme, a small homunculus creature and the hero, discovers that Anti-Zyme has snuck into Mr. Patron’s digestive system and is causing it to fail. With the help of the knowledgeable Dr. Chef and the player, Zyme sets off and enlists the player’s help to fix Anti-Zyme’s messes and save Mr. Patron.

From here on, the e-book is broken up into chapters, one for each major organ of the digestive system.

Mini-games and Interactive Simulations

*Down with Food* currently features two fully-levelled mini-games and one highly-interactive simulation. Each mini-game is based on a different popular game genre: the esophagus game is modelled on games in the rhythm genre such as *Dance Dance Revolution*, while the *Small Intestine* mini-game makes use of the tower defense genre such as *Plants vs. Zombies*. Key game components, typical of each respective genre, are mapped to corresponding elements of the digestive system. For example, in the *Small Intestine* mini-game, instead of towers that shoot at enemies, players place enzyme launchers that launch enzymes at oncoming food blobs in order to break down the blobs into their corresponding nutrients.

Each mini-game and simulation focuses on one primary learning objective to enhance systems thinking:

- **Esophagus**: Humans cannot breathe and swallow at the same time.
- **Small Intestine**: Nutrients from food are absorbed in the small intestine.
- **Stomach**: Food requires a highly-acidic environment in the stomach in order to digest; however, the cells on the stomach wall require protection to not be harmed by the acid.

- **Large Intestine** (future development): Optimal amounts of water must be absorbed by the large intestine in order to have healthy bowel movements: too much water results in constipation while too little water results in diarrhea.

![Figure 1: An interactive simulation based on the stomach organ.](image)

**Future Development**

By the time of the conference, *Down with Food* will progress from the alpha to beta phase of development. At this stage, we will have: (a) completed all e-book chapters including accompanying animations and interactive elements; (b) completed development of the stomach simulation; and (c) designed and developed a game based on the large intestine.

**Prototype in Action**

Footage of various elements of gameplay are available at http://downwithfood.com/videos/. Additionally, access to a downloadable demo of the most recent build can be requested at [http://downwithfood.com/prototypes/](http://downwithfood.com/prototypes/).

**References**


An Occurrence at Owl Creek Bridge

James Earl Cox III, University of Southern California

Short Game Description: *An Occurrence at Owl Creek Bridge* is a game adaptation of the Civil War story of the same name written by Ambrose Bierce. Besides the title and credits, it tells a story without the use of any game dialogue, be it text or audio. As such, the story is conveyed through the use of pixel styled graphics, diegetic sounds, and minimal controls. These allow the player to more freely explore the story, encouraging the use of imagination to interpret the art and build the narrative as they progress. *An Occurrence at Owl Creek Bridge* is able to move the player through a deep, historical story within the span of 5 minutes without the use of words.

Educational Goals and Approach to Learning

*An Occurrence at Owl Creek Bridge* (Figure 1) is a game focused on creating a gateway to literature. Because this game is an intermedia translation, it keeps the original story intact through an interactive medium in such a way that a reader of the short story could have a meaningful conversation about the fiction with a player of the game. This is important as many games based on short stories fail to retain the mood, tone, and themes of the work, making them more akin to a game wearing the narrative skin of the fiction, rather than allow the mechanics and plot to combine.

Figure 1: Screenshot of *An Occurrence at Owl Creek Bridge*.

Beyond the opening title screen and credits, this game contains no in-game dialogue or text, spoken or written, which allows this experience to be accessible to non-native English speakers as well as those with reading disabilities.

While *An Occurrence at Owl Creek Bridge* does teach the player the narrative of the short story, it also demonstrates how interactive media can convey classic literature through a new format, preserving the work and making it accessible for future generations.

Other Relevant Information

*An Occurrence at Owl Creek Bridge* received Silver at Serious Play Conference 2013 as well as Most Meaningful Game at Meaningful Play Conference 2014. It has been displayed at venues including: The Smithsonian, Game-scape at Artscape, Different Games Conference, and Blank Arcade at DiGRA.

Links to Game and Relevant Media

*An Occurrence at Owl Creek Bridge* may be downloaded from both GameJolt and Itch.io for play on PC.


Itch.io link: [http://just_delete_it.itch.io/occurrence](http://just_delete_it.itch.io/occurrence)

In addition, here is a link to the Youtube trailer for the game: [https://www.youtube.com/watch?v=yxbJ0t0Uvg](https://www.youtube.com/watch?v=yxbJ0t0Uvg)
The World the Children Made

James Earl Cox III, University of Southern California

Short Game Description: The World the Children Made is a critical narrative adaptation of Ray Bradbury’s The Veldt focused on tying a player’s emotions to that of the story. The challenge rested in translating the essence of a short story conveyed through a medium of pure dialogue to an engaging conventional videogame medium of visual interaction. Ultimately, the goal was to transcend cultural boundaries and compellingly move The Veldt to pixel from the page.

Educational Goals and Approach to Learning

The game was created by analyzing Ray Bradbury’s story The Veldt and extrapolating the meaning and conveyed visuals from the piece. The following is an example of this process:

“They walked down the hall of their soundproofed Happylife Home, which had cost them thirty thousand dollars installed, this house which clothed and fed and rocked them to sleep and played and sang and was good to them. Their approach sensitized a switch somewhere and the nursery light flicked on when they came within ten feet of it. Similarly, behind them, in the halls, lights went on and off as they left them behind, with a soft automaticity.” – The Veldt

Within this paragraph from the original story, we establish that the home is fully automated. As the story mentions the price of the automated instillation, we can assume that the family has only recently acquired this high-tech house. Further, the story was first published in the 1950s, so that for the game, the player’s role as mother will be portrayed as a homemaker. The combination of a diligent housewife usurped by an automated and distracting house results in an unsettling environment that should feel empty and removed.

Through the use of such analysis, the short fiction was translated from writing into an interactive game. This process ensured that the game will carry the mood, tone, theme, and feeling of the original work over into the digital space. Players of the game would be able to have a meaningful conversation with readers of the written fiction, such that this game becomes both a gateway to reading as well as a critical piece allowing for the same analysis that the short story could afford.

Games like The World the Children Made could easily be used for compare and contrast exercises, or as alternative means of communicating the story to students who learn more effectively through active hands-on means.

Figure 1: Screenshot of The World the Children Made.
Other Relevant Information

*The World the Children Made* has received both the title of “Best Digital Game 2014” as well as “Game of the Year 2014” by Miami University of Ohio. This game has also received a Silver medal at the 2014 Serious Play Conference and was displayed at the 2014 Meaningful Play Conference.

Links to Game and Relevant Media

*The World the Children Made* may be downloaded from both GameJolt and Itch.io for play on PC.


In addition, here is a link to a Youtube video of the beginning of the game: [https://www.youtube.com/watch?v=T-DITr4C4d3k](https://www.youtube.com/watch?v=T-DITr4C4d3k)
**Touching Triton**

Kelly East, HudsonAlpha Institute for Biotechnology  
Adam Hott, HudsonAlpha Institute for Biotechnology  
Neil Lamb, HudsonAlpha Institute for Biotechnology

**Short Game Description:** *Touching Triton* is a serious game focused on building understanding of common complex disease risk. Players are faced with real world scientific data for crewmembers about to embark on a mission to Triton and must make informed packing decisions to help keep the crew healthy while away from Earth. Wrestling with large datasets of realistic medical and genetic data and interactions with filmed personas provides the foundation for a challenging critical thinking experience all set in the engaging storyline of long term space flight.

**Game Description**

*Touching Triton* is a serious game focused on building understanding of common complex disease risk. Students take on the role of a member of the human resources team for the fictitious Chiron Avionics. The goal of the game is to assess a spaceflight crew’s risk for common complex diseases (e.g. type 2 diabetes and coronary artery disease) and pack a spacecraft for a 20-year round trip mission to Neptune’s moon Triton in order to keep the crew healthy and alive. Players are faced with real world scientific data for each crew member including medical records, genomic testing results and family history. Interactions with filmed actors instead of animated characters add to the real world immersion experience. Wrestling with large datasets of realistic data and interactions with filmed personas provides the foundation for a challenging critical thinking experience all set in the engaging storyline of long term space flight.

**Game Development**

Teachers and students have been involved in the development of *Touching Triton* from its earliest stage. The first iteration of the game (see Figure 1) was tested with over 70 students from three different classes and three different schools. These pilot schools continued to provide valuable feedback through in-class testing and observations throughout the design and development of the game. Through feedback from those students and educators, *Touching Triton* was refined in both graphics and interaction (see Figure 2) to make the experience as intuitive and engaging as possible while retaining the educational capacity of the game.

![Figure 1: 1st iteration of launch portion of gameplay](image-url)
Learning Objectives

1. Many genetic and environmental factors interact together in a complex manner to influence health and disease risk.

2. Genomic data can be used to determine a quantitative disease risk for an individual.

3. Current knowledge about genomics and risk factors for disease is ever changing.

4. Personalized disease risk can inform decisions regarding lifestyle and medical interventions.

Target Population

Touching Triton has been designed for and tested with high school students of various levels including introductory biology courses, honors biology courses and IB biology courses. Although the design was initially focused on creating a serious game for high school life science courses, Touching Triton has become a key component in a clinical rotation of undergraduate nursing students and has been used in undergraduate introductory biology curriculums.

Trailer and Other Videos

https://vimeo.com/adamhott/touchingtritontrailer
https://vimeo.com/adamhott/kairainterview
https://vimeo.com/adamhott/korayinterview
https://vimeo.com/adamhott/gabriellainterview
https://vimeo.com/adamhott/launch
**Backyard Engineers**

Matt Haselton, Filament Games
Trevor Brown, Filament Games
Brandon Pittser, Filament Games

**Short Game Description:** Create the ultimate catapult and launch water balloons at your neighbors! Customize different mechanical elements of the catapult, manipulating movement, accuracy, range, and damage to drench even the most evasive of targets. Each level of the game is a unique open-ended puzzle that challenges players to think like real engineers and find the fastest and most efficient way to soak their neighbors!

**Educational Goals**

*Backyard Engineers* is a physical science game that was created to teach introductory engineering and mechanical design concepts to be used within middle school classrooms. The game exposes players to how different parts of a machine can be customized and manipulated to achieve greater or lesser values in movement, accuracy, range, and damage. After creating a working design for a catapult, the player can then launch water balloons to soak their opponents. *Backyard Engineers* allows for players to experiment through trial and error to come up with a working solution to the level, and there are often multiple mechanical combinations that will work to solve each level. This allows for players to generate their own creative solutions to the engineering design problems they confront in the game.

**Reinforcing Learning Objectives**

Our development team started with standards from Benchmarks for Science Literacy, Common Core State Standards, and Next Generation Science Standards when developing *Backyard Engineers*. Game designer Matt Haselton made sure that gameplay would properly expose students to these standards and created learning objectives around them. For a full list of standards, see the Further Resources section at the end of this submission.

*Backyard Engineers* comes with two tools for educators that help reinforce learning objectives and key concepts: supplemental curriculum and a teacher dashboard.

As studies have shown, the greatest gains in learning outcomes have been achieved when educators surround students’ game experiences with additional support and instruction (Wouters et al., 2014). The standards-based curriculum works in tandem with gameplay and provides a mixture of activities, labs, discussions, and assessments to solidify ideas. At the end of each unit, students are given both a traditional assessment and a Next Generation assessment. The traditional assessment is administered in the form of a multiple-choice test or quiz and tests students on key terms and definitions. The Next Generation assessment gives students an opportunity to apply their knowledge by sketching their own catapult and labeling different types of simple machines and how they operate.

The second tool for educators to use with *Backyard Engineers* is the teacher dashboard. The teacher dashboard gives educators instant feedback by tracking student progress. The dashboard, which works with all student game accounts that are tied to an educator’s account, charts each student’s individual level progression and what standards they’ve been exposed to at each level. The teacher dashboard not only identifies at what point students are introduced to key concepts, but also is useful in identifying students who may be struggling so that an educator can provide just-in-time support.

**Game, Curriculum, and Teacher Dashboard Access**

To access *Backyard Engineers*, the full curriculum, and view an example of the teacher dashboard, please do the following:

1. Go to [www.filamentgames.com/user/login](http://www.filamentgames.com/user/login)
2. Log in with username: glsdemo@filamentgames.com and password: GLSdemo2015
3. You should now be at a page titled “My Library”
4. To play the game, click the red button that says “Play Now!”
5. To view demonstration students on your account, click “My Sections” in the blue header.

6. To view an example of the teacher dashboard, click “My Reports” in the blue header.

If you have any questions during this process, please email Elle Jacobson at ejacobson@filamentgames.com.

Further Resources

(3) Game Trailer: http://bit.ly/1JUNdIL

References


Acknowledgements

The full credits can be viewed here: http://bit.ly/185YKTP
Stagecraft: Promoting Language Learning Through Play
Jen Helms, Playmation Studios Inc.
Justin Helms, Playmation Studios Inc.

Short Game Description: Stagecraft is a foreign language puzzle game designed by Playmation Studios for players to interact with a world closely tied to the semantics and syntax of language. Stagecraft moves beyond simply tying vocabulary to pictures and enables learners to fully immerse in their target language through the broader context of each puzzle. When players move objects in game play, they can immediately read and hear how those changes are reflected in their target language. The game is intended to improve reading and listening comprehension and has been released in Spanish, French, and English.

Game Play Description

Each puzzle in the game is comprised of a target sentence, a description sentence, and game sprites. As the player moves around the sprites in the game, the description sentence changes to match what has been created. For instance, if you put a cat next to a table (see Figure 1), the description sentence will tell you (in the target language), “The cat is next to the table,” and if you move her to the top of the table, the description will update to, “The cat is on top of the table.” The objective is to visually match the meaning of the target sentence, at which point the description sentence and the target sentence will match.

![Figure 1: An example of moving game sprites to solve the puzzle.](image1)

The changes in the description sentence allow the player to explore and play with their target language. This instant feedback enables players to deconstruct meaning and allows the game to remove the layer of obstruction created by translation based learning methods.

Stagecraft has three modes (see Figure 2). In the first players explore how words, images, sounds, and grammar all fit together. Only after completing this mode can the player unlock the next two. The second is a reading comprehension challenge in which players are on the clock and docked for incorrect attempts at solving the puzzle. The final is a listening challenge in which players have to solve each puzzle by listening to the target sentence only.

![Figure 2: The three modes for the game, accessed through the three tabs.](image2)
Level Design and Emergent Complexity

Our game introduces over 200 words in various semantic contexts. Players progress in a way that ensures progression and learning without the player being able to guess what comes next. Additionally, by staging scenes at various intervals, previously learned words are reinforced. Puzzles become increasingly complex (see Figure 3) throughout the game. The number of possible descriptive sentences that can be invented before the completion of the puzzle increases dramatically as the target sentences become more complex. In total, our game produces tens of thousands of different sentences because of this emergent complexity.

Figure 3: Levels of increased semantic complexity.
**Time Zone X: Play and Learning**

William Jordan-Cooley, BrainPOP  
Kevin Miklasz, BrainPOP  
Allison Mishkin, BrainPOP

**Short Game Description:** Educational games can engage students (Gee, 2007) to drive learning and intrinsic motivation (Przybylski et. al, 2012), and provide embedded assessment (Shute and Ventura, 2013). *Time Zone X* realizes these potentials within the broader context and learning opportunities of the popular educational website BrainPOP. With the core mechanic of sequencing events in history, and content that highlights causal relationships, *Time Zone X* encourages contextual reasoning spanning time periods and content areas while also providing formative assessment to guide further instruction.

**Game Overview**

Moby has disrupted the order of Time Zone X and, with it, all of history! You must help Tim reconstruct Time itself by placing historical events in their correct order. Play begins by selecting a starting topic from the 800+ movies on BrainPOP (Figure 1). You receive one deck of 5-12 events related to your chosen topic and the timeline starts with one random event from the deck.

![Figure 1.](image)

Each turn, you place an event from the top of your deck(s) into the timeline. Correctly place an event and you get a bump on your Flux Meter. Incorrectly place an event and you're told “try earlier” or “try later,” the event returns to the top of the deck, and your Flux Meter bumps down. If you get your Flux Meter to the top (Figure 2), then you get to choose a new and related topic deck to bring into play.

![Figure 2.](image)

Incorrectly place 3 events in a row or run out of events and the game is over. Complete a topic deck to collect its hidden artifact. You win by completing all the topic decks on BrainPOP. This Tetris-style "endless" gameplay is designed to encourage individual goal setting and gradual improvement.
Learning Dynamics

The game appears focused on historical dates. However, the expansive range of content across topic decks and granularity of events within topics mean it’s very difficult to remember all the dates, so players decipher events’ relative order based on context clues and causal relationships. This dynamic promotes higher-order historical understanding through sourcing, contextualization, and corroboration, such as within the Reading Like a Historian curriculum (Reisman, 2012). Connections between events include causality in geologic events, political shifts, inventions, discoveries, etc. Players often cannot place events with absolute certainty. Instead, they must hypothesize based on available background knowledge and test these hypotheses multiple times.

The background knowledge that enables this sequencing as a problem-solving exercise comes from a few different sources. First, the player must activate prior knowledge about the topic (Schwartz and Bransford, 1998). Second, players read a short event description that links related events with subtle contextual clues. These descriptions are written with a careful signal-to-noise balance, giving players practice with critical reading and picking out relevant information. The game creates a “time to tell” (i.e preceding instruction with inquiry-based activity) for this valuable exercise in reading comprehension, a method shown to improve engagement and retention (Schwartz and Bransford, 1998). Third, multiplayer games of Time Zone X lead to rich discussions between players of historical events and periods, supporting the social construction of knowledge (Kim, 2001).

Game Link
https://www.brainpop.com/games/timezonexamericanrevolution/ Note: This build is still in beta and missing a few features like (a) the ability to create your own cards, (b) see your progress completing topics across gameplay sessions and (c) unlock topics across subjects.

References


Acknowledgements

Thanks to the production team: Scott Price (Producer), Demian Johnson (Art Director), Jon Feldman (Editor-In-Chief), Vin Rowe (Developer), Katya Hott (User Testing Lead), Tanya Roitman (UI Designer and Content Artist), Suzy Cho (UI Designer), Mike Dawson (Content Artist), Richard Ho (Editor), Dana Burnell (Content Writer), Anne Bitzegaio (Content Writer), Yoon-Ji Kim (UX Designer), Allison Mishkin (Data Analyst), Kevin Miklasz (Assessment Specialist) and William Jordan-Cooley (Game and Instructional Designer). Special thanks to all our teacher and student playtesters in the New York City and New Jersey areas.
CHL: *Dearth of Darkness*

Dana Klisanin, Evolutionary Guidance Media R&D, Inc.

Short Game Description: *Cyberhero League* (CHL) is an Internet-based “scout-like” gaming adventure that enables players to learn about and take action on global challenges via collaborative partnerships with nonprofit organizations. Players seek to earn the badges of partnering nonprofit organizations by completing a series of educational games in the form of Apprenticeships. Achieving the badges results in aid to partnering nonprofits. The first Apprenticeship, *Dearth of Darkness*, introduces players to the negative impact of light pollution while introducing the history of light, multicultural astronomy, the importance of circadian rhythms, and more. Players earn the badge of the *International Dark Sky Association*.

Overall Description

*Cyberhero League* (CHL) is an online gaming adventure that brings “scouting” into the 21st century through enabling youth to tackle global challenges using digital technologies as the means. Systemically designed to advance principles of connected learning especially in the core learning area of interest learning and the core design area of shared purpose. Participation is voluntary and individuals are united in their quest to improve conditions in the world. Gamers earn the badges of partnering nonprofit organizations (NPOs) through participatory, educational, and civic accomplishments (Figure 1). To earn a badge, gamers complete an Apprenticeship—a series of digital tasks that teach them about the issues being confronted by a specific NPO. Bonus points are earned through visits to museums, World Heritage Sites, National Parks, and through participating in community events.

![CHL badges.](image)

*Cyberhero League* addresses STEM learning as well as social-emotional literacy through providing an antithesis to the negative use of the Internet. Through introducing gamers to the Cyberhero archetype youth are presented with a counterbalance to the Cyberbully, encouraging e-civility (Klisanin, 2013). *Cyberhero League* is a voluntary learning platform and as such it breaks down one of the most overlooked barriers to participation in learning environments: mental barriers. Unfortunately, many young people do not associate “school” with fun. They’d rather be playing games or hanging out in online environments. *Cyberhero League* provides an online environment where learning takes place in the pursuit of higher goals such as helping others and saving the environment. Education content arises organically as the gamer addresses the concerns of the nonprofit organizations, thus it has more meaning to the individual. In addition to STEM content, players earn bonus points through visits to museums, World Heritage Sites, National Parks, and through participating in community events.

*Dearth of Darkness*—Game Play

The first game, or “Apprenticeship,” created in partnership with the International Dark Sky Association, enables players to learn about the effects of light pollution on human beings and the natural world while simultaneously taking action to prevent it. Gamers learn about the history of light, multicultural astronomy, and circadian rhythms, among other things.
Using the *Dearth of Darkness Apprenticeship Manual* as their guide, Players make their way through a series of learning adventures. The first is a Twine Game, *The Multicultural History of the Stars* that takes players into a Cave. Upon entering the Cave, players begin the Twine where they view the constellations through the eyes of ancient peoples around the world including the Babylonians, Egyptians, Chinese, Celts, Incans, Hawaiians, Native Americans, and so forth (Figure 2). After successfully navigating the Twine, players return to the *Apprenticeship Manual* where they have the opportunity to enter the Museum of Illumination. In the Museum players can go into the Library where they can study the “History of Light” or decide to go onto the Gallery to view celebrated artworks from around the world. Inside the Gallery, players download and use the Aurasma App to find and view an augmented reality rebus that provides them with clues to solve a larger puzzle. Players gain additional points toward their badge as well as in-game powers by taking action through downloading Stellarium, an online planetarium; signing the “Light’s Out” Pledge; and using the Dark Sky Meter to monitor light pollution. Bonus points can be earned by visiting planetariums, observatories, art museums, dark sky reserves (parks), and through participating in the “Great Star Count” the “Lights Out” community initiatives, or hosting a Star Party to introduce their friends to the problems caused by light pollution.

![Figure 2: Cave Entrance into Twine.](image)

After earning the badge of the International Dark Sky Association, players will chose a second Apprenticeship and set off on another learning and activism adventure. *Cyberhero League* currently has more than a dozen nonprofit partners addressing a wide array of global challenges.

**Future Directions**

We are currently designing a mobile app that will give players the ability to use their mobile phones to geotag themselves at Museums, Planetariums, and other physical locations.

**Links to More Information and Game Demo**

*Dearth of Darkness* is still in development. A beta version can be accessed by signing up at the *Cyberhero League* website and requesting the passcode via the Contact form.

*Cyberhero League*'s Website: [http://cyberheroleague.com](http://cyberheroleague.com)


*Cyberhero League*'s Indiegogo Campaign: [https://www.indiegogo.com/projects/cyberhero-league](https://www.indiegogo.com/projects/cyberhero-league)

**References**


**Acknowledgments**

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Choice: Texas
Carly A. Kocurek, Illinois Institute of Technology
Allyson Whipple, Independent

Short Game Description: Choice: Texas is an educational interactive fiction game addressing reproductive healthcare access in the state of Texas. Play as one of five Texas women attempting to navigate the state’s reproductive healthcare system. Latrice is an attorney in her 30s trying to negotiate her professional ambitions while supporting her mother and siblings; Leah is a small-town bartender unsure about her next steps as she considers moving on from high school; Alex is a promising high school student who struggles to live up to her parents’ expectations; Jess is looking forward to motherhood as she builds a life with her husband; and Maria is an LVN and mother trying to balance her family’s needs and her own desires. Although billed as interactive fiction, Choice: Texas is based on extensive research into healthcare access, legal restrictions, geography, and demographics, and is reflective of the real circumstances facing women in the state.

More About Choice: Texas
Choice: Texas is an independently produced interactive fiction game developed by Carly A. Kocurek and Allyson Whipple. Production was funded by a successful IndieGoGo campaign in September 2013 (Kocurek and Whipple), and the game was released as a free-to-play browser game in 2014.

The game was developed using Twine and relies on real demographic and legal information specific to the state of Texas. Players enter the game as one of five characters (see Figure 1), including ambitious attorney Latrice, small-town bartender Leah, high-school student Alex, expectant first-time mother Jess, and working mother Maria. The game home page also includes links to other information about the game, including a content note; the content note provides information on the types of content covered in each character’s storyline for players who may wish to avoid some topics. For example, Leah’s storyline begins with discussion of a sexual assault.

Figure 1: The Choice: Texas shows all five characters.

After selecting a character, players are taken to the first screen of that character’s story (see Figure 2). Players navigate the story by reading text passages and then making choices regarding the character’s response to particular situations. Player choice impacts both the information that is available to the player and the situations she will encounter. Throughout, the player has the option to restart the character’s storyline or bookmark progress so that she can return to complete the game at a later time.
**Figure 2: The first page of Latrice’s story in Choice: Texas.**

*Choice: Texas* applies two distinct approaches to education. First, the game relays factual information about reproductive healthcare regulation and access in the state of Texas throughout the narrative. In playing the game, players are exposed to information about state laws, clinic availability, adoption systems, and other information. Second, the game relies on narrative as a means of encouraging empathy. In this, the game draws inspiration from recent empathy games like *Depression Quest* (2013) and from research that suggests that games can be effective at encouraging empathy and understanding (Flanagan, Howe, and Nissenbaum, 2008; Belman and Flanagan, 2010; Greitemeyer, Osswald, Brauer, 2010).

Upon its release, *Choice: Texas* received positive coverage from *Paste Magazine*. Reviewer Jed Pressgrove awarded the game 9 out of 10 stars, and said in part:

> *Choice: Texas* seems unlikely to revolutionize videogames even though it has more to say than most of them. ... Perhaps the game’s lack of self-important and divisive politics has turned some people off — it’s nowhere near as controversial as predicted. In a gaming world where the shock tactics of *Metal Gear Solid V: Ground Zeroes* and *The Walking Dead* translate to phony relevance, *Choice: Texas* is respectfully profound. (2014)

To date, *Choice: Texas* has been exhibited at the 2013 F.R.O.G. Vienna Conference, the 2014 SWPACA Conference, and Different Games 2014.

**Access Choice: Texas**

*Choice: Texas* is available as a free-to-play browser game at [http://playchoicetexas.com/](http://playchoicetexas.com/).

**References**


Acknowledgments

Full credits for all members of the Choice: Texas development team are available at http://playchoicetexas.com/credits.php
EMPIRES: Trade Goats, Grow Grain, Master your Empire. And Pre-Algebra

J. Scott Laidlaw, MidSchoolMath
Martha Riecks, MidSchoolMath

Short Game Description: Empires: A compelling story takes learning deeper. And preparing for goat uprisings is just plain fun. Trading goats and researching metallurgy, entwined with a youthful love story amidst the creation of civilization in Ancient Mesopotamia is not the formula one would expect to see when a middle school math teacher sets out to raise the dismal track record of U.S. students in international math tests. Why does it work? Because goats, or metallurgy, or wherever else a civilization story can take you, helps math make sense.

The Power of Story-Based Pedagogy

Trading goats and researching metallurgy, entwined with a youthful love story amidst the creation of civilization in Ancient Mesopotamia is not the formula one would expect to see when a middle school math teacher sets out to raise the dismal track record of US students in international math tests. Why does it work? Because goats, or metallurgy, or wherever else a civilization story can take you, helps math make sense. Compelling story-based pedagogy takes learning deeper.

Story-based games are an extension of pretend play, one of the oldest, most powerful methods of human learning (Steen & Owens, 2001) making the dynamic structure of educational games a powerful and accessible solution for educators (Takeuchi & Vaala, 2014). Yet, when it comes to math games, almost none do more than overlay a textbook problem on to a computer graphic, using points or badges as extrinsic motivators. While research clearly shows that students will learn more and play longer when math problems are more fully integrated in the game-play experience (Habgood & Ainsworth, 2011), not a single one of the leading math games for schools truly veers from a drill-and-rewards format, driving memorization-based learning instead of developing problem-solving skills. Conspicuously absent is any sense of greater purpose, much less a justification as to why math has relevance; the math is relegated to a very low-level purpose within the context of the game. Furthermore, this format breaks the “flow” of the game experience, putting math in a position that interrupts the very mechanism that makes games so fun, engaging and addictive (Engeser & Rheinberg 2008).

But math is not disconnected from story. Math can be part of the story, just as math underlies and is involved in so many aspects of everyday life. Math teacher Scott Laidlaw, Ed.D. realized that using math as a key element that moves story along, as problems unfold, was crucial to creating engaged students, eager to learn through the story-based games he developed and used in his classroom. And he wondered if could reach more students, and maybe just help the US improve its dismal track record in math, by engaging middle school math students in compelling online games where math is used, in context and with purpose, to move the story along.

Empires: Release The Attack Goats! Solve That Equation!

Empires (Figure 1) is an online game for middle-school students, using innovative pedagogy and connected play that is aligned to the Common Core State Standards for 7th grade math. Developed with support from the US Dept. of Education’s IES-SBIR program, MidSchoolMath hosted a beta release of Empires on February 28, 2015, will conclude IES-SBIR Research in the spring of 2015 and is already prepared for commercial use of Empires by schools in the 2015-2016 school year.

Set in Ancient Mesopotamia during the Neolithic Era, at the brink of the agricultural revolution and the beginning of trade economies, Empires (Figure 1) invites students into an epic civilization story, with characters, a rich plot and individual empires run by each student Provident. Students manage their empire, tallying assets, investing and distributing resources as they choose across a vast array of options that appeal to boys and girls, from goats to metallurgy, from armies to agriculture, and from caring for children and communities. As each activity unfolds, opportunities for deep learning of math–and repetitive practice–appear, woven into the context of the game. Math uniquely comes to life within Empires (Figure 2). Ratios and proportional relationships are explored as resources are invested in projects; students learn about and practice percentages as they calculate the odds of an attack goat rising; the Pythagorean Theorem serves as a tool that allows the measurement of distance and time between a neighboring empire to complete a trade. Peer-to-peer interactions are encouraged, in the classroom and in the socially-networked game as story plays out, creating rich opportunities for furthering educational understanding.
Empires is a modular game, ideally suited for use in class increments of 40 to 60 minutes. The game offers the critical ability to save mid-game, even if the student has not yet solved a math problem in its entirety. Teachers can monitor student progress, identify strengths and weak points and link performance data to real-time assessment within the teacher dashboard and learning management system. Story-based, strategic and collaborative, Empires is a first-of-its kind math game, setting an entirely new standard in educational gaming, using math within the context of a rich and robust story, and truly leveraging the power and fun of educational games to transform math education. We feel that Empires may just be the game that turns the tide of math education through genuine student engagement and mathematical skill building, while supporting true mathematical understanding.

A demonstration video of Empires can be viewed at https://vimeo.com/110586214. Access to beta accounts for testing and game play available upon request.

References


**Twelve a Dozen**

Justin Leites, Amplify
Joe Mauriello, Amplify

**Short Game Description:** *Twelve a Dozen* (*Twelve*) is a puzzle-platformer that takes you on a journey through a universe of numbers. Join the heroine Twelve as she sets off on an adventure to rescue her family during a cataclysmic event befalling the town of Dozenopolis. Follow along as she and her companion Dot explore the universe and solve puzzles along the way. Meet a quirky cast of characters and test your brain in a fun and engaging way. Designed to support middle school math curriculum, *Twelve* takes a refreshing approach to educational gaming. The story and game puzzles integrate mathematics at a core level, encouraging players to create and solve algebraic expressions in an engaging way. With the help of scattered “numbles” you’ll use addition, subtraction, division, and multiplication to unlock the powers to overcome the game’s tricky puzzles and dangerous environments. *Twelve* gradually covers more complex mathematical operations to challenge players over time.

**Educational Goals for Twelve a Dozen**

*Twelve* (Figure 1) aims to allow players to achieve the following goals:

- Understand the beginning thought processes of algebra.
- Understand order of operations.
- Explore algebraic equations beginning with simple expressions before moving into more complex ones.

![Figure 1. Learn math through an engaging story](image1)

These *Twelve* (Figure 2) specific goals are in addition to what Amplify aims to achieve across all of its Math games:

- Positioning math as a tool and not an obstacle in games.
- Allow players to experiment and fail within the game without any punitive consequences.

![Figure 2. Solve puzzles and gain new powers](image2)
With regard to the Math Common Core Standards, *Twelve* is mapped to the following math common core standards:

- **CCSS.MATH.CONTENT.5.OA.A.1.** Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.
- **CCSS.MATH.CONTENT.6.EE.A.1.** Write and evaluate numerical expressions involving whole-number exponents.
- **CCSS.MATH.CONTENT.6.EE.A.2.C.** Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations).
- **CCSS.MATH.CONTENT.6.EE.B.6.** Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.
- **CCSS.MATH.CONTENT.6.EE.B.7.** Solve real-world and mathematical problems by writing and solving equations of the form \( x + p = q \) and \( px = q \) for cases in which \( p, q \) and \( x \) are all nonnegative rational numbers.
- **CCSS.MATH.CONTENT.6.NS.B.2.** Fluently divide multi-digit numbers using the standard algorithm.
- **CCSS.MATH.CONTENT.6.NS.B.3.** Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation.

**Amplify Learning Games Approach**

In addition to Amplify’s in-classroom curriculum, Amplify is trying to extend learning beyond the classroom and captivate students with rich and vivid educational games that will keep them motivated to learn long after the school day ends. Our STEM and ELA games encourage players to adapt a growth mindset, a concept based on research from Carol Dweck. Amplify Games also provides mechanics to allow students to experiment, such as the rewind mechanic in *Twelve*, which allows players to undo any action they have taken, ranging from mathematical operators to actions within the game.

Amplify partners with some of the world’s top game designers to create educational games that are as enthralling as commercial games. Game designers focus on creating immersive experiences, while Amplify ensures that the content is accurate and meaningful. Unlike assigned schoolwork or homework, students choose to play Amplify Games for enjoyment, and in doing so, extend their time focused on academic concepts covered in class.

**Additional Materials**

- Official Trailer: [https://www.youtube.com/watch?v=TYWmf0-4wcc](https://www.youtube.com/watch?v=TYWmf0-4wcc)
- Gameplay video: [https://www.youtube.com/watch?v=PIDivXvaejc](https://www.youtube.com/watch?v=PIDivXvaejc)

**Acknowledgments**

Developed by Bossa Studios as a project for Amplify.
Applying Escape Room Game Concepts to Informal Learning: 
*Operation Sabotage Stanwix!*

Scott Nicholson, Syracuse University School of Information Studies

**Short Game Description:** Escape Room games are live action games where players work together in an enclosed space to discover clues, solve puzzles, and accomplish tasks to reach a goal in a limited time. This game, *Operation Sabotage Stanwix*, has players working as British agents discovering what parts of Fort Stanwix are vulnerable to aid an American prisoner in sabotaging the Fort.

**Overview of Escape Rooms**

Escape Rooms are live action games where players work together in an enclosed space to discover clues, solve puzzles, and accomplish tasks to reach a goal (usually unlocking a door and escaping the room) in a limited time (Nicholson, 2015). The lineage of the Escape Room genre can be traced to two other gaming genres—live action role playing games and point-and-click adventure games. Escape Rooms capture the excitement of being in a live action game; some advertise themselves as “live video games”. Live action roleplaying games have been running since the 1970’s as a way of making tabletop roleplaying games more immersive. Many of the aspects of a live action roleplaying game are in Escape Rooms—players are put into a situation, they may be part of a narrative, and engage with a physical world to take on challenges while a gamemaster ensures safety and helps the players to have an engaging experience. While most Escape Rooms do not require players to do roleplaying or engage in mock physical combat, the magic of live action gaming builds engagement and excitement during an Escape Room experience.

Many of the core game mechanisms of Escape Rooms come from point-and-click adventure games. Players have to search the space to locate items. Combining different items gives players the ability to solve puzzles, many of which have no directions. As they solve puzzles, they use those answers to move into other parts of the game. They may also be challenged with physical tasks, akin to action sequences in adventure games. In the mid-2000s, the genre of web-based escape-the-room games became the modern implementation of point-and-click adventure games. Combining these concepts creates the Escape Rooms that are rapidly spreading around the world today (Nicholson, 2015).

The amount to which these Escape Rooms embrace a narrative varies greatly by the room. Some rooms have no theme other than “Escape the Room,” and players are presented a series of themless puzzles to solve. Many rooms have a theme, such as horror, mystery, or military. But while these rooms may have a theme, many times the puzzles do not fit within the overall theme of the room. Finally, some rooms have a meaningful narrative; where there is a theme, the players are in a specific role, and the puzzles all make sense as existing within the space and narrative (Nicholson, 2015).

**Applying Escape Room Game Concepts to Informal Learning**

While there are learning outcomes of all Escape Rooms surrounding teamwork, communication, observation, and logical thinking, these games can also have a learning connection to a topic. Some are set in historical settings, such as Escapology’s *Cuban Crisis*, where players have an hour inside Fidel Castro’s offices to learn what kind of orders have been given. *Museum Escape: The Polar Domes* was a pop-up Escape Room produced by Rosie Amos from the Polar Museum and Nicola Skipper at the Sedgwick Museum, both part of the University of Cambridge (UK). In *The Polar Domes*, the players are finding the hidden research of a polar geologist who is afraid that her work is being suppressed by others (Amos & Skipper, 2014). *Memori* was a pop-up Escape Room run at the State Library of Australia and designed by Games We Play and Excalibur productions that had players exploring stories from Western Australia history (*Memori*, 2014).

Because Escape Room games create moments of intense engagement with a topic and a physical space, they are good models for places of informal learning like museums, libraries, and in the case of Fort Stanwix, a national monument featuring a military fort. We developed and ran this pop-up Escape Room all day at the Fort on June 13, 2015 with teams running each half hour.
Case Study: Operation Sabotage Stanwix

Fort Stanwix National Monument, located in Rome, New York, was a military fort important during the French and Indian war and the Revolutionary war. It is now part of the National Parks service and its staff wants to create new services that bring the Fort to life for visitors. The design goal of the Escape Room at Fort Stanwix was to maintain the gold standard of design for an Escape Room for informal learning—that the narrative behind the room be based upon reality, the puzzles lead to authentic learning outcomes about the topic, and that the puzzles fit within the reality of the narrative. In order for an escape from American-held Fort Stanwix to make the most sense, the players would need to be on the side of the British while trying to escape from the Fort. During the initial brainstorming, interpreters at Fort Stanwix located a story of an American prisoner in the fort who was planning to sabotage the fort and cause a mass desertion in exchange for an officer rank in the British Army. This concept provided the starting point for the narrative of the game.

The players are working for the British army, and have a list of potential sabotages for the Fort. They have learned through intelligence that suspicions have been raised and preparations have begun to increase the security and safety within the Fort. The team’s job is to sneak into the Quartermaster’s Office, find the plans for added security, determine which of the potential sabotage plans are still viable, then get that information to the prisoner. They have 20 minutes while the quartermaster eats lunch to sneak in, get information, and sneak out, leaving the office in the same shape that they found it. In addition, they know another British agent has already been sent ahead and is missing.

During a briefing session, the players are shown a picture of the other agents, and are given a map of the Fort with several locations written up with details on how they could be sabotaged. When the players enter the office, they encounter one of their colleague agents, who is chained down. The agent explains that the guards will be walking by the office every five minutes (which is why he/she was caught), and one has just passed. The agent also explains that he/she will be transferred soon to the prison, so can carry the message of which sabotage is the one to pursue, if the players can figure that out before the quartermaster returns.

The puzzles will not be detailed here, as the Fort may use this game in the future, but all of the puzzles were built around different methods of passing secret information at the time. Since there was suspicion at the Fort, orders to the quartermaster are coming in via different channels, but all are encoded in some way. As players solve the puzzles, they learn about different authentic methods that were used to pass messages during this time, and are able to eliminate sabotages. In order to eliminate a sabotage from the list, the players will have to understand what that area of the Fort is used for and figure out how changes in procedure would then impact specific locations within the Fort.

The captured agent NPC serves as gamemaster by passing hints on to the players if they are stuck and alerting the players when the guards are coming around every five minutes (which serves as a timer for the game). An audio track with footsteps and discussion is used to provide the players the sound of the guards passing as the players are encouraged to hide to avoid detection. The agent will also ensure the players are not too destructive to the room, reminding them that everything needs to be put back in place. The players win the game if they can correctly identify which sabotage is still possible and get out of the room within 20 minutes. Win or lose, they learn more about the Fort and methods of communication during the time, and are then able to head out with their maps and see the real Fort!

References


Acknowledgments

I would like to thank Angela Rammarine-Rieks and Alexandra Heidler for running the room at GLS, the Syracuse Game Designers’ Guild for brainstorming and staffing, students at the Syracuse University School of Information Studies for playtesting, and the Fort Stanwix National Park staff.
Splattershmup: A Game of Art & Motion

Andrew Phelps, Rochester Institute of Technology
(Additional credits and documentation provided in-game or at Splattershmup.rit.edu)

Short Game Description: Splattershmup is a game that explores the intersection of the classic shoot-em-up (or “shmup”) arcade game and gesturalized abstraction or “action painting” (a term coined by critic Harold Rosenberg in 1952 and often used to describe the work of American artist Jackson Pollock). It is intended to allow the player to reflect on their in-game actions and strategy through visual record, and to approach the creation of art as an arena of action. Art can thus be created, shared and discussed that comes “from inside the moment” of game-based decision.

Goals & Rationale

Splattershmup was built as an exploration of a popular criticism of gestural abstraction, namely that ‘anyone can throw paint at a canvas’ and that such designs are ‘random’. In fact, the elements of composition of such paintings are exceedingly thoughtful designs, with a great deal of planning and forethought as has been recently brought to light. Interviews with artists like Jackson Pollock highlight a notion of being ‘in the zone’ or ‘in the moment’ during the execution of the design, describing what is often termed ‘flow’ in a gameplay experience. Splattershmup attempts to marry these elements by creating a visual record of the deliberate actions of the players in response to environmental stimulus (i.e. the game world), with a controlled but playful simulation of painting media. The game highlights a sense of purposeful design, linking survival, pick-ups, and kills to the visual record, and thereby inspires players to reflect on works of gestural abstraction in a different way.

Website & Playable Demo

http://splattershmup.rit.edu/

Currently in open beta, available for play in Google Chrome, Windows and Mac desktop applications, and at the Microsoft Windows Store. Video is also available on the website.

Screenshots

Figure 1: In-game screenshot of Splattershmup: A Game of Art & Motion with green background, and player-selected palette.

Figure 2: A painting generated through gameplay inside Splattershmup
Acknowledgements

Team Splattershmup would like to thank the School of Interactive Games & Media and the Center for Media, Arts, Games, Interaction & Creativity (MAGIC) at the Rochester Institute of Technology.

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Short Game Description: *Czechoslovakia 38-89: Assassination* is a serious game on contemporary history. It features strong narrative, interactive comics and authentic audiovisual materials. It presents key historical events from different perspectives, including previously marginalized groups. The game develops abilities to comprehend and analyze sources of facts and create critical judgments.

Introduction

Recent meta-analyses on the instructional effectiveness of digital game-based learning (DGBL) demonstrated educational games’ and simulations’ modest superiority over a “traditional” type of instruction (e.g. Wouters et al., 2013). Similarly, empirical studies on the use of games and simulations for curricular history education reported promising results (e.g. Kennedy-Clark & Thompson, 2011). As far as we know, there is no educational simulation available dealing with the contested issues from Czech, and more generally Eastern European, contemporary history.

Game Description

*Czechoslovakia 38-89: Assassination* is a complex single-player dialog-based adventure game with a strong narrative, including interactive comics and authentic audiovisual materials. It presents key events from Czechoslovakia’s contemporary history and enables players to “experience” these events from different perspectives.

Educational Objectives

The game aims to develop deeper understanding of the multifaceted political, social and cultural aspects of this time period. Its content stems from historical research and personal testimonies. Emphasis is given on the diversified historical experiences of the population, including previously marginalized groups. At the same time, the game aims to develop abilities to comprehend, compare and analyze sources of facts and create critical judgments.

Figure 1: Dialogue scene (left) and comics (right) in *Czechoslovakia 38-89: Assassination*.

Story

The story of *Czechoslovakia 38-89: Assassination* covers the period following the assassination of Reinhard Heydrich, “Reichsprotektor” of the Nazi-occupied Czech Territories and leading architect of the Holocaust. Players are presented with different responses to the assassination of Heydrich, which in reality triggered a wave of brutal retributions, including the annihilation of the Czech village Lidice. Amid the repression, our protagonist struggles to understand: why his grandfather, J. Jelinek, was arrested after the attack? What role did he play in the attack? Why did he not tell his family? Was he brave or reckless to endanger their lives by becoming a “resistance fighter”?
Game Mechanics

Players in the game interact with the “eyewitnesses” in the present and “travel” back in time through these “eye-witnesses” memories evoked during conversations (see Figure 1). Player cannot change the history in the game yet discover different layers of it through individual testimonies and historical materials. The individual testimonies are often times contradictory, incomplete, or the eyewitnesses simply do not want to talk about certain aspects of their past with the players. As a result, players have to critically evaluate the gained information, exert social skills and empathy, and analytically approach the social constructions of history.

Evaluation

We have evaluated *Czechoslovakia 38-89: Assassination* in 24 Czech high school classes with students aged 15-19 in autumn 2013 and 2014. Seventeen teachers (8 males, 9 females) overall took part in the evaluation. For this study’s purpose, we designed model lessons consisting of selected sequences of the simulation, students’ worksheets and other teaching materials. During and after each lesson, we investigated teachers’ and students’ interest in the topic and their comparative assessment of model vs. “standard” lessons through questionnaires and non-participative observation. Each teacher also filled out a detailed final report after the evaluation. The goal of the evaluation was to test the acceptance of the game by teachers and students as a learning tool in a formal schooling environment.

The evaluation’s key results show that the students perceive the game to be attractive, authentic and immersive. They self-report it enables them to develop a better imagination and deeper understanding of the time period. More specifically, the students mentioned, that thanks to this game they are able to understand several different points of view on one historical event. From the perspective of the Czech teachers, the game is an effective, innovative learning tool that motivates students to learn about Czech contemporary history. Teachers self-report that the game stimulates students’ interest and curiosity and that it provides multi-faceted perspectives on historical events (see Sisler et al, 2014).

We are currently running a large-scale experiment testing the real learning effect of the game. The experiment also investigates the suitability of several design elements (e.g. degree of interactivity) for the educational objectives mentioned above.

Development

We have employed a top-down design process, during which designers refined incrementally the game scenarios together with historians, educationalists, teachers and artists. We have separated game content data from the engine, exploiting benefits of the data-driven software architecture. The home-built engine enables modifications and expansions of the game, as well as development of new projects.

References


Acknowledgments

*Czechoslovakia 38-89: Assassination* has been developed at the Faculty of Arts and the Faculty of Mathematics and Physics of the Charles University in Prague and the Institute of Contemporary History of the Academy of Sciences of the Czech Republic. The development of the game was financed by the Czech Ministry of Culture. The research of learning effects was supported by the Inner Grant FF_VG_2015_157 of the Faculty of Arts of Charles University in Prague. More info: [http://cs3889.com](http://cs3889.com).
Posters
Exploring Teachers’ Pedagogical Approaches and Strategies in Designing Educational Games

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Abstract: This study aims to explore how teachers design their own games and how their perceptions of digital games change after game design. Twenty teachers participated in the study. The participants first completed a pre-survey. Then, they designed an educational digital game on their chosen topic and provided feedback to each other. In the game design process, they did not use computers. A game design template was provided for conceptual design of an educational digital game. Finally, the participants completed a post-survey. Both quantitative and qualitative data were collected from online surveys (pre- and post-surveys) and game design documents. The results of the study showed that most participants applied the constructivist learning approach to the design of educational games. The game design experience had a positive influence on the participants’ attitudes toward and perceptions of digital games.

Introduction

Many teachers are unaware or skeptical of the pedagogical value of video games, due in part to their lack of experience with this type of media (Gaudelli & Taylor, 2011; Schrader Zheng, & Young, 2006). Research shows that game design can help teachers better understand game-based learning and afford them opportunities to re-conceptualize pedagogy (Li, 2012). Only a few studies have investigated teachers’ game design experiences. This study aims to investigate how teachers design their own games, focusing on their pedagogical approaches and strategies. This study also examines how the game design experience affects their perceptions of educational digital games. Findings from research on teachers’ game design show that teachers’ limited programming skills or the constraints of game design software often prevented them from implementing their original ideas. Therefore, this study focuses on conceptual design of digital games. The following questions guided our research investigation:

1. What pedagogical approaches and strategies do teachers use for their games?
2. How does game design experience affect teacher perceptions of educational digital games?

Method

The study was conducted in an online graduate course in the College of Education at a public university. This study focused on one of the course assignments which required the students design an educational game on a topic of their choice. Twenty students chose to participate in this study. Of these, 13 (65%) were female and 7 (35%) were male. The participants ranged in age from 20s to 40s. They were all school teachers.

The instructor sent a link to the pre-survey to the participants. Once they completed the pre-survey, the instructor provided them with the instructions for the game design assignment and a game design template. The participants designed an educational digital game on their chosen topic. They did not use computers for the game design. They were engaged in conceptual design using the given template. After submitting their game designs, the participants were asked to provide feedback to the games designed by their classmates and then to complete the post-survey.

We used descriptive statistics, t-tests, and Wilcoxon Signed Rank tests to analyze quantitative data from the pre- and post-surveys. Specifically, the paired-samples t-tests were used to compare pre- and post-surveys scores in the following categories: (a) Interest, attitudes, and self-efficacy, (b) Perceived benefits, and (c) Perceived problems. The Wilcoxon Matched Pairs Signed Rank tests were used to compare pre- and post-scores on individual items.

We used constant comparative method to analyze qualitative data from the surveys and game design documents.

Results

Pedagogical Approaches and Strategies

Most participants (75%) applied the constructivist learning approach to the design of their games. A small number of participants (25%) designed educational games using the behaviorist approach. Major engagement strategies used by the participants include creating an avatar, role-playing, real-life situations, fantasy contexts, rewards (e.g., points, stars, power-ups), unlocking new items/areas/levels, and time limit.
In terms of scaffolding strategies, many participants, especially those who used the constructivist learning approach, planned to provide scaffolding using non-player characters (NPC). Other scaffolding strategies used include increasing the difficulty levels, information embedded in virtual resources (e.g., virtual handbook, virtual encyclopedia), pop-ups (just-in-time information), immediate feedback, hints and clues, tutorials, and help.

Perception Changes

The majority of the participants initially viewed digital games as motivational tools. They reported that digital games make learning fun and keep students engaged. After completing the game design assignment, however, they realized that digital games have many other educational benefits. This result showed that the game design experience positively improved their perceptions of the educational value of digital games. T-test results revealed a significant increase in the scores ($t(19) = -2.20, p = 0.04$) from pre-survey ($M = 3.75, SD = .72$) to post-survey ($M = 4.04, SD = .64$) in the category of interest, attitudes, and self-efficacy. This result suggests that the game design experience had a positive influence on the participants’ interest, attitudes, and self-efficacy regarding the use of games in the teaching. Initially, 75% were interested in using digital games in the classroom ($M = 3.90, SD = 1.07$). After designing their own educational games, all but one of the participants agreed or strongly agreed that they were interested in using digital games in the classroom ($M = 4.25, SD = .91$). A Wilcoxon Matched Pairs Signed Rank test revealed a statistically significant difference between self-efficacy scores (“I have knowledge and skills required for using digital games in the classroom”) before and after the game design assignment ($Z = 4.50, p = .005$).

We found a significant decrease in the scores from pre-survey ($M = 2.17, SD = .61$) to post-survey ($M = 1.77, SD = .52$) in the category of perceived problems; $t(19) = 4.204, p = 0.000$. Further, Wilcoxon tests revealed a significant difference between pre- and post-survey scores on the following two items: “Digital games may draw students’ attention but do not help them learn” ($Z = 55.00, p = .003$), and “Digital games are not compatible with my teaching style” ($Z = 32.50, p = .033$).

Although most participants believed that teachers should be involved in the process of educational game design ($M = 4.15, SD = .75$), several participants were initially neutral about teacher involvement in educational game design. After the game design experience, however, all participants agreed or strongly agreed that teachers should be involved in the process of educational game design ($M = 4.55, SD = .51$). A Wilcoxon Matched Pairs Signed Rank test showed that the difference between the pre-survey scores and post-survey scores on the teacher involvement item was statistically significant ($Z = 11.00, p = .033$).

References


Playing a Mobile, Exhibit-Based STEM Game:  
Gender Differences in Behaviors and Perceptions

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Abstract: This study examines gender differences in affective outcomes, gameplay behaviors, and perceptions of gameplay of fifth to eighth grade students who played an exhibit-based mobile game during a group field trip to a hands-on science center. This mixed-method, quasi-experimental study used a pre-/post-administration of the Motivation to Learn Science Questionnaire, first-person GoPro video, and follow-up interviews. Results indicated that girls had higher science self-efficacy before their visit to the science center and outperformed boys on every measure of game achievement. The content of the qualitative data suggested that Lazzaro’s 4-Keys to Fun (2004) was a good fit framework for describing participants’ behaviors and perceptions of the game and visit to the science center. Data revealed that girls tended to be more goal-oriented, persistent in the face of difficulty, and appreciative of “hard fun”. However, gender differences in science self-efficacy did not exist on the post-measure.

Introduction

This study examined affective outcomes of playing a mobile game during a group field trip to a hands-on science center. Designed for fifth through eighth grade students, The Great STEM Caper (The GSC) was a challenge-based game intended to guide and mediate players’ experiences at the science center in a way that engaged them in STEM practices through problem solving with specific exhibits. The study was designed to answer particular questions: How does playing an exhibit-based mobile game during a group field trip to a hands-on science center affect students’ science self-efficacy and overall motivation to learn? How does gender interact with perceptions of the game and self-efficacy? Are there differences in the way boys and girls play the game?

The Game

An open-source, location-based game platform called ARIS (Augmented Reality and Interactive Storytelling) was used to create the game. The GSC used QR codes and a challenge-based game structure to encourage engagement in STEM practices at specific exhibits and created opportunities for student collaboration. Participants played in same-gender pairs sharing one iPad. The GSC preserved free choice but enhanced the traditional discovery-oriented exhibit interaction with goal-oriented motivation provided by a game-based learning experience. Players earned “skill units” in the categories of science, technology, engineering, and mathematics by completing challenges found throughout the science center. When players earned three skill units in any one category, they earned a badge in that category. A total of seven skill units were needed to win the game. Because self-efficacy is a strong predictor of performance and motivation to learn (Brophy, 1987) and mastery experiences lead to increased self-efficacy (Bandura, 1997), this research explored whether game-based mastery experiences, described as “fiero” moments by McGonigal (2011), would result in increased self-efficacy when compared to a traditional discovery-based visit to the science center.

Research Methods

This design-based, mixed-methods research study began with the development and pilot testing of The Great STEM Caper game over the summer of 2013 with small groups of children. After small-group pilot testing and game adjustments, the game was playtested with a school group of 17 seventh and eighth grade students. The final phase of data collection included four main types of data: a pre/post Motivation to Learn Science Questionnaire (MLSQ), first-person Go-Pro video recording during gameplay or science center visit, in-game player rating of the individual challenges, and follow-up interviews with a sample of players from each trial. Outcomes were compared between two groups: the game group played The GSC during their visit (n=79) and the comparison group explored the science center in the traditional discovery-oriented way (n=42). Both groups consisted of fifth to eighth grade students who completed the pre-visit survey approximately a week before the group visit to the science center. All groups completed the post-visit survey on-site before departing the science center. In each group, a boy and a girl wore the GoPro camera throughout the two-hour visit. Samples of six students in each group were interviewed after the visit to the science center.
Results

Overall, there were no significant differences between the game and comparison groups from pre- to post- on the MLSQ. Girls scored significantly higher than boys on the pre-measure of the science self-efficacy subscale of the MLSQ, but after the visit, their scores were statistically similar. Remarkably, the game group girls’ post-visit self-efficacy scores decreased despite the fact that the girls outperformed boys on every measure of game achievement (see Table 1). In-game “fiero” experiences did not translate into a positive change in self-efficacy for girls.

<table>
<thead>
<tr>
<th></th>
<th>Male (n=34)</th>
<th>Female (n=26)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Mode</td>
</tr>
<tr>
<td># Challenges Completed</td>
<td>90</td>
<td>2.65</td>
</tr>
<tr>
<td># Skill Units Earned</td>
<td>204</td>
<td>6.00</td>
</tr>
<tr>
<td># Badges Earned</td>
<td>22</td>
<td>0.65</td>
</tr>
<tr>
<td>WINS</td>
<td>15</td>
<td>0.44</td>
</tr>
</tbody>
</table>

Table 1: Game performance by gender.

All qualitative data (i.e., 40 hours of GoPro video, 26 interviews, and open-ended survey responses) was analyzed in NVIVO using a general inductive analysis approach. After all themes (approx. 80) had emerged and been analyzed for redundancy and overlap, it was determined that Lazzaro’s 4-Keys to Fun (2004) was a good fit framework for the data. Lazzaro describes four motivating factors for game players: hard fun, easy fun, serious fun, and people fun. Table 2 shows the percentage of references in the data for each type of fun disaggregated by gender. Both genders enjoyed the “hard fun” afforded by a goal-oriented science center experience that included playing The Great STEM Caper; but girls were slightly more likely to be motivated by “hard fun” than boys, and boys were slightly more likely to be motivated by “easy fun” than girls.

<table>
<thead>
<tr>
<th></th>
<th>A: Easy Fun</th>
<th>B: Hard Fun</th>
<th>C: People Fun</th>
<th>D: Serious Fun</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Female</td>
<td>25.09%</td>
<td>42.78%</td>
<td>23.01%</td>
<td>9.12%</td>
</tr>
<tr>
<td>2: Male</td>
<td>31.58%</td>
<td>36.61%</td>
<td>27.01%</td>
<td>4.81%</td>
</tr>
</tbody>
</table>

Table 2: Types of fun references by Gender.

Conclusions

Although girls exhibited higher levels of science self-efficacy than boys on the pre-MLSQ and outperformed boys on every measure of game achievement, their in-game “fiero” experiences did not translate into a positive change in self-efficacy. Girls enjoyed the challenge and having a goal to work toward during their science center visit; they enjoyed the “hard fun” nature of the gameplay experience. However, girls expressed more confusion and frustration related to gameplay than did boys. They were also more likely to seek and/or receive adult help. It may be that girls found the application of STEM problem solving required by the game more challenging than their experiences in school science. Success in the game may have been more difficult than previous in-school science experiences, and therefore may not have been perceived as a mastery experience at all.

References


Roles People Play: Key Roles that promote participation and learning in Alternate Reality Games

Elizabeth Bonsignore, iSchool, University of Maryland
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Kari Kraus, iSchool, University of Maryland

Abstract: We present an initial framework for roles that are assumed by players and designers of Alternate Reality Games (ARGs) to help promote and sustain participation and collaboration during gameplay. These roles are being derived from analysis of a sample of ARGs and interviews with designers. In particular, we find that approaches designers take to incorporate in-game protagonists (e.g., “protagonists-by-proxy”) can influence the ways in which 1) players gain access to disparate narrative and ludic elements within an ARG and 2) designers can integrate collaborative learning opportunities authentically into the narrative and gameplay.

Introduction

Identifying key roles that individuals play in learning communities is an important strand of research within education and related fields in the social sciences. Studies that inform our understanding of roles have been applied to improve the design of technologies that support collaboration (Salovaara et al., 2005), to motivate increased civic engagement and community participation (Preece & Shneiderman, 2009), and to structure and analyze online learning communities (e.g., Maor, 2003). Our study aims to extend research on the design and influence of social roles in communities with a focus on the collaborative play system known as the Alternate Reality Game (ARG).

An ARG is a form of transmedia storytelling (Jenkins, 2006) whose narrative context is not bound within any single communications platform or media type; its story fragments can be scattered and hidden in websites, phone calls, text messages, or books (EDUCAUSE, 2009; Kim et al., 2008). ARGs are instances of participatory culture (Jenkins et al., 2006), as they allow players to have a central role in assembling the story world by collecting, connecting, and sharing the narrative across various media. ARGs also engage players in new literacy practices, such as evaluating and sharing information across multiple media, analyzing complex problems, and using new media tools to re-interpret existing content or create new expressions (Bonsignore et al., 2012; Jenkins et al., 2006).

Because of the success with which players collectively operate, ARGs offer designers and researchers insight into effective designs for collaborative methods and tools that support learning (Bonsignore et al., 2012; Kim et al., 2008). In addition, categorizing social roles that players assume during gameplay may enhance our understanding of the ways in which successful problem-solving communities self-organize and offer options for explicitly engineering these roles into future designs.

Methodological Approach and Initial Keystone Species (Roles)

Our goal is to identify and categorize community roles that exist in ARGs by exploring the question, How do designers develop key social roles in ARGs to help promote and sustain participation and model positive learning behaviors? Our analysis includes qualitative coding of transcripts from interviews of 15 game designers and researchers who have experience designing ARGs and similar transmedia works. We also selected a sample of ARGs for analysis based on their 1) level of influence in developing the genre (e.g., I Love Bees, followed by over 500,000 players and 3 million viewers); 2) format (e.g., the book-based Cathy’s Book Series); and 3) purpose (e.g., to raise awareness of a major social issue, like World Without Oil).

We identified four types of keystone roles that occur in ARGs. Keystone species are essential to the survival of an ecosystem (Nardi & O’Day, 2000). In ARGs, keystone species ensure players become and remain engaged as they progress from launch to endgame. Our analysis of the keystone roles that ARG designers create is also guided by design suggestions for crafting non-player characters (NPCs) that promote higher engagement and participation by players (Isbister, 2006). For example, Isbister (2006) examined NPCs along design dimensions that lead to role formation such as power dynamics and hierarchies (e.g., “minions” are loyal to players) and defining interaction moments (e.g., “minions” mirror player excitement over successes). We divide our keystone roles into two categories:

Narrative-Centric, Defined Pre-game. These roles include characters who are integrated into the narrative pre-game and whose social roles remain distinct from players throughout gameplay. Two social roles fall within this category: 1) the Protagonist-by-Proxy (PbP), a character who is part of the narrative but works as a close ally
and informant to the player community (Anderson, 2008); and 2) the Protagonist-Mentor, who acts as the ARG’s help system and authority figure, often directing the players to complete specific missions and offering training or advice that enables them to do so. The PbP discovers the story in tandem with players. Players are presented with the same artifacts and information—such as URLs, copies of documents, photographs, email addresses, or phone numbers—as the in-game protagonist. From an information literacy perspective, the PbP can often model productive information-seeking and problem-solving behaviors that the players can emulate.

**Gameplay-Centric, designed for and emerging post-launch.** These ARG social roles may be established and assigned pre-game; however, little narrative content or interaction is developed pre-game. These roles are activated for engagement after the game is launched. Three social roles fall within this category: 1) Community Conduits, who are responsible for dynamically reporting player activity to designers; 2) Planted, Proxy Players who interact with the player community as players, but who are insiders, part of the game-running team. Proxy players essentially act as “super-players,” and are charged with welcoming and orienting new players, encouraging players individually to sustain participation, and providing feedback to ARG Community Conduits throughout the game.

**Conclusions and Future Work**

We identified several “keystone species”, or specific roles and associated behaviors that designers can implement to positively impact player participation in ARGs and similar transmedia storytelling experiences. Designer-crafted social roles can be integrated into the ARG narrative (e.g., Protagonist-by-Proxy) and enacted during gameplay (proxy-players). These keystone roles hold implications for use in the design and play of ARGs for learning. Educators (in informal or formal education contexts) could act as community leads and encourage more hesitant players. The Protagonist-by-Proxy could be used to model target literacy practices as well as motivate players on a peer-to-peer level. Due to the Protagonist-by-Proxy’s narrative-centric role, much of the character’s interactive content can be created in advance of game launch and thus offer opportunities for reuse. We are developing a more comprehensive typology of social roles and modes of interaction to design ARGs in learning contexts.

**References**


Acknowledgments

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Redesign: Using Educator and Student Feedback to Enhance Functionality and UI

Kelly East, HudsonAlpha Institute for Biotechnology
Adam Hott, HudsonAlpha Institute for Biotechnology
Neil Lamb, HudsonAlpha Institute for Biotechnology

Abstract: As the primary development phase of Touching Triton was finishing, a multipronged approach to evaluation was begun. Through evaluation of student learning, student opinion, and teacher surveys and interviews, a number of changes to the UI were needed to make the experience more engaging for the students and more functional for the educators. Four areas of change were needed and made. Dissemination of Touching Triton is now underway as a more engaging and useful serious game.

Overview of Touching Triton

Touching Triton is an online serious game designed to teach players about common complex disease risk and risk estimation. In the game, players take on the role of a member of the human resources team at the fictional Chiron Avionics. Chiron Avionics will be launching a long-term space flight mission that will carry six crewmembers to the moon of Neptune, Triton. The player’s objective for the game is to analyze medical record, family history, and genomic data for one of the crewmembers to determine that person’s risk for six common complex diseases (diabetes, heart disease, colon cancer, Parkinson’s disease, age-related macular degeneration, and venous thrombosis). Once disease risk has been analyzed and determined, students are faced with the task of managing packing decisions for the crew to prevent and treat onset of these diseases. Because common complex disease risk is neither 100% nor 0%, packing items will modify risk but not eliminate it completely. This adds a level of uncertainty within the algorithm used to determine outcomes of the game. Once packed, players launch the Argos1 (the ship that will carry them to Triton) and follow the journey as crewmembers travel to Triton and return home.

Before development of the game began, four foundational learning concepts were established for Touching Triton: 1) Many genetic and environmental factors interact together in a complex manner to influence health and disease risk; 2) genomic data can be used to determine a quantitative disease risk for an individual; 3) current knowledge about genomics and risk factors for disease is ever changing; and 4) personalized disease risk can inform decisions regarding lifestyle and medical interventions.

Evaluation Methodology and Results

An external evaluation group was contracted to assess the effectiveness of Touching Triton to deliver content as well as collect data on student engagement and educator opinions. A multifaceted, quasi-experimental case-controlled study design was implemented that included pre and post student surveys on gaming habits and content assessment questions, educator interviews, in-classroom observations, and educator post surveys.

Because evaluation and game finalization were concurrent, some evaluation data was used to modify gameplay. Specifically, four large changes have been made based on direct feedback from students and teachers. During in-classroom observations, evaluators noticed that the majority of educators told students that as they played the game, they would be taking on the role of one of the crewmembers that was traveling to Triton. Since the students were set up with the wrong expectation, the ending of the game was a significant disappointment to many students. In order to rectify the miscommunication, an introduction video was crafted that clearly states the role of the player and sets up the interactions and expectations. Based on additional feedback from students about the graphics and interaction at the end of the game, the decision was made to redesign this experience. The game concludes with the launch of the crewmembers aboard the craft that will take them to Triton and back. Originally, this was designed to reflect a schematic that one might see when watching a monitor at mission control (see Figure 1A). The redesign incorporated a much more graphically pleasing format, video flybys of each waypoint along the trip, and interactive health cards for each character changing a completely passive and nearly static conclusion to the game into a visually appealing and interactive experience for the player (see Figure 1B-D).
Teacher feedback from early adopters prompted a change to the educator portal of *Touching Triton* where those with teacher accounts can create classes, missions, and track student progress. Tracking student progress in real time has been a feature of the educator portal from the beginning. The interface for doing so was very schematic in nature and not able to generate student reports easily. The redesign of this section includes updated visuals as well as the ability to generate PDF reports that can be emailed or printed. In addition to an updated educator portal, teachers also requested more background material on the content covered in *Touching Triton*. Instead of creating a physical manual for the game, a separate web portal was created called HG Helix (hghelix.hudsonalpha.org). When complete, HG Helix will work seamlessly with *Touching Triton* with teacher, student, and public facing versions of the site. Logged in educators will have access to teacher specific content: deepening articles, additional education resources, and online tutorials.

**Dissemination Plan**

Dissemination of *Touching Triton* requires educators to be trained in a meaningful way on the implementation of the serious game. Educator training is being done around the state of Alabama, drawing teachers from the surrounding states of Mississippi, Florida, Louisiana, Georgia, and Tennessee. During these daylong training sessions, information is being gathered so that an entirely online training module can be created with the intent of being able to train any teacher anywhere. In addition to training sessions in Alabama, *Touching Triton* training has taken place at the Georgia Science Teachers Association conference and is currently being planned for the National Association of Biology Teachers conference (Providence, RI) and the National Science Teachers Association conference (Nashville, TN). Additional presentations are being planned for the Games+Learning+Society conference (see Figure 2). It is currently estimated that the full online tutorial will be available online by the autumn of 2016, making *Touching Triton* accessible to educators worldwide.

![Map of U.S. with training and presentation locations](image)

*Figure 2: Currently scheduled training and presentation locations throughout the U.S.*
Transformational Play Spaces For Microeconomics with EconU

Jason A. Engerman, Pennsylvania State University

**Abstract:** As students advance in our educational system, disengagement increases and may contribute to high drop out rates in higher education. Video game play can be a tool to re-engage learners in powerful ways. Transformational Play theory includes conceptual understandings to make sense of and transform a problem-based fictional context. Informed by this theory, the focus of our work is to examine the potential of a game-based learning environment to provide an opportunity for improved learning for an undergraduate economics course.

**Introduction**

A recent Gallup polls show worldwide engagement in school and work steadily decrease throughout grade school and directly into the workplaces (Crabtree, 2013). The Institute of Play reports that college drop out rates are at 46% in the US and this education crisis can be viewed as an engagement crisis ("Institute of Play", 2014). Video games can provide learners with engagement opportunities that improve academic achievement (Barab et al. 2009). EconU was developed by the Educational Gaming Commons in collaboration with Dirk Mateer and Dave Brown from Pennsylvania State University’s Department of Economics (See Figure 1. EconU). The main goal of the EconU project was to reinforce economics content by engaging students in more authentic and immersive experiences. Utilizing economic algorithms, EconU was designed so that students would rely on conceptual content knowledge to succeed in the game. In EconU, students took on the role of protagonist as a University President and were expected to build and maintain their own fictional University, by demonstrating knowledge of the following key microeconomics concepts:

- Elasticity
- Trade Offs
- Demand/Supply
- Total Revenue
- Costs
- Diminishing Returns
- Among others

![Figure 1. EconU User Interface](image-url)
Building from previous data, this study represents a design-based iteration that explores game play through Transformational Play (Barab, Pettyjohn, Gresalfi, Volk, & Solomou, 2012).

**Theoretical Frame**

This research draws from Conceptual Play Spaces with its original theory based on a focus of the design of the instrument. As the team refines its process, we take a more internal stance and begin to draw from the work of Dewey with transactivity (Barab, Gresalfi & Ingram-Goble, 2010), which helped birth Transformational Play. Dewey referred to transactivity as the notion that experiences modify their participants. Barab and colleagues further this idea and determine that these are dictated through transactive states of participation (Barab, Gresalfi, Dodge, & Ingram-Goble, 2010). This study will focus on applying conceptual understandings to make sense of and, ultimately, transform the context (Barab et. al., 2012) through the transactive state of substantive participation (Barab et al., 2010). Substantive participation speaks to Target Concepts of core understandings and practices that students are expected to learn; Legitimate Tasks of increasingly complex real-world and fantastical challenges with nested goals and Embedded Scaffolds that show the availability of appropriate tools, resources, and lessons for understanding. We will use a mixed methods approach to refine the design and implementation of games to support, reinforce, and improve learning in Economics courses. The research questions that guide our DBR study are:

- R1: Are there differences in the impact of EconU compared to traditional methods of review for Econ 102?
- R2: What are the qualitative differences in participation between EconU students and traditional review students?

**Current Findings**

Preliminary findings suggest that designated C students preferred this method of review and showed more positive reflections of the experience than A students. This may suggest the engagement of EconU resonated with a particular population that would otherwise go unnoticed and deemed marginal students of microeconomics. Towards a critical agenda and contrary to a well-known social stigma, this design work seeks to show that gaming environments can provide meaningful and powerful learning tools and engage a marginalized learning population. This critical design is addressed not only by context (gaming) but also in content (economics), as the study of economics represents the social science that studies the activities surrounding the processes that govern production, distribution and consumption of human resources. Our work aligns with Barab et al. as we view our design in context and content, services a bottom-up change, where our intervention could be leveraged as an instrument for broader social change and potentially stretches beyond economics content (Barab et al, 2007).

**Next Steps**

In the service of our broader agenda, we take on an ethnographic approach. As an ethnographic study the investigators intend on being participant-observers. They will attend the classes regularly, play the game and participate in the student forums. Toward understanding several layers of meaning that reflect the identities of the members of the learning community, the researchers will work to build a stable profile of the economics learner. We intend on iteratively refining the practical application of the game including the game mechanics themselves to meet Transformational Play needs for meaningful participation (Barab, Gresalfi, & Ingram-Goble, 2010).

**References**


Abstract: Videogames can be effectively used in an educational setting to improve grades, IQ, motivation and learning. In this paper, we improve upon a previous SEG in order to enhance engagement using both intrinsic and extrinsic motivators. Using in-game improvements, events that break the fourth wall, classroom, school and instructor led activities. The standard and improved version of Cerebrex was tested with 6th graders in two private elementary schools in Guatemala City. The children in the control group played the standard version while the experimental group played the enhanced version for ten weeks. The results show that the children who played the improved version registered an increase in the total number of games played of 200% and 1000%.

Introduction

It has been argued previously that games can be used as a force for good (Przybylski, Rigby, Ryan, 2010; Ferguson, 2010), and have successfully increased grades, IQ, motivation and learning (Baranowski, Buday, Thompson, & Baranowski, 2008), (Lemus, Baessa, & Garcia 2014). Still an open question is how to make games fun? There are researchers who warn us to stay away from what has been coined “chocolate covered broccoli,” while other researchers argue that the educational system is compulsory so it is OK to use extrinsic motivation to motivate play. We believe the game must be fun in itself - intrinsic motivation (Deci & Ryan, 1985) but also can use extrinsic motivators to attract student attention and bring them to play.

The improved version of Cerebrex, henceforth called Cerebrex Ultimate, included many motivational improvements, including better graphics, improved stability since most bugs were fixed, a customizable player character, various types of items that would alter game mechanics such as armor and weapons, weekly in game events amongst others. Additionally, posters were placed in school bulletin boards with game elements, especially game relics, and a special poster with the weekly top 10 players was posted in-class where grade teachers would congratulate the player with the best score and the most constant player.

Objective

The main purpose of the current study is to assess if the improved version of the serious educational game Cerebrex would enhance engagement measured by how many games the children played.

Methodology

Participants and Setting

Data was collected for two upper class private elementary schools in Guatemala City hereafter called school 1 and School 2. School 1 was an all-boys school which had 35 participants in each group. School 2 was an all-girls school with a total of 20 participants in each group. Average age for both schools was 12 years old which ranged from 11 to 13 years old.

Instruments

The standard Cerebrex game was used for the control group while the experimental group used the enhanced Cerebrex Ultimate. Both games record user interaction with the game, so usage statistics was derived from the logs in each game. Training on how to use the game was provided to the students before engaging in the experiment.

Procedures

The first phase lasted 10 weeks where the control group would play the standard Cerebrex game in school 1 & 2. The second phase also lasted 10 weeks and the experimental group played the improved Cerebrex Ultimate. Before beginning the second phase, we started placing Cerebrex posters throughout the school creating an ex-
pectation campaign. We also agreed to send a weekly report to the teachers so they could congratulate in person the player with the best weekly score and the most constant player.

### Results

Games played are the total number of games the students completed during the 10 week interval (Table 1).

<table>
<thead>
<tr>
<th></th>
<th>School 1: Total Games Played</th>
<th>School 2: Total Games Played</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cerebrex</td>
<td>284</td>
<td>549</td>
</tr>
<tr>
<td>Cerebrex Ultimate</td>
<td>3062</td>
<td>1032</td>
</tr>
</tbody>
</table>

Table 1: Total games played during both phases in each school.

![Figure 3: Comparison of the total of games played between schools.](image)

### Conclusions

Both Figure 3 and Table 1 clearly state a high increase in games played. This indicates that the improvements implemented in Cerebrex Ultimate translated effectively into more games played and that combining intrinsic/extrinsic motivators can improve engagement.

### References


Building a Community: Games in Library Training and Development

Andrew Evans, Rose Library, James Madison University
Kelly Giles, Rose Library, James Madison University

Abstract: To develop training programs that would engage, inform, and cultivate a sense of community among student assistants in a university library, games were created involving individual and team challenges in various formats. The integration of games and game mechanics into on board and continuing training events created new opportunities for observable individual and team growth.

Background

The Library is the science and health library at a University, and typically employs about 30 student workers each semester. These student employees are responsible for many services including circulation, re-shelving of materials, stacks maintenance, and basic technical support at the library’s Information Desk. For a number of years the training of student workers and wage employees was handled jointly by library staff at different campus libraries and lacked cohesiveness. The position of the Library Information Desk Training Coordinator was created to provide more effective training for our student workers.

Training originally consisted of one traditional lecture-based training session at the beginning of the academic year, plus a series of individual online training modules that student assistants completed through an organizational Blackboard site. These modules required students to read through instructional documents or view a training video and then complete a short test. This format created an isolating atmosphere and contributed to a sense of apathy among the student assistants. After implementing a similar online training program for library staff and student employees at the University of Arizona, an employee survey found that “while there was general agreement that the content helped prepare them to do their jobs and almost everyone liked the pace and the ability to refer back to the training, most were not as engaged by online delivery” and wanted the online training to be supplemented by face-to-face interaction (See & Teetor, 2014, p. 85-86).

Once I began my role as training coordinator, I hoped to develop training programs that would engage student assistants, as well as build a greater sense of community. In their study of student workers training, Mitchell & Soini (2014) found that “ongoing training to reinforce skills and knowledge is essential for success of students in their role” but emphasized that “variety is the key when training students and for fostering a skilled student team” (p. 602-603). I sought to create more active training tools and events that would offer learning opportunities that would also encourage the student assistants to interact with one another. With limited time and funding, I have created training games that not only engage student assistants with training materials but also give them greater opportunities to learn about each other.

Development

Through a process of trial, error, and observation, I began to create games and integrate them into the training process. I wanted to give students a shared experience that would bring them together as a team while actively engaging them as they learned about the various library and building systems.

First, I developed several “choose your own adventure” style games using PowerPoint that could be integrated in the existing online training. These were simple, humorous games aimed at simulating possible customer service and reference interview situations. Soon after their implementation, I observed students talking to each other about the experiences they had while navigating the game.

Soon afterward, I received approval to host an hour-long training event. This was a mandatory workshop and I was able to bring together all of our current student staff, who previously only came together for a large annual training event at the beginning of the fall semester. For this training, which focused on the Library of Congress call number system and maintenance of our library stacks, I created a game based on the children’s television game show Legends of the Hidden Temple. Student assistants competed in groups of five or six to complete three separate challenges: trivia, a timed call number sorting demonstration, and exploring the library stacks. Feedback from student workers after this event indicated that they had fun playing the game. However, during the event I observed many of them getting caught up in the competitive elements of the game and was concerned that this may have detracted from the intended message about teamwork and cooperation. 88% of the students that attended left...
positive feedback on an exit survey, specifically about the game and activities.

In 2014, I created a game based upon the popular party game *Apples to Apples* to be used at the annual training event for all campus libraries. This adaption of the original game involved matching adjective cards to cards naming library people, places, and policies. The mechanics of this game, in which players take turns in groups of six or more take turns deciding which of the proposed matches is best, eliminated much of the previous competitive focus of the student assistants while still keeping them engaged in the game and training information. Afterward, 45% of the students reported on an exit survey that this game was the most helpful part of the training event.

**Conclusion**

With reasonable effort and resources, the creation and integration of games into training can create great opportunities to develop staff interest, communication, and a sense of community. Even with a large staff of student employees who often only work three at a time at the Information Desk, I was able to observe new friendships being fostered during training events. Games helped to create an atmosphere of communication and teamwork among a large, diverse group of student assistants. The exit surveys I collected following the training revealed that the format and the implementation of the games impacted the results, but every game led to greater engagement from the student assistants both at the training events and during their shifts working at the Information Desk.

**References**


Using Games to Teach Global Interconnectedness

Matthew Farber, New Jersey City University

Abstract: In the fall of 2014, Matthew Farber, a middle school social studies teacher, created a project-based learning (PBL) unit with essential questions supported by tabletop and digital games. The PBL centered on the Columbian Exchange, the intentional and unintentional exchange of goods, ideas, and diseases between Europe and the New World. Farber consulted Matt Leacock, designer of the award-winning cooperative tabletop game Pandemic, and designers from GlassLab, publishers of SimCityEDU. As a result, a mix of digital games (i.e., SimCityEDU and Pox: Save the People), along with the board game Pandemic, was used to teach themes of global interconnectedness and systems thinking competencies. After the project concluded, students continued to display the ability to be systems thinkers, such as the role the Silk Road network played in the spread of the Black Death from Asia to Europe.

Interconnectedness

The world is comprised of complex and dynamic interconnected systems. In a causal loop, a cause has an effect, which becomes another cause, and so on (Senge, 2006). Actions have consequential effects, setting other events in motion. The smallest interconnection of a system is the feedback loop—also a component in the ecology of games.

If a goal is to create a game out of schoolwork, then all parts of the game system must be present and functioning (Farber, 2015). Games are models of interconnected systems that “encourage players to think about relationships, not isolated events, facts, and skills” (Gee, 2005, p. 36). It was proposed that, if a game had the core mechanic of balancing systems, then competency would be reinforced.

Role-Playing in the Classroom

When students learn in a project-based environment in a physical classroom, they are often arranged to be working in specified stations, or learning centers. The classroom space is, in essence, the “magic circle” where learning happens. Students in this project were arranged in groups of four, each with an assigned role and task. This arrangement combined Kagan’s cooperative learning structures with The Multiplayer Classroom’s guild configurations (Clowes, 2011; Sheldon, 2012; Farber, 2015). Pandemic—a four-player, role-playing cooperative tabletop game—was the culminating activity. Either everyone wins together, or all is lost. The board itself is a map of interconnected world cities. Like a personalized “power-up,” roles in Pandemic are unique for each player. For example, “Dispatchers” can move players anywhere around the board; “Quarantine Experts’” curtail outbreaks. The game’s roles gave meaning to Farber’s students. After play, students were observed bonding over the roles each group shared. Pandemic designer Matt Leacock explained the power of role-play. In a December 2014 interview with Farber, he said,

> You turn everyone into superheroes. I believe it was Steve Jackson [designer of the popular role-playing series, Munchkin, and Zombie Dice] who said that every game is a role-playing game. I try to create hooks so people can pour themselves into their character (personal communication).

Aside from divvying responsibilities in cooperative projects, (i.e., one student researches facts on the Internet, while another is tasked with curating digital images), roles in the context of games have the potential to empower learners.

The Columbian Exchange as a Game

In the fall of 2014, Farber created a project-based learning (PBL) unit supported by games for a sixth grade social studies class. (Farber is also a published author on game-based learning, as well as a doctoral candidate on the topic. The book was written from a practitioner’s standpoint.) The result was a project centered on the Columbian Exchange, the intentional and unintentional exchange of goods, ideas, and diseases between Europe and the New World. During the Age of Exploration, Europeans brought animals and crops back and forth from the New World (Crosby, 2003). Small pox also travelled to the Americas, which wiped out much of the native populations.
Games are an interconnected system of goals and rules, where all components interconnect; change one piece and the entire dynamic shifts. To illustrate this to students, Farber had students modify ("mod") rules to Rock-Paper-Scissors. The PBL also involved playing through SimCityEDU: Pollution Challenge! The game’s objective—balancing city systems (i.e., pollution and employment rates)—served as a contextual lens to view historical cause and effect loops. Farber was able to assess student competencies using the GlassLab Teacher Dashboard feature.

Next, students conducted Internet research. They each designed a playable deck of trading cards about the Maya, Inca, and Aztec civilizations. Read-Write-Think’s Trading Card application was the authoring tool. Students wrote rules for their card games and then playtested one another’s designs. Other resources came from the Institute of Play’s Q Games & Learning Design Pack, including the “Parts of a Game” chart and the “Playtest Reflection Template.”

The mechanics of interconnectedness supported Columbian Exchange concepts. The final stage of the PBL pertained to interconnected global cultural exchange. Farber asked the class to predict how the system of Meso-American life changed once the Conquistadors arrived. Learning centers were set up throughout the classroom. Primary source documents in Stanford History Education’s Reading Like a Historian curriculum, in which the Incas met the Conquistadors, served as the text-based assignment. The other was video-based, from PBS Learning Media. Connections to current events were also made, including the Ebola outbreaks in Western African nations and the recent measles outbreaks in America, using BrainPOP resources. To learn about outbreaks, students played Pox: Save the People on iPads. Its mechanics teach vaccinations circles.

For formative assessments, Farber used exit tickets, asking reflection open-ended questions before students left the classroom. For example, students were asked how Pox’s core mechanics delivered its message. In other words, how does a vaccination circle work? Regarding Pandemic in the culminating station, game play was not assessed; rather, as students played, they took “field journal” notes, written from the point-of-view of the role they chose. Students who were the Quarantine Experts boasted on their ability to halt disease outbreaks. Furthermore, many displayed the ability to be systems thinkers in subsequent units, such as the role the Silk Road network played in the spread of the Black Death from Asia to Europe.

In cooperative games, players must look at the others’ faces just as much as the game board. Players must communicate with others to succeed. Leacock discussed social mechanics—actions taken in games with the goal of promoting player interactions—with Farber. He said,

Naturally, it’s in the very structure of a board game—you’ve got the board on a table with players encircling it. It forms a common space, a circle—a protected area of interaction, where all the players feel safe within all of the confines of the rules. You’re not just staring at a screen; it’s not a solitary experience (personal communication).

In December 2014, “Pandemic Parties” began sprouting up around the globe. They were organized to raise awareness and money for Doctors Without Borders (the goal of $50,000 was met in 2015). To that end, Farber added his class to the Pandemic Parties Google Map and Facebook page, enabling students to make authentic connections from the map on the game’s board to the real world.

References


Analyzing Game Discourse Using Moral Foundations Theory

Thomas Fennewald, Concordia University

Abstract: This poster addresses challenges in the study of morals in games and the design of games that elicit moral reasoning by utilizing Troubled Lands, a common-pool resource dilemma simulation game designed to support political-style debate and diverse moral conversation (Fennewald and Kievit-Kylar, 2014). Discussions from ten sessions of the game were analyzed using Haidt’s Moral Foundations Theory (2012), a theory that describes six moral foundations that are innate yet vary in expression across cultures. We find that players make a number of anomalous actions (actions that would not be expected under standard game theoretic predictions) and that these anomalies are justified using a variety of moral claims analogous to the foundations described in Moral Foundations Theory.

Introduction

As Sicart (2009) and Zagal (2011) point out, games can provide a space in which players can engage in making moral claims and judgments. Several studies of ethics and morals in gameplay take an ecological approach, studying the moral potential of commercially available games; however, a smaller number of studies have been dedicated to the design of morally rich games and game mechanics meant to push the boundaries of what is possible in terms of in-game moral elicitation—a notable example in this regard is Brenda Romero’s series The Mechanic is the Message (Braithwaite 2010, Swain 2010).

Prior work in gaming studies has applied Kohlberg’s Theory of Moral Development (1973, 1981) to gaming (Staines, 2010). An alternative theory of morality that might apply more to in-game moral examination is Haidt’s Moral Foundations Theory, a theory that states there are six moral foundations upon which actions can be justified: care—acting to aid those in need, fairness—acting out of proportionality, liberty—acting in ways that preserve self-autonomy, authority—acting out of respect or deference, loyalty—acting in ways that uphold a group or social bond, and sanctity—acting out of respect to something considered pure or sacred. This theory suggests that rather than looking at morals as developing along a trajectory, it is more productive to consider morals as belonging to one or more categories.

Haidt’s theory is valuable to game designers, researchers, and moral educators because it suggests that a variety of moral behaviors and reasoning could exist in games. Further, Haidt’s theory can be applied as a test of how often particular games elicit particular kinds of moral foundations. For example, the moral content of a game’s discourse can be analyzed as one indicator a games moral elicitation potential. This application of Haidt’s theory is theoretically significant as it represents an opportunity to conduct a proof-of-concept test of which moral motivations can arise within gameplay for any particular game. This study is also significant because if games can elicit particular moral reasoning from within-game events then this could point the way toward producing more games and game mechanics that emulate moral situations and choices found in real life.

Methods

To expand theory in the area of moral reasoning and behavior in gaming, we first adapt Haidt’s Moral Foundations Theory to study moral discourse in games. We redefine Haidt’s six moral types in terms of game play and then show examples of various moral claims made by players that include examples of Haidt’s six moral types: care, fairness, liberty, authority, loyalty, and sanctity – when players discuss the purity of the ecological commons presented in the game. We look for Haidt’s moral six moral foundations (care, fairness, liberty, authority, loyalty, and sanctity) in the game because they are a helpful heuristic for sorting through the diversity of moral action that could exist in games.

Having developed our adaptation of Haidt’s Moral Foundations Theory, we apply our adapted framework to the study of ten gaming sessions of Troubled Lands, a game that we made in 2014 specifically designed with the aim of eliciting a wide range of moral claims within gaming experience. In the game, three players with different abilities and goals share a common space that is in danger of environmental collapse. Players are asked neither to work as a group nor to compete with each other, but rather to perform as well as they can in their own position. Play is balanced by having each players compete tournament-style against another player who is playing the same character with the same abilities but in another group, such that each group has three roles, e.g. A, B, and C in group 1 and A’, B’, and C’ in group 2. Thus, A and A’ are competing, B and B’ are competing, and C and C’ are competing. This means that in any one group, players are not obligated to collaborate or compete but are rather given the
option to decide freely how much to collaborate, cooperate, or compete. In this way, our game was designed to elicit moral discourse, with asymmetry and inequality among players such that each player represents the rich, the middle class, or the poor.

Results & Discussion

In our study, we find examples of moral claims for many of Haidt’s moral foundations suggesting that a wide variety of moral foundations can be elicited in games. In the poster, we provide descriptions of moral foundations and quotations from game play transcripts to illustrate our findings. For example, as evidence of care, we find that some players sacrifice themselves for others. One player states “I'll lose so you guys can win.” As evidence of sanctity one player states: “It was like this whole game we were trying to keep things green ... because we don’t want to hurt the earth.” In some cases, players were so motivated by these moral foundations that their actions worked against their in-game success.

Other foundations were also seen. Liberty was observed when players act in their self-interest and refuse to assist or go along with other players, instead opting to score their own points. Not many examples of authority are seen in this particular game, except when one player becomes bossy or when other players follow that player's direction, which did occur on occasion. Loyalty is seen in that some groups for a strong in-group identity. Fairness is seen in nearly every game with players acting on reciprocity or taking turns in taking beneficial actions.

Loose connections to Kohlberg’s stages are also found, but the connections are more difficult to make between our data from this game and Kohlberg’s theory as compared to Haidt’s theory. This does not suggest that Kohlberg’s theory is incorrect, only that our game does not necessarily elicit development or that development of this kind cannot be detected during a 45-minute play period.

Conclusion

This study is significant as a proof of concept application of Moral Foundations Theory to gaming studies. Further, it documents how a game that can be learned and played in less than one hour can elicit a wide range of moral types.

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Beyond Collaboration, Cooperation, and Competition:
A Typology of Player Goals in Games as Metaphors for Life

Thomas Fennewald, Concordia University
Ellen Jameson, Indiana University
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Abstract: Some games have educational value as metaphors for socially complex real-world situation such as war, espionage, resource management, teamwork and community life. In part, the educational success of these games depends on providing goals that align players’ motivations and interactions with corresponding realities. Traditionally goals like collaboration, cooperation, and competition have been used to support gameplay, however new kinds of games have arisen recently, including semi-cooperative, meta-collaborative, and traitor games, suggesting that the range of possible game formats is more nuanced. To make sense of this emerging space of game types and to link game formats to player experience, this poster describes a typology of games that focuses on interdependence between players and categorizes features such as goal states that might contribute to players’ ability to relate what they learn from in-game interactions to external contexts.

Introduction

Game theorists have traditionally separated games into two broad categories: cooperative and competitive. In the first decade of the 2000s tabletop collaborative games became increasingly popular and Zagal et al. (2006) emphasized the importance of considering a distinct third category: collaborative. While these three basic categories describe many of the games on the market today, the growing popularity of semi-cooperative, metacollaborative, and traitor games suggests the need for a more nuanced examination of player interdependencies in different game formats and their affordances for learning and research.

A number of other ways to categorize games exist, and many of these are beyond the scope of our focus on player interdependencies. These include: by platform (e.g. tabletop vs. electronic, console vs. PC), by complexity/time commitment, casual vs. not casual, by mechanic (e.g. press your luck, trick-taking, roll the dice), and by genre (simulation, strategy, racing, puzzle, role-playing game, economic, etc.). A number of such game typologies have been developed including Aarseth et al.’s multi-dimensional typology of games (2003), Elverdam and Aarseth’s game classification system (2007), Djaouti et al.’s G/P/S typology for serious games (2011), and Järvinen’s (2003) typology of rules. All of these typologies are more general than our specific focus on how goals and mechanics can relate to social experiences in realistic situations.

To aid in the design, selection, and study of games that afford players opportunities to learn things they can productively apply to contexts outside of games, we suggest a detailed game typology based on an analysis of characteristics that influence player social experience. With tabletop games as our focus, we aim to show how particular combinations of goals and mechanics can support the simulation and emulation of real-life motivations across socially complex situations such as war, teamwork, resource management, espionage, business negotiations, and community life. This typology could potentially be used to map relationships among established and emerging game types, to locate gaps in current game design where novel game types could be developed, and to help in the design, selection, and study of educational simulation games.

Methodology

We take as our starting point the way the commonly used categories collaborative, cooperative, and competitive describe how particular rules and mechanics create affordances for behavior, thinking, and affective experiences that have real-world correlates in situations that include teamwork, resource management, and war respectively (Zagal et al. 2006). From this starting point, we examine foundational attributes of each of these categories. For example, we examine the attributes of zero and non-zero sum rules and we describe the way zero-sum game play defines collaborative and competitive interactions and the way non-zero sum rules help define the nature of cooperative game play. We also explore how these categories of collaborative, cooperative, and competitive are defined by the goals players are given, the way players are allowed to interact through game mechanics, and how much and in which ways players relate to one another - both in degree of antagonism/support and in a degree of mutual interdependence.
Having explored the basic categories of collaboration, cooperation, and competition, we investigate how we can expand this classic typology by exploring several simulation and gaming fields: (a) game theory, (b) popular gaming and (c) educational gaming. To develop our expanded typology and detailed list of the factors which define categories in our typology, first we refer to game theory and political science literature that describes multi-actor situations with relational interdependencies that are important to investigate represent (e.g., Poteete et al., 2010; Ostrom et al., 1994). Likewise, we consider the recent expansion of game types in popular gaming including semi-cooperative (e.g. CO2, Lacerda, 2012), meta-collaborative (e.g. Dead of Winter: A Crossroads Game, Gilmore & Vega, 2014), and traitor (e.g. Battlestar Galactica, Konieczka, 2008), all of which do not fit neatly within the basic three categories. Finally, designers in educational and serious gaming have been applying popular game design techniques and game theoretic principles to develop games that represent realistic situations involving sustainability and negotiation. Together, these domains suggest a more detailed and nuanced set of realistic situations worth simulating and categorizing in game play.

Within each of these domains of game theory, popular gaming, and educational gaming, we examine how particular game rules and mechanics support interplayer relationships. In this way, we attempt to build up a more detailed and nuanced typology of game player relational interdependencies that shows both what design factors are essential to describing any given typological category and also what new design categories might be possible. In this process we define a number of factors that (a) occur and help define relationships in real life, and (b) we consider key to game design. These factors influence how players relate to one another including: continuity of payout, asymmetry, the perception of inequality, and the need for deception during successful play.

**Discussion**

We find that the player experience is strongly influenced by numerous factors relating to the relational interdependence among players including degree of asymmetry, the perception of inequality, the continuity of payout, having dynamic or a fixed goal point, the need for deception during successful play, and the presence of zero to non-zero sum goals, in addition to the experience of cooperation, competition, and collaboration. As a result of this theoretical investigation, we are now planning to develop a survey of game experiences with a focus on how players relate to each other in ways that include moral orientation and levels of cooperation for specific games. With this poster we are focused on presenting our typology as a work-in-progress and providing views examples and rationale for the categories we are developing. Our aim is to elicit feedback from poster session attendees on the development and refinement of this typology as well as a questionnaire that we are developing to empirically test our typology.

**References**


The Role of Story in Computer Science Games for Girls

Elisabeth Gee, Arizona State University
Kelly Tran, Arizona State University
Carolee Stewart, Kean University
Gail Carmichael, Carleton University
Lori Hopping, Hopping Fun Creations

Abstract: This poster describes the goals and preliminary findings of a study aimed at designing games to introduce girls to computer science concepts. The specific focus of the research is on the role of story in supporting learning and engagement.

Introduction

In this study, we are investigating the role of story in promoting girls’ engagement with and learning from games that aim to foster understanding of computer science (CS) concepts. Story is commonly cited as an element of games that might have particular appeal for girls (Kelleher, Pausch, & Kiesler, 2007). While we are skeptical of broad generalizations about girls’ or boys’ preferences for particular game features, we believe that stories have affordances for engagement and learning that might help to overcome, for example, stereotypes or misconceptions about domains such as computer science. Here we describe the initial stages of our research, including an analysis of story in existing STEM games and the analog game prototypes we have created to introduce several core CS concepts.

Rationale and Approach

A plethora of efforts are underway to change how computer science is introduced and to expand the participation of traditionally under-represented groups. One popular approach is teaching participants simplified programming languages using game design as a vehicle or goal for learning to code. Our project is based on a different vision of how to introduce computer science and how games might be a useful vehicle for this purpose, particularly for our target population of middle school girls. We will use game play to teach girls about CS concepts: in this approach, games provide an engaging way to enhance players’ understanding of these concepts in a situated way (Gee, 2007).

Our vision rests on the importance of a motivating and appealing story to make CS concepts meaningful and relevant to the girls we seek to reach. Our interest in story is inspired in part by popular books that introduce CS concepts through narratives appealing to girls, such as Lauren Ipsum (Bueno, 2011). Yet we know little about the actual value of story, alone or combined with games, for enhancing learning in STEM fields. Furthermore, stories involve many elements, such as plot, character, setting, and conflict, and these elements can be incorporated into games in varied ways. Investigating the full range of approaches to integrating story and games is beyond the scope of an exploratory study such as this one. Instead, we are designing and assessing the impact of games in two different story conditions. The first will be games contextualized within a fictional setting, and the second will be games integrated with an actual story-line with a plot and dramatic arc. We will compare the impact of these conditions to that of game play alone to determine whether either condition enhances players’ learning and engagement.

Story and Games

We have adopted Bal’s (1997) definition of story as “a series of logically and chronologically related events that are caused or experienced by actors” (p. 1). We define a fictional setting, or story context, as the elements of a story world that provide a concrete scenario and vocabulary for the CS concepts to be learned and applied. Bateman’s (2006) discussion of explicit and implicit storytelling in games is helpful in clarifying this distinction. An explicit story in a game is spelled out for the player, as in a book or movie. An implicit story consists of the elements of the game world that set the stage and give meaning to a game but do not specify a sequence of actions or plot, such as the environment, available tools and objects. These elements can be fashioned into a story through the player’s imagination.

One literature review on educational games indicates that narrative context provides motivation for learners to continue playing (Dondlinger, 2007). Research about learning and games suggests that story could have a strong impact on learning. Consider Gee’s principles of learning found in effective video games (Gee, 2007). Stories may help learners adopt an identity and feel part of a field’s academic activities; a story setting may not allow players
to invest as fully in such an identity. A story’s structured progression of events can be used to ensure problems are well-ordered. A story setting might give context to information needed on demand, but a story could help control the flow of information so it is not only just-in-time, but also more deeply meaningful. Essentially, while the context of a story setting may help situate educational content, a story may be able to do so in a more structured and meaningful way.

**Game Analysis**

To better understand possible ways of incorporating story and fictional context with educational game play, we conducted a content analysis of 49 games that address STEM content or skills. These included explicitly educational games, such as *Lightbot*, as well as games designed for entertainment but happen to involve STEM-related content or ideas, such as *Plague, Inc.*. We included analog as well as digital games. While we sought out games designed for computer science, we also included games with other STEM content to capture a potentially wider range of story examples. Only seven (14%) of these games had an explicit story, while 29 (59%) had a fictional context. While we cannot make claims for the representativeness of this sample of games, it seems evident that fully developed stories are not widely used in STEM games. We also analyzed more specific elements of the games’ story and fictional setting, including the characteristics of protagonists, the type of setting, and how well the story or context was aligned with the educational objectives of the games and game mechanics.

**Game Prototypes**

Currently we are pilot testing game prototypes that introduce players to CS concepts of data representation, algorithm writing, and data searching/sorting. Each prototype has three conditions: (a) a basic game without story elements, (b) a game with a fictional context, and (c) a game with a more fully developed plot and characters. For example, the basic game condition for writing algorithms is a relay race in which teams race to accomplish a series of tasks (such as writing directions to locate an object on a map) by writing and following instructions for their team mates. The game with fictional context adds the scenario of an escaped cat that the teams compete to find by solving puzzles related to tracking and trapping the cat. The full story condition is based on the true story of a calico cat named Collins, who ends up on a long sea voyage. There are news reports, a radio retelling of her story, and pictures. The stops in the relay race are locations and events in Collins’ “great adventure” and the story unfolds as players take on the role of international rescue groups.

**Implications**

While the focus of this project is to teach CS concepts, the findings can be a starting point for further exploration of the role of story in the effectiveness of educational games in other STEM areas. More specifically, the findings will be used to guide the development of a more comprehensive digital game intended to introduce learners, particularly girls, to multiple CS concepts. Developing and testing nondigital prototypes will allow us to focus on core design issues without the complications of technical constraints and tools. In addition, the analog games we develop will be useful products in themselves, that can be used immediately in a wide range of informal learning settings.

**References**


Goal-Orientated Activity in Story Games

Chris Georgen, Indiana University

Abstract: This poster is a theoretical argument for the use of activity theory to better understand the role of goal orientation in playful learning contexts. Of particular interest is the “story game,” a rules-light, narratively-driven, tabletop roleplaying game. Here, it is posited that identifying the goal-directedness of players leads to a better understanding of the activity system and, therefore, learning within the system. Moreover, activity theory provides a useful analytical toolkit for the investigation of story as a transformative element of play, and the relationships between the lived experiences of players, mediators, and goals.

Introduction

For many, a sociocultural view of learning and development is historically rooted in the tradition of dialectical materialism. This framework grounds learning in the discovery and resolution of contradictions, characterized in the tension between the internal and external, the psychological and material (John-Steiner & Mahn, 2007). Vygotsky (1978) considered a dialectical approach to be the only adequate means to understand the complex process of human development and learning, one marked by qualitative transformations of social signs into internal psychology functions. Simply put, one of Vygotsky’s core assumptions is that learning is socially mediated. Activity theory (Engeström, 1987; 2008) expands this notion by establishing the minimal unit of analysis to be activity. This theoretical framework is extraordinarily apt for the study of games and learning, as it allows for the study of the processes of gameplay rather than its products. In this poster, I apply an activity theory framework to the play of analog roleplaying games to better understand story as a mediator of play and play as a mediator of story.

Activity Theory

Activity theory analyzes activity by attending to individuals (or groups of individuals) who are oriented toward goals and mediated by tools, rules, community, and divisions of labor (Engestrom 1987; 2008). Squire (2002) offered activity theory as a potential theoretical framework for investigating the idiosyncratic goals of players, capturing the dynamic interactions of gameplay, and understanding broader sociocultural contexts of play. For example, whether the goal is winning a game or learning about a phenomenon differently transforms the player, the act of play, and the surrounding system. DeVane and Squire (2012) applied activity theory to digital media and learning technology. Here, the goal of activity was ludic (i.e., winning/completing the game) or educational (i.e., a specific learning outcome). However, a particular genre of game — the story game (Duncan, 2014) — exists wherein the collective goal (or object) of activity is the collaborative construction of story. And so, using activity theory as a lens, story games may provide new perspectives on the relationships between purpose and play in goal-directed activity.

Story in Goal-oriented Activity

Goal-orientation is a focal point of activity theory. According to Roth (2007), conscious goal formation and subsequent transformation is inseparable from mediated activity. In the context of games for learning, story typically mediates the resolution of a subject and their ludic or narrative goal (see Figure 1). For example, story can mediate a series of event-based experiences, grounding a player’s progression through and immersion in a game. In the context of educational games, this goal is typically tied to learning about a particular phenomenon. Though this is perhaps a simplified representation of mediated activity in games, the intention is to forefront story as a mediator of gameplay.

However, in story games, the players’ goal becomes story building (see Figure 2). The game, now functioning as a mediator, transforms narrative, while narrative simultaneously transforms the players and mediating artifacts. In this form of joint activity, the collective goal of story directs play, although idiosyncratic individual goals can still be
realized. Further work can address the relevant mediators of activity in story games (i.e., rules, community, and divisions of labor) and their appropriation. Due to the rules-light, analog design of story games, preliminary work suggests that these mediators may play a central role to the transformation of play in story games. In other words, changing the purpose of play necessarily reshapes the relevant mediators of activity.

![Figure 2: Activity in story games](image)

**Discussion**

In the field of games and learning, the role of story in motivating play and design has been a connecting theme among many scholars. Of course, not all games are designed to tell story. However, story can be intentionally embedded into a game's design, arises out of the emergent conditions of play, or connect to pre-existing narrative associations (Jenkins, 2004). Regardless, the rhetoric surrounding the relationship between games and story often places story as a mediator of a larger ludic or educative goal. To be clear, the suggestion is that story can mediate ludic goals (e.g., mastering a set of skills or systems), narrative goals (e.g., progressing through a plot or timeline), and learning goals.

This poster is aimed at demonstrating the potential for a new and exciting genre of games to inform and expand studies in games and learning. At the same time, if we take activity as central to learning, this poster offers a method, theoretically grounded in activity theory, for the investigation of story in playful contexts of learning. Activity theory appears to be well suited for the analysis of collective activity in story games. Moreover, activity theory can articulate the role of mediators in educational games and story games. Overall, this poster offers activity theory to explore the ways in which story mediates and is mediated by player experience, providing the tools for identifying contradictions and critical moments of learning through play. In all, story as a mediator of ludic and instructional goals presupposes a particular kind of game and role for instruction. Story games problematize this application as they provide clear and provocative examples wherein ludic goals and educative goals are peripheral to story.

**References**


A Scavenger Hunt vs. an ARG as a Library Orientation Activity

Kelly Giles, James Madison University

Abstract: This study compares two library orientation activities for freshman engineering majors, a scavenger hunt and a simple mystery-themed alternate reality game (ARG). Survey results indicated that students preferred the ARG, although both activities increased student confidence in their ability to perform library tasks.

Background

In 2010 I developed an activity modeled on alternate reality games (ARGs) to use as a library orientation assignment for freshman engineering majors at James Madison University (JMU). My goal was to encourage students to explore JMU’s Rose Library and give them practice with basic library tasks. The ARG requires players to solve the mystery of a stolen book by following a trail of clues through the library and finally hacking into a RefWorks account belonging to the “thief” (Giles, 2015).

While my ARG is relatively simple, creating and maintaining the clues does require special effort on my part. I wondered if this additional effort resulted in a library orientation that was more engaging or effective than a more traditional activity, the scavenger hunt. A library scavenger hunt “comprises a list of questions that have no immediate relevance to course content” (McCain, 2007), and research indicates that scavenger hunts can be more effective than guided tours at familiarizing students with the library building and available resources (Marcus & Beck, 2003).

To test the ARG against a scavenger hunt, I created a set of worksheets covering the same tasks as the ARG, such as looking up the call number of a particular book. A library scavenger hunt can also include a fictional narrative and hidden clues, but this would have required planning comparable to that needed for the ARG. To minimize my preparation time, the scavenger hunt worksheets presented students with the tasks they were to complete in a straightforward manner without a narrative.

Methods

The participants in this study were students in a 100-level course required of all engineering majors. In the fall of 2012, two sections of the course were assigned the library ARG as homework. After completing the activity, students were asked to rate their familiarity with different tasks on a 5-point Likert scale (1=Strongly Disagree, 5=Strongly Agree) as part of an online survey. They were also asked to provide feedback about the ARG. A third section that did not participate in an orientation activity served as a control group. The following semester, two sections of the course were assigned the scavenger hunt activity during instruction sessions held in Rose Library. One section received the survey on library tasks at the beginning of the session, before starting the scavenger hunt. The other section was surveyed after they had completed their scavenger hunt worksheets.

Findings

Survey results indicated that both activities were similarly effective at making students feel more confident in their ability to navigate the library and perform common library tasks (see Figure 1).

![Figure 1: “Do you know how to perform the following tasks at Rose Library or online?”](image-url)
Students who participated in the ARG were more likely to agree that their orientation activity was fun and helpful than those who participated in the scavenger hunt (see Figures 2 and 3). When asked if they would recommend that the activity be used with future classes, 79% of the ARG participants and 59% of scavenger hunt participants marked “Yes”.

**Figure 2: Student response to the ARG assignment, fall 2012 (n=34)**

- **I had fun with this activity**: Agree/Strongly Agree 62%, Neither Agree nor Disagree 26%, Disagree/Strongly Disagree 12%
- **I feel more comfortable using the library now**: Agree/Strongly Agree 74%, Neither Agree nor Disagree 21%, Disagree/Strongly Disagree 6%
- **I learned about the library from this activity**: Agree/Strongly Agree 58%, Neither Agree nor Disagree 10%, Disagree/Strongly Disagree 4%

**Figure 3: Student response to the scavenger hunt assignment, spring 2013 (n=22)**

- **I had fun with this activity**: Agree/Strongly Agree 55%, Neither Agree nor Disagree 36%, Disagree/Strongly Disagree 9%
- **I feel more comfortable using the library now**: Agree/Strongly Agree 59%, Neither Agree nor Disagree 23%, Disagree/Strongly Disagree 18%
- **I learned about the library from this activity**: Agree/Strongly Agree 77%, Neither Agree nor Disagree 14%, Disagree/Strongly Disagree 9%

**Discussion**

Both activities were considered fun and educational by a majority of participants. However, survey results and my own observations indicate that students preferred the ARG to the scavenger hunt assignment. For me, the difference in student response to these activities is enough to justify the additional effort required to organize the ARG.

Students were also asked to rate their own familiarity with different library tasks. Although the survey indicated that the two activities were similarly effective as instructional tools, a majority (70%) of the scavenger hunt worksheets contained at least one incorrect answer. Scavenger hunt participants may have overestimated their own competence on the survey because during the activity they could not tell when they had made a mistake. In contrast, students participating in the ARG were unable to proceed until they found the next clue. Instead of a self-evaluation, a library skills quiz might provide a more accurate measure of the educational effectiveness of these activities.

Although I had intended for both activities to require a similar amount of library exploration, I observed that most of the students participating in the scavenger hunt remained sitting at the computers and completed their worksheets with information they found online. At the time, I assumed that this was because they preferred searching online to searching in the library stacks. However, in the comments section of the survey the most common suggestion for improving the scavenger hunt was to have it involve more exploration of the building. (The most common suggestion from ARG participants was that the game should be longer.) Students wanted to explore the library, but unlike the ARG, the scavenger hunt assignment failed to motivate them to do so.

**References**


Assessing Student Growth in a Constructivist and Integrated Digital Curriculum

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Abstract: This poster explores the process of assessing student learning in constructivist digital settings on student engagement, and ultimately students’ academic and social-emotional growth. In particular, this paper examines how explicitly integrated and constructivist digital curriculum better engages students in learning and how this can be measured. We situate our examination of constructivist digital curriculum in a descriptive case study of the Wisconsin Center for Academically Talented Youth, a blended online program that offers stand-alone replacement courses for students in grades 5-8. Early findings suggest digital education can be a vehicle where media is used to create a student-centered, educator-driven and ultimately co-constructed curriculum leading to greater student engagement and learning. Yet, this case also illustrates the significant time, capacity, and communication required when implementing assessment systems in a constructivist digital curriculum.

Objectives

This poster will explore the possibilities and challenges in assessing student academic, social and emotional growth in constructivist digital instruction. We will investigate these possibilities through a descriptive case study guided by the following research questions:

1. What are both the possibilities and limitations to implementing a truly constructivist curriculum in the digital education context?
2. How do live instructors assess student academic, social and emotional growth in a constructivist digital instructional setting?

These questions are significant to not only gaining better understanding of both the promise and perils of digital courses, but to offer concrete examples of how assessment of a constructivist digital curriculum might function.

Conceptual Frameworks

This paper will draw upon the concept of epistemic frames, or the idea that learning in our global society must occur in a community that shares and constructs knowledge, skills, practice and ways of knowing (Shaffer, 2006; see also Morrison & Collins, 1996). This concept of co-constructing knowledge and learning within a community of practice is central to a constructivist curriculum, which is based on the premise that students make meaning and construct knowledge through experiencing and reflecting upon the world around them (Brooks & Brooks, 1999; Honebein, 1997). This analysis also draws upon a related research base on the importance of integrated and interdisciplinary contexts to learning, which suggests that such a curriculum can positively impact student attitude towards and engagement in schooling, problem-solving skills, and higher achievement in college (Austin, Hirstein, & Walen, 1997; Barab & Landa, 1997; Kain, 1993).

Research Design

We situate our examination of constructivist digital curriculum in a descriptive case study of the Wisconsin Center for Academically Talented Youth (WCATY) Academy, a blended online program that offers stand-alone replacement courses for students in grades 5-8. WCATY is a not-for-profit, university-based organization that enrolls approximately 1,400 participants per year from 130 different schools across the state. Each WCATY Academy course translates to either nine or four weeks worth of course credit for students and is designed to replace part of a district’s language arts curriculum. This investigation draws upon early findings from this case study of the processes in which WCATY develops and implements its online-only and blended online courses. Case studies situate phenomena (i.e. constructivist digital curriculum) within its real-life contexts (i.e. the WCATY Academy and its students), they are bounded by both time and place, and they involve data collection from multiple data sources that triangulate with one another (Yin, 2003).
Our case study of the WCATY Academy blends a qualitative investigation of the nature of the digital curriculum, with a quantitative analysis of descriptive and assessment data. Data sources include focus groups with district coordinators, WCATY staff using a semi-structured protocol and parents of students enrolled in WCATY courses. Responses are analyzed with codes based on the above research questions. Observations of both digital and in person settings of blended courses use a standardized, tested observation instrument. Student, parent and district coordinator pre and post surveys are analyzed for perceptions of both academic and social-emotional growth. In addition, program documents and websites are analyzed with the same coding structure as above. This paper will include descriptive data on student enrollment rates, subcategorized by total enrollment, return rates and demographics, and along multiple years.

**Early Findings**

This poster details ways in which the WCATY Academy illustrates instruction that creates epistemic frames, or communities of practice for students and both the curriculum and assessment process is truly constructivist and integrated in that both instructors and students determine the direction of the course through game and project-based learning. Students are expected to consistently use higher order thinking skills, not only to respond to instructor prompts, but also create and assess the content of their learning experience. The WCATY case illustrates how digital education can be an avenue where media is used to create a student-centered, educator-driven and ultimately co-constructed curriculum and assessment.

Yet, this case also illustrates the significant time, capacity, and communication required when implementing and assessing a constructivist digital curriculum. This presents important questions when considering the extent to which constructivist digital programs such as WCATY could go to scale in ways similar to the static and asynchronous software-based courses offered to school districts across the country. Emerging research on the digital curriculum present in low-income settings suggests it often consists of skill and drill routines that demand little critical thinking (Burch & Good, 2014). This is of special concern when many large school districts serving students from low-income families have adopted technology plans that invest millions of dollars in hard and software that will deliver less than innovative digital curriculum.

**Scholarly Significance**

Digital and blended online learning has great potential to engage students and teachers in co-constructing learning, knowledge and media itself. Yet as this case study illustrates, a truly constructivist and integrated curriculum requires considerable time and expertise on the part of instructors and may be difficult to bring to a large scale across multiple settings and contexts. This is especially true in school districts facing constant budget cuts. This case study offers insights into the theoretical possibilities and importance of constructivist and integrated digital curriculum, but also a concrete and empirically-based examination of how digital education programs and school districts can bring innovative digital curriculum to their students. A study such as this has implications for the level and quality of student access to engaging, integrated and constructivist curriculum in the digital age.

**References**


Abstract: The Space Science Institute is developing Starchitect, a stellar and planetary evolution game for Facebook. Supported by NSF and NASA, the game uses the “sporadic play” model of games such as Farmville, where players may only take actions a few times a day, but may continue playing for months. This framework is an excellent fit for teaching about the evolution of stars and planets: systems evolve in scaled real time (a million years to the minute), so that massive stars supernova within minutes, while stars like our sun live for weeks, possibly evolving life before ending their lives as white dwarfs. Simultaneously, however, the framework raises a variety of challenges relating to depth and breadth of content, conflicts between known science and gameplay, and evaluating long duration activities with finite resources. We will examine some of the challenges (and opportunities) we have encountered to date.

Starchitect

With support from NASA (NNX11AI26G) and NSF (DRL-1010624), the Space Science Institute is developing an end-to-end stellar and planetary evolution game called Starchitect for the Facebook platform, with external access for middle school students. We have focused specifically on the “sporadic play” approach popularized on Facebook (early examples included Farmville and Mousehunt). A defining characteristic of these games is the deliberate limiting of gameplay for a single sitting. In the case of Farmville, crops are planted and the player must wait a day or more to harvest them. In Mousehunt, players can only attempt to catch a mouse every 15 minutes. Game actions also tend to be simplified, which serves to keep the game low key and inviting. Simultaneously, the game is structured so that the player benefits by returning regularly. Unattended games will either stop progressing or, in the case of Farmville, crops may wither and die. This strategy appears to simultaneously attract players who are only seeking occasional distractions, while encouraging ongoing play. We find this model particularly interesting in an education context, where it creates an opportunity to reinforce the game’s content and message.

In addition to this framework being of general interest for educational games, it is an excellent fit for this particular context of teaching about the evolution of stars and planets since, like the plants in Farmville, the systems evolve over time. Players select regions of the galaxy to build in, then watch as the systems evolve in scaled real time over days to weeks. Massive stars supernova within minutes, while lower mass stars like our sun live for weeks, possibly evolving life before passing through a red giant stage and ending their lives as white dwarfs. Successful systems advance players, allowing them to create different types of stars and planets, seed life, and customize their worlds. As players progress in the game they explore concepts that include stellar lifecycles, habitable zones, and the roles of giant worlds in creating habitable solar systems.

Game Elements and Learning Goals

Starchitect runs persistently in the background so that systems continue to evolve while the player is offline, extending game play to weeks or more. The time scale for the game is one million years per minute (for reference, that would make our own solar system a little over three days old). This approach allows us to introduce the relative time scales of a variety of events relevant to solar system evolution: giant worlds can be built in a few minutes, terrestrial worlds a few minutes after that. Single cell life can arise within an hour, but complex life can require several hours. Star lifetimes can range from seconds (for super-giants) to weeks (for sun-like stars).

Game flow is controlled through a combination of energy (which is consumed to create worlds, but replenishes over time) and locks, which lock out features until certain conditions are met. The game encourages specific actions through “Feats;” accomplishing each Feat earns badges and titles and unlocks more features (for instance, moons).

The structure of the game lets us directly address a number of key astronomical concepts, including that stars differ from each other in size, temperature, and age; stars have a life cycle: they are born, age, and die. These life cycles depend on the star’s initial mass and have dramatically different lengths and outcomes; giant worlds have significant effects on the structure and habitability of a solar system; and “habitable zones” influence the habitability of terrestrial worlds, varying with the star type.
In addition, the Feats system lets us target individual tasks that might have educational value: for instance, we can challenge the player to recreate our solar system, or to place a terrestrial world in the habitable zone of a red dwarf star.

Finally, several mini-games are included that allow us to include content that might not be well addressed in the main game framework or that enable us to target specific misconceptions. One example of this is Sizemology, a mini-game that compares the sizes of different objects (Earth compared to the sun, the sun compared to an astronomical unit, etc.) It was clear from the start that players would want to view their systems with the exaggerated scales typical of solar system illustrations, but we wished to avoid reinforcing misconceptions about solar system scales. The compromise solution was to build in the ability to "fake" the scale sizes of objects in the solar system but to lock that feature until players successfully explore the minigame. Sizemology therefore serves both to address a set of "size and scale" learning goals and to provide the unlock mechanism that allows players to alter the scale of their own systems.

Progress, Early Results, and Next Steps

Starchitect is currently open to play both on Facebook (search for “starchitectgame”), as well as externally through www.starchitect.net. The non-Facebook access was designed specifically to make the game available to middle school students; however, the feature has proved useful even at the university level, where the game has been used as an extra credit assignment for introductory astronomy classes. This is aided by a “group” feature that allows students to see each other’s progress.

Formative evaluation was performed iteratively, recruiting adult players and observing play using screen sharing. We can also examine in-game data to determine how players are using the game, analyzing how much time players spend in the game and over what period. Early assessment of this data suggests that we are meeting our goals with respect to the sporadic play, frequent return model. We define “elapsed time” as the time between first and last touch of the game (independent of how much they played), and a “session” as a 30 minute or less encounter with the game (independent of the time over which those sessions occurred). Of players who returned at least once, the medium elapsed time is approximately 12 days. However, the distribution has an extremely long tail: 20% of the players had an elapsed time of greater than 30 days, and 10% greater than 90 days. Similarly, the median number of game sessions is only 4, but 20% returned 22 times, and 10% over 50 times. Note that these values are strongly skewed by the fact that the game has only been broadly available for six months or so.

Processing of in-game data has also provided us with a number of other preliminary results: By comparing in-game quiz results to existing surveys, it appears that the population playing the game is more science literate than average. This includes astronomy as well as non-astronomy related content (for instance, the percent of correct answers to “Antibiotics kill viruses as well as bacteria, true or false” is 14% higher for the game population). Facebook players are much more likely to return to the game for a second day than non-Facebook players (35% versus 13%). This isn’t particularly surprising, since one of the advantages of the Facebook platform is to make long-term games easier to access. Pre/Post assessments (also implemented through the in-game quiz) suggest at least marginal improvements in content knowledge, ranging from gains of a few percentage points to 15 percentage points (though there is one apparent example of a negative gain). However, the number of data points is still small, with N ranging from 12 to several hundred, depending on the question.

Over the next six months we will be focusing on increasing the number of players and tuning the game, while the summative evaluation examines in depth the degree to which we have met our goals for the project. Summative will consist of a combination of data collected in-game as well as interviews with selected players who opt into the evaluation. This should allow us to determine not just if the game succeeds in teaching players more about astronomy but whether the “sporadic play” design holds potential for other education efforts.
Abstract: Individuals with autism spectrum disorder (ASD) experience social deficits that affect functioning across their lives. One area that is particularly affected is the ability to make and maintain friendships. Video game play may be an appropriate context for bringing children together to increase positive interactions and the potential for establishment of friends. Prior to implementation of this type of intervention, patterns of game play for children with and without ASD need to be better understood. This study examines the allocation of visual attention to video game features by children with and without ASD to identify similarities and differences.

Autism spectrum disorder is characterized by a core deficit in social communication (APA, 2013). As a result, many individuals with ASD experience social isolation that negatively influences all aspects of development as well as long-term outcomes (Muller, Schuler, & Yates, 2008). In particular, limitations in social skills can restrict an individual’s ability to make and maintain friendships, obtain and maintain employment, live independently and fully participate in society at large (White, Keonig, & Scahill, 2007). Friendship is one of the most fundamental aspects of quality of life, and its benefits are well documented. Many children with disabilities, including children with ASD, experience substantial difficulty in making and maintaining friends (Petrina, Carter, & Stephenson, 2014).

Interventions to increase quality and rate of social interactions of children with ASD have primarily sought to teach specific social skills, such as appropriate ways of entering a social group or asking partner-centered questions. Acquisition of these specific skills has largely not translated to increases in the number and/or quality of friendships for children with ASD. We propose these efforts have failed to generate lasting friendships because they are missing one or more of three key elements: (a) presence of mutually motivating activities, (b) repeated opportunities for interaction, and (c) creation/maintenance of equal status between children (cf. Kampert & Goreczny, 2007). It seems necessary to reframe the effort to promote friendships by grounding the approach in the naturally occurring social environments.

One ubiquitous form of leisure in which the vast majority of adolescents engage with their friends is video game play. In addition to being popular, video games have the unique advantage of containing all three of the critical elements for promoting friendship. There is no doubt they are highly motivating and offer repeated opportunities for interaction; Lenhart et al. (2008) reported that 99% of boys and 94% of girls under the age of 18 years old play some form of video-based games on a regular basis. Children with ASD have an interest in video games that is comparable (Hickerson, Finke, & Choi, 2014) to typically developing children. Finally, unlike most other forms of game play, many video games allow players to play cooperatively and as equals at whatever skill level they possess (i.e., games with “subjective difficulty” - such as Super Mario Galaxy and Sonic Generations). This allows players of varying ability levels to play together to accomplish a task as each player performs an important job for team success.

Objectives

It is not known if children with and without ASD play video games similarly. It is critical to examine how children with ASD look at and interact with characters in a video game. Unusual visual attention patterns are central to ASD, so children with ASD might engage with video game characters differently than their peers. If there is a difference, it might affect the way individuals with ASD play the game and how they play with a partner. If we fail to understand such possible alterations in visual attention, we risk overlooking a barrier to the success of a video game-based intervention for promoting friendships. This project examines the allocation of visual attention of individuals with ASD compared to same-age and gender peers while watching a video game stimulus with LOW and HIGH social demands. The dependent measure is the duration of fixations on the main elements of interest, relative to their size and time on screen. The animate elements (i.e., the characters) should attract the majority of attention.

Approach

Fifteen neurotypical individuals and 15 individuals with ASD of the same chronological age and gender were recruited. Participants watched two 60-second clips of a video game that contained various levels of social de-
mand (i.e., *LEGO Marvel Super Heroes*). In a cutscene clip, the characters in the game interact with one another, providing narrative structure for the game (high social demand). In a game play clip, the characters are not interacting with each other directly (low social demand). Data were collected via a 17-inch Tobii T60 eye-tracking monitor connected to a specially adapted PC laptop equipped with the Tobii Studio stimulus presentation and data acquisition software. The T60 monitor contains a projection strip built into the top of the monitor, by which infrared light is projected onto the participant’s pupils and corneas; the Studio software provides a record of point-of-gaze based on the reflected light. Visual attention will be coded by hand using a coding scheme already developed by the research group, and reliability of coding will be analyzed on at least 20% of the data.

**Data Analysis**

Data have been collected for the study, and we are currently in the analysis phase. The live feed from the eye tracker is coded by hand using a coding scheme that has been developed and successfully piloted. This process evaluates the number, chronology, and duration of fixation to three areas of interest: (1) the main characters, (2) the facial features of the characters, and (3) the main non-animate elements of interest. Preliminary visual observation of the data indicates that children with and without ASD have similar visual attention patterns (see Figure 1).

![Figure 1: Gaze pattern for Nonverbal ASD participant](image)

**References**


What Game Are You Playing? Affordances of Tools for Incorporating Game Elements into Classrooms

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Abstract: A variety of applications have been designed in response to the growing interest in using game elements to create more engaging classroom environments. We reviewed these systems, identifying which game mechanics each supported and type of motivation they support. We propose a classification system to help frame the discussion around the patterns of implementation in these applications.

Introduction

Inspired by the intense engagement produced by video games, efforts to add “game design elements in non-game contexts” have grown rapidly (Deterding, Dixon, Khaled, & Nacke, 2011). In education, this has taken the form of using game mechanics to make classroom environments more motivating (Fishman et al., 2013; Sheldon, 2012). Managing these courses with the tools built for the traditional classroom has proven administratively challenging, with both instructors and students reporting difficulty keeping track of progress (Holman, Aguilar, & Fishman, 2013), thereby limiting the potential for this pedagogical shift to impact engagement.

To address this issue, course management applications have been developed that support a variety of game mechanics directly. However, each system has implemented support for individual game mechanics independently, selecting the items they perceive to be most desired by their particular community or most important to creating a particular vision for new course designs. Do the courses these systems then support result in different styles of games? Do the mechanics that are available and the manner in which they are implemented suggest different types of motivation are being supported for the students who use these systems? Our goal was to identify which systems currently support which mechanics, as a first step to understanding any differences in the style of games available, and the motivational impact of each platform.

All of the systems support core elements that define games; many also use playful language to affirm the different frame within which these courses are operating. Beyond these basics, we have classified each game mechanic as being either “gamified,” or “gameful.” We term gamified mechanics as ones that primarily rely on extrinsic motivators in order to encourage students to participate in class activities. Gameful mechanics require the re-design of classroom structures to emphasize agency, belonging, and support for competence in way that is meant to increase intrinsic motivation.

Methodology

We identified all available systems designed to add game elements to classroom instruction. We excluded applications that host educational games (e.g. BrainPOP, Manga High), and instances where the gamified features are part of a platform delivering set content (e.g. Duolingo, Khan Academy). We selected six systems for analysis: 3D GameLab, Classcraft, Class Dojo, Gamified, GradeCraft, and Youtopia.

<table>
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<th>Core Game Mechanics</th>
<th>The Game Frame</th>
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<td>Youtopia</td>
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Table 1: Game Mechanics Supported per Course Management Application
Using documentation, branding materials, and, where possible, demo accounts, we documented each system’s game-related features (Table 1). We classified each mechanic as primarily producing extrinsic or intrinsic motivation. We identified individual quests, points, and levels as elements that are core to the game itself. The use of avatars and game-like language (i.e., renaming “Assignments” to be “Quests”) stood out as features that are not truly game mechanics but do establish a playful environment, reducing perceived risk and encouraging the exploration of identity. We have labeled these features as supporting the “Game Frame.”

**Discussion & Conclusion**

Points and leaderboards are the only mechanics that appear across all six systems. *ClassCraft* and *ClassDojo* are specifically designed to manage *classroom behavior* using game mechanics; as a result they do not include a way to set quests for learners to choose from (thereby supporting autonomy), but rather students are rewarded with points (or receive “Hit Point” penalties) in exchange for good behavior. *ClassCraft* is the system that supports the perception that you are playing a game (particularly a role playing game) most strongly, having an interface that uses extensive game language, and an elaborate interactive avatar system; it offers a mix of extrinsic and intrinsic mechanics, placing a strong emphasis on teamwork by enabling students to use their powers to ‘save’ other classmates, and offering a sense of that one’s competence is progressing through the ‘unlock’ of abilities (i.e., eating in class, taking notes into a test) in exchange for good behavior. *ClassDojo*, on the other hand, supports the same gamified mechanics of leaderboards, rewards, and penalties, but none of the gameful ones. It also does not include the majority of features we would consider core to games and thus relies solely on the extrinsic motivation of gamified mechanics to spur action.

*3D GameLab*, *Gamified*, and *GradeCraft*’s approach is quite different from that of *ClassDojo* and *ClassCraft*, as the systems lay out all available quests for students to autonomously select from, and then inform them of their progress per task, and for the whole class. These three systems generally support similar game mechanics: they establish a playful environment using game language, use badges and leaderboards to extrinsically motivate action, and support one to two gameful mechanics each. *3D GameLab* has implemented both an quest unlock system, requiring students to complete tasks to specific degrees of mastery before they are able to progress on to more advanced tasks, and a distinction between experience points (XP) and skill points (SP), encouraging students to reflect on their growth in competence throughout the course. *Gamified* (the platform) also supports the XP/SP breakdown. *GradeCraft* has supports the gameful principle of belongingness through implementing the mechanics of Teams and Group Quests. *Youtopia* is the best at supporting multiple contexts, being intended for use in classrooms as well as co-curricular spaces. Like *ClassDojo*, *Youtopia* has chosen not to implement core game features like levels, game language, and avatars, in favor of supporting two core gamified mechanics, and three gameful ones, as a result feeling less like a game but engaging in a variety of different ways.

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Educational Roles and Structures of Interaction in a
Minecraft Affinity Space

Joey Huang, Indiana University
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Abstract: We discuss preliminary findings based on social network analyses of a gaming affinity space. We focus on the constructions and interactions among participants who identified themselves as teachers or youth in relation to the gaming and learning activities through Minecraft. The findings show the ways in which the underlying identities of participants can shape interactions and structure discussions in a nurturing affinity space.

Introduction

This study illustrates how the identities and roles in real life may shape interactions in an affinity space. Affinity spaces are identified as rich and effective sites of informal learning in which learners pursue shared interests and interact through online networks (Gee, 2005; Duncan & Hayes, 2012). One of the major features of affinity spaces is anonymity; participants do not have to share social factors such as age, geography, or occupation. According to Gee (2003), affinity spaces are democratizing, egalitarian spaces where participants exchange information and express opinions without physical constraints and identity bias. In previous studies of affinity spaces, we have assessed how participant role or identifications with real life roles can shape how the communications and tensions may change (Duncan & Huang, 2014).

Pellicone and Ahn (2014) examined the social network structure of an affinity space, focusing on game-based learning in communities of Minecraft players. They claimed that informal leadership played a key role, and a minority of participants usually accounted for the majority of participations. Although the space they analyzed was contributed to by a large majority of participants, participants did not directly reference or interact with each other. In addition, it was unclear if and how real-world identities (e.g., such as gender and ethnic identities) influenced the interactions between participants in the space (Pellicone & Ahn, 2014). We wished to extend both our previous work and the social network approach of Pellicone & Ahn (2014) by analyzing social factors and constructions within the space’s structure and how interactions and conversation structures may change depending on the identity of participants.

Methods

Data Collection

We sampled text from four threads from a dominant discussion community for Minecraft (Reddit’s subreddit /r/minecraft), focusing only on threads wherein the original poster clearly flagged themselves explicitly as a teacher or as a youth using Minecraft in a school. These threads were labeled according to whether or not the original poster self-identified as a youth (Y1, Y2) or as a teacher (T1, T2). Original posters (henceforth OPs) of Y1 and Y2 shared a key commonality about how they used Minecraft to accomplish school assignments or for educational purposes, posting pictures of their works on the site for discussion. In contrast, the OPs of T1 and T2 both identified themselves as teachers who looked for instructional advice in applying Minecraft to classroom and school settings. Data was collected by starting at the first post in each thread and coded in a chronological order to record the interactions of participants. Y1 included a total of 156 posts (three deleted before our analysis) contributed to by 91 unique posters, while Y2 included 197 posts (nine deleted) from 116 unique posters. T1 included 149 posts (5 deleted) from 100 unique posters, while T2 included 178 posts (10 deleted) from 93 unique posters.

Social Network Analysis Findings

In order to better understand the interactional structure of each thread, we applied the Girvan-Newman clustering approach (Knoke & Yang, 2008) by clustering according to features of modularity in the threads. Findings showed that, unsurprisingly, the majority of discussion for all threads centered on the OPs, nodes in yellow, and these discussions were constructed by a large majority of the single participants who only had interactions directed at OPs (red nodes). However, both threads created by youths (see Figure 1 A and B) represented greater density of subgroup discussions compared to the threads posted by teachers (see Figure 1 C and D). In particular, the constructions of Y1 and Y2 displayed there was a majority of single participants who joined the subgroup discussions and did not interact with OPs directly. Instead, participants of subgroups from T1 and T2 often directly connected and interacted with OPs on both threads posted by teachers.
Figure 1. Described in rows from top left: A. The social construction and interaction of thread Y1, with the width of 128 ties representing the strength of interactions. B. The social construction and interaction of thread Y2, with the width of 160 ties representing strength of interactions. C. The social construction and interaction of thread T1, with 128 ties. D. The social construction and interaction of thread T2, with 139 ties.

Discussion and Implications

Based on these preliminary analysis, we speculate that the identities of the participants in real life and their concomitant means of framing their instructional activity (as questions by teachers, and as contributions by youth) potentially influence the shape of discussions in affinity spaces. Interactions between participants vary in relation to the density and engagement of subgroup discussions, in particular. These results provoke a further analysis of how the roles and identities of participants shape discussions in affinity spaces. In future work, we wish to explore the motivations of participants and how they may frame the discussions and engagement in affinity spaces.

References


Abstract: The matter of invention is important for learning processes once repetitive or recogni-
tive actions lack flexibility before problems of varying magnitude, even though they may work well
for the resolution of specific problems according to a given model. Location-based games may
offer an interesting occasion for invention, for they demand coordinations between territory and
game. In other words, it is necessary to match two different dimensions, which is a characteristic
of invention according to Simondon (2013).

Introduction

This paper is meant to present the first analyzes of the invention made possible by the game named “A Day in the
Botanical Garden”. This game was developed to be used as a research and intervention instrument in a partner-
ship between UFRGS (Federal University of Rio Grande do Sul) and Porto Alegre's Botanical Garden, which is
part of the institution Fundação Zoobotânica do Estado do Rio Grande do Sul (Zoo-Botanical Foundation of the
State of Rio Grande do Sul). It is a location-based game, made with ARIS platform, in which players are invited to
go around the garden to locate and plant virtual seeds for the preservation of the Botanical Garden’s living collec-
tions. In order to accomplish these goals, players must walk around the garden as they use their tablets to find the
seeds and the necessary tools for planting them, such as a watering can, water, and a shovel, which are hidden
around as virtual items. Along the way, there are other agents (non-playable characters) that might help the player
as s/he seeks to complete the main goals or that will make the game more challenging. In the game the player
chooses to see a map or satellite image of the place. The screen shows images of things or characters in specific
places and a dot where the player is. When physically close to the place of one of those, the game shows that there
is something nearby and the player can choose to interact with it, going into a conversation screen with multiple
options that may give or take items from the player’s inventory and may award points. The gameplay is mainly
based on the interactions with the Botanical Garden (and choice of trajectories) through the map and the choices
on conversations. Those choices are centered on choosing what items to collect, to lose or trading them for points,
and the places where the player decides to go change the amount of points awarded. The idea of matching a ludic,
interactive and technological element to the Botanical Garden’s already scientifically and educationally meaningful
environment comes from the fact that games have two major dimensions: they consist of (1) real rules with which
players interact with and of (2) a fictional narrative.

Inventive Trajectories

In order to play the game, players must produce a compatibility/match between their own move throughout the
garden along with the representation of such move on the map showed on the iPad. This achievement may be
considered as an invention, for anticipation and prediction are not enough for resolving the challenges. Therefore,
anticipations have to be continuously compared to the current situation, which will require players to rectify or
change their trajectory followed at a given occasion according to a goal. Invention is more than problem solving, it
is about creating new and complex ways of interacting with the world (in this case, with a game).

During the year 2014, we conducted workshops with students for testing out the game’s second version. In total,
12 workshops were carried out with students of 4th and 5th grades from a public school situated nearby the Bo-
tanical Garden (Kroeff, 2014). On this poster we present and discuss the trajectories followed by pairs of students
who participated in the first game quest: finding the gardener (Kroeff, 2014). The colored lines (Image 1) present
a sample of the results collected, by showing the trajectories followed by three of those pairs. By only considering
each pair’s resolution speed of the problem, it is possible to establish an order of actions: first the red; second, the
green and third the yellow pathways. However, in terms of invention, it is interesting to analyze different trajecto-
ries, as the problem was only solved by resorting to mediations not readily available within the participants’ action
schemes, which would eventually lead to invention.
The different trajectories taken by the players made it possible to observe their search for distinguished mediators as they produced a compatibility between both action domains (territory and game). On one hand, one pair of players would resort to the semiotic system available in the Botanical Garden itself, such as the reading of signposts, maps and icons. Another pair, on the other hand, preferred to address the Garden staff or the visitors, yet another one chose to establish a coordination of actions between themselves, by distributing tasks and producing trial and error analysis. Such difference between the action modes revealed distinct mediation levels. Mediation may consist in a mere change in the operating model adopted—as it was the case for the pair of players who distributed tasks between them—or it can assemble an intermediate object whose choice and use may require a cognitive turn.

The problem may be solved when communication is established between game and territory. Our analysis suggests that invention, besides making it possible for the resolution of a problem, gives rise to the experience of cognitive reversibility; a feedback that starts with the full resolution, by moving through the organization of the means needed for the decision making about the actions according to the compatibility mode followed by each pair in their choice for mediations.

References

Gaming With New Players: Should You Self-Handicap? Should They Know?

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Abstract: Many tabletop game enthusiasts report not actively pursuing victory when playing with new players in order to provide a positive gaming experience. Does self-handicapping affect the preferences and future play intentions of beginners? In this experiment, an experienced player taught a tabletop game to new players and played with them. Participants (N = 60) were assigned to one of three conditions: control (experienced player actively pursues victory), overt self-handicapping (experienced player restricts her choices and announces this to the new player), and covert self-handicapping (experienced player self-handicaps without telling the new player). Participants then reported their gameplay experiences and their interest in playing it again. We discuss the study results and implications for game-based interventions.

Overview

When we introduce someone to a game for the first time, we hope they will find it engaging, enjoy the challenges and interactions it presents, and want to play in the future. And when we design or adapt games for education, well-being, or social causes, they are more likely to succeed when players want to keep playing after their initial exposure. What features of a first experience with a game matter to the new player’s enjoyment and interest?

One way experienced players in multiplayer games attempt to provide an engaging experience is through self-handicapping, which involves changing some aspect of the game, or their approach to playing it, so that new players have a chance at victory. There are many ways experienced players can self-handicap, including (a) not fully applying one’s effort and knowledge toward winning (“easing up”), (b) trying to win but imposing additional challenges or barriers to victory on oneself, or (c) setting different win conditions for the experienced versus new players or starting new players with a certain number of points at the beginning of the game (e.g., handicaps in golf). In this study, we focus on the second approach, termed by Vossen (2008) as lusory self-handicapping.

Gamers appear to spontaneously engage in self-handicapping when playing with young or inexperienced players. For example, Woods (2012) found that nearly 40% of surveyed hobby board gamers engaged in self-handicapping when teaching new players a game. Respondents stated that they did so to help new players learn the game, facilitate a level playing field, and provide a more enjoyable experience, partly to maximize the likelihood that the new players would enjoy the game and want to play in the future. Similarly, Smith (2006) observed a skilled player self-handicapping in a racing video game by slowing down to prevent a discouraged new player from abandoning the game.

Self-handicapping may be effective in providing an engaging experience and thus foster interest and enjoyment. First, self-handicapping may prevent the frustration of performing poorly or losing badly by calibrating the game challenge to an appropriate level for the new player. As such, self-handicapping can be viewed as an example of scaffolding (Vygotsky, 1934) by providing support for new players to learn and begin the process of mastering rules and strategies. Koster (2014) argues that to be fun, games must require players to develop and apply skill, but if games are too difficult, disinterest will result. Thus, until proficiency is reached, challenges should be moderate so as to prevent frustration. Second, self-handicapping may result in a more engaging social experience. A gaming experience is more likely to feel ‘shared’ from the elusory type of self-handicapping, in that it levels the playing field while still allowing the experienced player to pursue victory. Therefore, we expect that new players will enjoy the game more when the experienced player engages in self-handicapping.

How might a new player’s awareness of the self-handicapping behavior influence their experience? While beginners do not wish to lose handily to a more experienced player, they might resist some of the commonly employed self-handicapping approaches (Lanza, 2005). Deci and Flaste (1996) note that “to be intrinsically motivated people need to perceive themselves as competent and autonomous” (p. 86, emphasis in original), suggesting that new players may not appreciate obvious self-handicapping as it undermines the inherent challenge in learning the game and restricts their free choice. Thus, we hypothesized that the positive effects of self-handicapping would be stronger when the experienced player self-handicaps in secret, without the new players’ knowledge.
Methodology

Participants

Participants ($N = 60$) were undergraduate psychology majors at a mid-sized public U.S. university who participate in exchange for research credit and a chance to win a tabletop game.

Design, Procedure, and Measures

Each participant learned and played the card game *The Builders: Middle Ages* (Henry, 2013) with an experienced assistant. Participants were randomly assigned to one of three conditions: control (the assistant pursued victory), overt self-handicapping (the assistant employed self-handicapping by restricting herself to only 60% of the available cards each turn, and announced this before play began), and covert self-handicapping condition (the assistant silently self-handicapped).

After play ended, the participant completed a post-game questionnaire. All outcome measures were designed for the purposes of this study. These included: ease of learning the game, enjoyment of the game, level of effort expended while playing, self-confidence in playing well, evaluation of the game's quality, and motivation to play again. The outcome of the game and participant experience with strategic tabletop games were also assessed. Participation in the study took 30-45 minutes.

Results

Statistical analyses revealed that the participants’ experiences and raffle choices did not depend upon whether the assistant self-handicapped (overtly or covertly) or not. Based on their ratings (on a 7-point Likert scale), participants in all three groups reported having fun ($M = 6.01$, $SD = .85$), trying hard to win ($M = 5.88$, $SD = 1.12$), liking the game ($M = 5.38$, $SD = 1.07$), and being interested in playing again ($M = 5.69$, $SD = 1.07$). The game outcome (who won, margin of victory) also did not impact participants’ experiences. Interestingly, the participant evaluated the game more favorably if they happened to know the assistant personally ($t(58) = 2.16$, $p < .05$, $d = .57$), and participants who reported being familiar with strategic games and enjoying board/card games more were more likely to enjoy the experience, be confident in their play, and want to play again.

Discussion

There are several plausible reasons why participants had a positive experience regardless of the condition or the outcome of the game. For example, new players may expect to perform poorly relative to an experienced player, and may not be discouraged by losing. Also, the game we studied has little direct conflict between players (cf., chess, *Risk*); perhaps self-handicapping is more important in such contexts. Our assistants also consistently created a pleasant gaming experience (e.g., no trash talk). The results of this study suggest that in some gaming setting, there is no need for the experienced player to self-handicap, and that other factors (e.g., familiarity with other players, enjoyment and familiarity with similar games) may more strongly affect the new player’s experience.

References


An Unlikely Partnership: Problem-Solving with Lara Croft

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Abstract: Crystal Dynamic's title reboot, Tomb Raider represents a shift in the traditional relational dynamics between player and avatar. The designed emotional connection to the avatar allows for education through accessing the avatar’s stored knowledge, while simultaneously acting as a motivation for play. These modes of interaction immerse the player in the spectacle of play and create an opportunity for contextual learning.

The first title release of Tomb Raider in 1997 prompted a plethora of critical analysis and critique on the subject of femininity, gender representation, and power within the context of gaming. In this study, analysis of the Tomb Raider (2013) reboot suggests that Lara’s vulnerability as the central hero draws the player into a more intimate connection with her and a complex partnership can develop between the player and Lara. Neither Lara nor the player acts independently as the hero; but instead they work collaboratively to overcome obstacles, solve problems, facilitate the transference of knowledge, and, ultimately, complete the story of the game.

Throughout the many games in the franchise, the character of Lara Croft has demonstrated elements of both masculine and feminine classical narrative archetypes (Jung, 1953, 1980; Wolff, 1956) through her appearance and her actions. These archetypes serve to represent storytelling devices that have been repetitive and familiar (Campbell, 2008). In Lara’s previous characterizations, her role as the protagonist of the story has conformed to masculine archetypes, in contrast to her hyper-sexualized outer appearance (c.f. Flanagan, 1999; Kennedy, 2002).

Creating a player-avatar partnership

The Lara Croft portrayed in Tomb Raider (2013) exemplifies a new ethos. Lara, alone, is a powerful hero, and throughout the game Lara’s actions reinforce the concept of separation between player and avatar, and actively resists the projected identity of the player into Lara as a vessel (Gee, 2005). Throughout the game Lara engages with the player by speaking directly to him or her regarding the narrative development and her “thoughts” or “feelings” on their paired experience thus far within the story. In this way, not only is the player being engaged in an emotionally driven partnership, but the two are also working actively in collaboration to reach the conclusion of the over-arching narrative.

From the beginning sequence the game mechanic establishes the innate vulnerability tied to Lara’s character and the need, therefore, for the player’s participation. The degree by which the player participates in the narrative and in the gameplay, and the vulnerability of Lara and her inevitable deaths, both create an emotional connection between the player and Lara as partners. The player is taken into the game not as the sole protagonist but as an invisible character alongside Lara. The player is not a passive audience of the cinematic event, but as a necessary active force working in Lara’s interest to defend her from death within the narrative. It is a dynamic compromising partnership in which both sides rely on the other in order for the narrative to exist and to make accessible the virtual world.

Learner engagement through Partnership

Tomb Raider’s (2013) co-production of the narrative illustrates some design possibility for interactive storytelling and player-avatar partnerships for educational uses. In the game the player has the responsibility of participating in interactive cut-scenes. The player helps Lara through each challenge of the cut-scene by pressing the correct button. If the player fails Lara is killed and they are both prompted to restart from the beginning of the cut-scene.

These deaths are alarmingly gruesome; in them, Lara is killed in multiple grisly and repugnant ways depending on the sequence and circumstances. The death of Lara as the result of the player’s failure strengthens the emotional response to her inherent vulnerability as a mechanism of the narrative. The immediate response is not sympathy, however, but remorse. By Lara’s life in the hands of the player, the narrative structure encourages the player to help her through correct participation as one half of the partnership.

Throughout the Tomb Raider story arcs, the player explores and finds objects of interest hidden through the island. The difference in Tomb Raider (2013) is that with each item found, Lara elaborates upon the narrative and the item’s place within the real world history, drawing connections to real world events such as World War II, Japanese...
Culture and history, and the Nazi regime. The game not only acts as a platform for learning, but also engages the player in learning through an emotional connection to the avatar and the player’s intrinsic motivations to collect, explore, and achieve (Bartle, 1996).

Lara’s privileged knowledge within the virtual space sets her specifically apart from the player while the narrative unfolds around them both. Learning is occurring as the player engages in routine explorative game-play and relic collection. Collecting relics through the game is a mechanic of the game itself, but does not advance the narrative. Similar to the implied learning that Gee (2003) identifies in the original Tomb Raider (1997) where the player is rewarded for ignoring the information presented, the learning environment created in partnership is something that runs in concealed parallel to the narrative taking place. The motivation for learning, therefore, is synonymous with the motivation which drives the player to intentional postpone the progression of the narrative for the sake of exploration and achievement. By utilizing these intrinsic motivations for play coupled with an emotionally driven partnership to the avatar, Tomb Raider (2013) offers an example of active learning that can occur within a dynamic narrative.

As a teaching technique, player-avatar partnerships may arguably be more effective than traditional practices for students with non-normative learning tendencies because of its informal nature. In allowing a character like Lara to engage in partnership with the player, she has the voice and the opportunity to share her knowledge and opinions about the narrative, and it is through this exchange that learning takes place.

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Understanding Conceptual Engagement and Accuracy in an Assessment Game

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Abstract: We are conducting an exploratory analysis into the clickstream data produced by a new “assessment game” appearing on BrainPOP, the popular educational resource. The game involves ordering and sorting information along a Timeline, and easily supports plug and play content from different subject areas. In this poster, we will present preliminary data on this game’s performance as an assessment tool. We will analyze clickstream data to characterize common user patterns, map those user data onto a framework for conceptual accuracy and engagement, and test the framework’s validity.

Introduction
Games have great potential as assessment tools, particularly for performance-based assessment (Steinkuehler and Squire, 2013). Digital games can automatically and unobtrusively observe student performance without the time-intensiveness of video recording or observational work. Clickstream data may systematize assessment if a student’s sequence of clicks can be tied to learning claims, such as through evidence-centered design (Shute and Ventura, 2013). This holds great educational potential, particularly if assessment techniques can be generalized across different kinds of content or games (Owen et al. 2014). Thus, creating and validating assessment games’ efficacy becomes critical when exploring the future of learning games.

An assessment game called Time Zone X is intended to work as both a game and an assessment tool across any given content area. In this poster, we will analyze clickstream data from students’ gameplay and adopt an exploratory approach to understanding how players interact with the game and how the game itself can act as an assessment tool for student knowledge.

Time Zone X Game Description
Time Zone X is loosely based on the physical card game, Timeline (Frederik, 2015). Players have cards with chronological events on them and they must accurately place those events in a sequence (Figure 1). Events are grouped based on BrainPOP movie topics into separate “decks” and players decide which deck to play from each turn (Figure 1). Completing a deck in a single game session awards the player a historical artifact (relevant to game theming). The goal of the game is to create a Timeline that is as long as possible. Placing multiple correct events in a row lets the player unlock new decks and extend the length of their Timeline with that deck’s cards (Figure 1). Placing multiple incorrect events in a row ends the game.

The game, featured on BrainPOP’s GameUP platform, is referred to as an “assessment game.” It was designed specifically to assess student knowledge on BrainPOP topics. Assessment games can incorporate content from many different topic areas, but all rely on a single assessment framework. Additionally, this particular framework (described in the next section) is intended to be flexible enough to apply across different assessment games. The framework has only been implemented on one previous game, so this will be the first attempt to apply the framework across games.

The Analysis
The analysis will be supported through repeated user testing sessions. These sessions will help us explore user play patterns and refine the assessment framework.

Before each session, we will work with a teacher to understand what content his or her class is expected to know. We will then set up two versions of Time Zone X: one with content that students have recently reviewed and one with content that students are unlikely to have seen before (i.e. content targeted one or two grade levels above the students). The class will be separated into two groups. Each group will play one version of the game and then switch to the other halfway through the class. We expect to run this experiment at 2-3 user testing sessions, gaining gameplay data from about 60 students.

An exploratory analysis will be conducted on this data to identify dominant patterns of user interaction. For each student we will have two sets of gameplay data: one expected to contain a higher content understanding and one
expected to showcase lower content understanding. We can also group the data by first and second play-through of the game. This allows us to simultaneously test for the effects of prior content understanding and game familiarity.

Building on the engagement data, we will apply BrainPOP’s existing assessment framework to Time Zone X. In a previous game called Sortify (BrainPOP, 2013), a two-pronged approach was developed to report on conceptual accuracy and engagement from student gameplay. In this framework, conceptual accuracy is defined as percent correct out of total attempted items (as related to a particular concept in a given activity). Meanwhile, conceptual engagement refers to how much a player chose to use a concept that was available to them in a given activity.

We have applied these general definitions of concept-specific accuracy and engagement to Time Zone X gameplay. In Time Zone X, we interpret accuracy as number of correctly placed events out of total attempted events. Incorrect answers will be weighted by the distance from the correct time interval. Meanwhile, we define engagement, in this context, as the total number of events related to a certain concept that were used by a player. A small qualification: the exact application of this framework to Time Zone X will be adjusted in ways that seem reasonable, based on the results of the exploratory analysis.

This presentation will involve two analyses. First, we will present an exploratory analysis of the clickstream data, highlighting user interaction patterns. Second, we will determine if the definitions of conceptual accuracy and engagement are correlated with prior content understanding or familiarity with the game mechanics. This will help us determine if the BrainPOP framework can generalize across different content and assessment games.

Figure 1: On the left, a screenshot of the starting screen, which shows the starting (titles directly correspond to BrainPOP topics). In the middle is a typical image from gameplay. The bottom portion of the screen holds the decks that a player can choose from while the top depicts the current Timeline. The meter in the middle of the screen shows the current correct (to the right) or incorrect (to the left) placement streak. Currently, the meter is one correct placement away from unlocking a new deck. The right screen shows how new decks are selected, after being unlocked by a series of correct placements.

References


Beacons in the Museum: Findings from a Pilot Study using iBeacons within a Mobile AR Game in a Natural History Museum

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Abstract: Mobile augmented reality (AR) games can be engaging learning experiences, leveraging real-world artifacts and locations with a digital overlay of information, narrative, and interactivity. By integrating iBeacons, AR game platforms create a viable means for informal learning organizations (e.g., museums) to create indoor, location-based mobile games. A pilot implementation targeting youth ages 6-12 paired with adults visiting a natural history museum demonstrated that participants were able to locate specific items in galleries densely crowded with artifacts. Participants also found the experience highly engaging, felt that the game provided a lens for closely observing and comparing artifacts, and fostered synthetic thinking across exhibit spaces.

Background

Mobile experiences can promote the types of visitor engagement valued by informal learning organizations (Cahill et al., 2011; Hsi & Fait, 2005; Klopfer, Squire, Perry & Jan, 2005). Played on mobile devices, located-based augmented reality (AR) games provide information based on the player’s current location linking gameplay to the physical world. In this way, AR games leverage the physical environment by providing a layer of narrative, information, or other digital interactivity. In informal learning venues (such as zoos, nature centers, and museums), AR games can potentially engage visitors in a number of ways: guiding visitors to locations and artifacts they might not otherwise visit, encouraging visitors to look closely at specific artifacts, prompting visitors to access prior knowledge, offering visitors behind the scenes information, and highlighting the research agenda, broader goals, and values of the host venue.

However, implementing location-based AR games in indoor locations can be challenging. Over the past several years, visual tags (e.g., QR codes) allowed visitors to scan or input information enabling their device to presume the player’s current location (Ceipidor et al., 2009). However, this approach has three potential drawbacks: First, the visual codes need to be within line of sight of the visitors, often cluttering the visual landscape. Second, players needed to pause from gameplay to actively enter their location, which can disrupt gameplay and eliminates the possibility of a surprise experience. Third, unless signage is pronounced, these visual cues do little in and of themselves to guide the player to a novel location.

iBeacons

The recent development of iBeacons allows mobile devices to connect to a point-of-interest (POI) via Bluetooth. The mobile device senses the beacon’s unique identifying code, allowing the mobile software to estimate the device’s current location within the indoor space. While not invisible, these devices (small plastic units the size of a walnut) can be mounted out of visual line of sight, requiring only proximity detection. As the player approaches the beacon, the mobile device can react automatically, giving the player clues, information, or feedback, and ultimately giving the player a potentially more natural, flowing experience.

Pilot

Researchers at MIT conducted a study to investigate whether integration of beacons into TaleBlazer (a platform for making and playing mobile location-based games) could: (1) guide visitors to specific POIs, (2) promote observation and discussion, and (3) provide an enjoyable, engaging experience. In Spring 2015, a pilot game using beacons was developed at the Harvard Museum of Natural History (HMNH) in collaboration with the MIT STEP Lab. This pilot sought to offer youth visitors role-playing activities that playfully engage them in STEM practices within indoor exhibit spaces. In parallel, the authors sought to provide informal learning organizations with a proof of concept pilot demonstrating the capacity of indoor AR tools and practices that thoughtfully utilize existing exhibits in indoor learning spaces.
The pilot game “Super Survivor”, aimed at tweens and their families, aimed to promote observation of animal physiology and discussion of bodily adaptations. Gameplay took place within three adjacent museum galleries (Africa, New England Forests, and the Great Mammal Hall) all of which feature densely exhibited mounted specimens located inside glass cases. The player is assigned a specific biome (desert, tundra, or rainforest) and is tasked with customizing a fictional creature to best survive in that biome. Upon entering a room, beacons sense their location and provide instructions and clues to find each of four specific “landmark” specimen, large and generally recognizable organisms. The player is then prompted to closely observe three nearby specimen and to select their preferred feature (e.g., teeth from the honey badger). The player ultimately obtains feedback indicating how the assembled traits helped or hindered their fictional creature’s survival in their assigned biome.

Sample and Methods

During the roughly 45-minute pilot, nine groups (adults and children ages 6-12) played the game on borrowed iOS smartphones/tablets. Researchers closely shadowed participants, recording at 30 second intervals their location and level of engagement (with adults categorized as “actively involved,” “observing,” or “off task,” and youth categorized as “actively involved,” “related task” or “off task”). Observers also noted any particular areas of confusion or frustration (e.g., locating specific target POIs). Additionally, players completed a written post-survey and participated in a 20-minute post-game focus group to probe players’ feelings about the experience.

Findings and Discussion

Participants averaged 20 minutes of gameplay, though duration was highly variable across groups ranging from 11 to 31 minutes. Children were generally highly engaged by the game (83% on task), with only two children observed to be off-task, one of whom was visibly not feeling well during the game. Adults frequently (86% of the time) took an active role in playing the game, reading the text to the children and discussing the choices with them. Researchers observed players looking closely at the exhibits; when deciding between teeth options, for example, many players bent down to the ground so that they could look more closely at the honey badger’s teeth. Some challenges included groups with multiple kids sharing a single device, in which the adult felt as if she needed to guide youth in sharing the device and collaborating. Despite these challenges, post-survey findings demonstrate that the game was very well received. Using a five-point Likert scale, participants said the “technology was intuitive” (4) and the “game was easy to start” (4.25). Adults found the experience “meaningful” (4.38) and felt it helped them “think in new ways” (4.63), enjoyed finding the objects (4.88), and agreed it was a “fun way to spend time together” (4.75), saying they would play it again (4.88). Children liked the story/quest (4.63), agreed it was a fun way to visit a museum (4.81), enjoyed finding the real-world objects (4.63) (“It was cool when things popped up to say you’re near”) and would like to play a similar game again (4.75). Participants felt the game added to their visit, commenting, “[the game] made me look closer at things” and gave them something to do—“instead of just watching the animals, we’re discussing [them].”

Data from this pilot demonstrate the viability of using iBeacon technology as a means to foster youth/family engagement within a museum setting. Future work includes additional game mechanics to engage players in tasks other than observation, as well as wayfinding support from the technology, which will be particularly useful in games that utilize a larger physical space.

References


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Thinking and *Troubled Lands*: Supporting Student Inquiry with a Sustainability Simulation Game

Joli Sandoz, The Evergreen State College

Abstract: In this poster, I assess the first phase of a two-phase classroom research project designed to investigate student knowledge-making elicited by play of *Troubled Lands*, a multi-player, collective action problem card game. During gameplay, players of unequal abilities managed a shared common pool resource. Qualitative findings indicated insights related to public policy process and participatory governance (two of the topics of the course), and appreciation for game play as a knowledge-making experience. Students participating in phase 2 of this project during 2015-2016 will play *Troubled Lands* in a different academic context, that of an educational games course.

Introduction

Games are among a variety of strategies I use to prompt student learning in interdisciplinary courses at The Evergreen State College (Olympia, WA). This poster presents qualitative findings from phase 1 of a two-phase action research project to integrate game-based activities into two undergraduate courses. The first course, taught during fall quarter 2014, focused on public policy making and related topics; the second, which is scheduled for fall quarter 2015, will center on the design and use of educational games. After looking at a number of policy-related and politics-themed games, I selected a tabletop version of *Troubled Lands* (formerly entitled *The Farmers*) for use in both courses, in part because the game is designed to elicit reflection on player experience of social dilemma—conflict between self- and collective-interest (Fennewald & Kieval-Kylar, 2012, 2013, 2014). *Troubled Lands* also features three different win conditions that can simulate various interpersonal approaches to problem solving (or to public policy making and implementation), as well as asymmetrical abilities among participants. Finally, the game’s rules can be grasped quickly, it is easily available, and play can be adjusted to fit to time available.

Methods

Players of *Troubled Lands* make a series of choices while they manage crop yield from a grid of 12 land plots in various and fluctuating states of productivity. Three rounds of play allowed phase 1 students to experience each of the game’s win conditions – direct competition, full collaboration, and a mix of indirect competition and collaboration. Faculty asked students to reflect on connections between game play and making public policy (represented in *Troubled Lands* by game rules), about policy-making process in situations where inequity is present, and on the game as a tool for learning.

Gameplay took place during weeks four and five of a 10 week academic quarter. Course content to that point addressed various aspects, and methods, of public governance. In the week before gameplay, students viewed a short video about policy and common pool resources, and read and discussed a relevant article (Ostrom, 1999). Students were introduced to *Troubled Lands* through written rules and a related slide presentation, after which they drew numbers to form playing groups. One of the game’s designers was present via phone and internet video technology during all three playing sessions. Prompts designed to solicit students’ written expectations, and their reflections on insights associated with gameplay, were administered before and after the collaborative round of play (round 1), and before and after gameplay a week later, a class session in which participants played first a competitive round (round 2) followed by an independent, or mixed condition, round (round 3). Players also responded in writing to post-play questions at one week, and again at three months, after the final in-class round of play.

Results

Phase 1 students’ written statements of game-based knowledge-making in part addressed both personal and shared values, and the fact that “throwing our values out the window” was rejected in a variety of ways during play (even under the competitive win condition). The contributions of communication to fruitful collaboration, and to achieving “peaceful and effective and fair solution[s]” to problems, also appear repeatedly in reflection writing. Several students wrote about the possibility and importance of policy flexibility and change. For example, one student said, “If public policy sets the goals and strategies [as do game rules, in this student’s view], it changes outcomes. We can change policy, as we did with the goals of the game, in order to change outcomes.” A second respondent (again in company with several others) focused on the transfer of observations about in-game competitiveness to
If everyone were to be working for what would give them the most individual points, the other community members, resources and land would crumble. This is applicable to politics because if the “action making characters” care only for personal gain, then the greater community will first be tested for resilience, but eventually [will be destroyed].

A third comment, this one focused on what games might contribute to policy making, read: “Playing games opens us (people) up to learning and trying new ideas and new ways to . . . establish policies that work,” concluding that “Playing games [is] light and fun . . . Making policy is heavy and difficult. What if we could make policy challenging and fun?”

**Implications**

Phase 1 of this research suggested the usefulness (within the specific setting of one Evergreen course) of gameplay to inquiry-based learning; specifically, the usefulness of repeated play of the game *Troubled Lands*, to thoughtful reflection on public policy making and participatory governance. Participants also expressed appreciation for game play as a knowledge-making experience. Methods-related adjustments suggested by situations encountered during phase 1, including allowing adequate time for thorough debriefing discussions and for written reflection, will be made during phase 2. Phase 1 playing groups also spontaneously amended game rules, especially during the competitive round, in ways that phase 2 debriefings will be modified to record, if applicable.

Danish game scholar Thorkild Hanghøj (2013) draws on the work of John Dewey to explore classroom uses of games as “inquiry-based laboratories . . . used to explore and experiment with the construction, deconstruction, and reconstruction of knowledge” (p. 82-83). In keeping with Evergreen’s stated expectation that graduates demonstrate ability to address practical problems through several modes of inquiry, the phase 2 course – focused on designing and using games as tools for learning – will continue to explore the relationship of gameplay, including play of *Troubled Lands*, to inquiry-based learning.

Researchers welcome comments regarding plans for phase 2: Participants will approach initial rounds of *Troubled Lands* play much as did phase 1 students; engagement with the film and article will be followed by a short introduction to the game itself. After gameplay and associated reflection, work with the game will become a small-scale participatory research project. That is, students will research, identify, and then propose what they want to learn about (a) educational gameplay in general, and (b) how best to design, introduce, conduct and debrief gameplay sessions for a post-secondary audience, with specific learning objectives in mind. Phase 1 participants documented conceptual application of insights acquired during gameplay to policy making and governance beyond the classroom. Phase 2 students also will be asked to apply their experience and knowledge from *Troubled Lands* to a larger frame—educational gaming in general—as they propose redesigns of pre-play activities, learning assessments, and the game itself.

**References**


Learning Outcomes In Adults Playing and Self-debriefing
Get Water!, a Game for Change

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Abstract: This poster presents an experimental study examining how playing Get Water! (Decode Global, 2013), a water-scarcity themed casual mobile game, affects attitudinal, behavioral and cognitive learning outcomes. Using a three-group design (n=251), we asked (1) how playing the socially-themed game influences players' knowledge, attitudes and advocacy behaviours relative to a control group that played Little Amazon (Bulkypix, 2013), a mechanically comparable game without a social theme, and (2) how a self-debriefing exercise administered post-play influenced those player outcomes. We will discuss role of prior civic engagement and guided reflection on the educational and persuasive effectiveness of games. The results of this study will provide directions for the design of games for social change by identifying conditions that impact the attainment of the game’s goals.

Introduction

In this study, we examine Get Water! (Decode Global, 2013), a water-scarcity themed mobile game. The game was conceived within a growing trend of digital game development and sponsorship by international governmental bodies and non-governmental organizations, which hope to harness the engaging qualities of interactive new media to increase public awareness of global public affairs. Other games exemplifying this trend include the World Food Program-sponsored game PC game, Food Force (Konami, 2005), and MTV’s Darfur is Dying (MTV, 2011). This trend in digital game development will likely continue, as organizations such as UNESCO continue to sponsor design competitions (e.g., the UNESCO MGIEP Gaming Challenge). Yet as organizations increasingly turn to digital games to educate the public, there is a need for empirical examination of the effectiveness of the games-based learning experiences that these tools afford, and to identify design elements that support sustained engagement in the international civic sphere.

Casual games like Get Water! offer simple gameplay that nearly anyone can pick up and play in a short period of time (Juul, 2012). The promise of casual games with civic content is that they may provide accessible learning experiences that build awareness and understanding of complex social problems. However, casual games are typically light in both playable and educational content, leading some (e.g., Arora & Ito, 2012) to question whether or not such games really do more than preach to the converted. It follows that two important empirical questions are (1) what – if anything – players learn or change from playing these games and (2) how they function as informal learning tools. Further, it is important to address the issue of debriefing; the inclusion of debriefing post-play has long been considered an essential aspect of game presentation in the Simulation and Gaming community; debriefing activities post-play are recommended to facilitate player reflection and meaningful integration of new concepts and experiences encountered through play (Crookall, 2010). Debriefing activities guide players to (1) describe and analyze what was done in the activity; (2) reflect on their current state of knowledge, and (3) reflect on how their learning could be applied elsewhere (Nicholson, 2012). Many “activist entertainment” games do not explicitly include debriefing as part of the player experience; although some well-funded projects such as Food Force have external resources available for teachers to use in class, post-play debriefing activities for the general audience of players are rarely incorporated.

The Study

Our study is intended to investigate two questions. First, we are interested in seeing how effective the game Get Water! is as an educational and persuasive tool for adults. Second, we also hope to investigate the persuasive and educational effectiveness of Get Water! in combination with a brief reflective exercise.

The Game

Get Water! is a mobile game available for iOS, Android and Windows devices, released in 2013 by Decode Global. It is a side-scrolling endless runner game; the player guides the protagonist, Maya, by drawing her path on the touchscreen. Maya runs through a procedurally generated 2D cartoon landscape, collecting water and special items, and repelling or avoiding obstacles. Maya, the protagonist, must leave school because the local water pump is broken, and her mom needs her to help collect water. Most of the civic and social justice content is not explained...
during core gameplay but rather through the metagame experience: animated storylets depicting Maya’s life, a screen shown between levels that presents factoids about the importance of water, and quotes in support of the game’s cause contributed by users. From the game’s home screen, players can choose to click “Learn More” to access more information about water scarcity and the charitable partner, charity:water.

**Debriefing Intervention**

Our aim was to add a debriefing element that encourages active processing of the play experience but does not overwhelm the player. We wanted the players to practice reflection skills that are actually used to participate in discourse about public affairs, including expressing and defending positions on public issues, and thinking constructively about how to improve current conditions. Based on these requirements, we determined that a mock “Tweeting” exercise would provide an authentic and appropriately brief post-play exercise. Prompts instructed players to compose brief microblog messages identifying one key idea from the game, and identifying opportunities to apply this idea in one’s life. The players were then prompted to evaluate the messages they had composed, indicating whether or not they would want to disseminate each message, and whether they thought they needed to learn more about the subject matter.

**The Pilot Study**

Prior to running a pilot study with 22 participants, we had some doubts about the effectiveness of the game due to the placement of water scarcity content outside of core gameplay. Yet most pilot participants responded positively to the experience; one said, “When I answered that survey before, I know I answered [that] gender inequality and access to water … weren’t really alike … Seeing how the game worked, I mean, you can kind of see where they’re leading in that there is a correlation between them … So it made me more aware of that.” Another suggested that “the game makes you feel like your actions help this person, and then maybe [you] would take that to the next level and think, ‘Well, what can I do to help?’” Of the 18 participants who returned the one-month follow-up questionnaire, 16 discussed the game with someone else, and 8 tried to learn more about either women’s access to education or water scarcity. The larger control trial will enable us to determine whether or not these promising outcomes are typical and whether or not they are attributable to playing the game, and not an effect of contact with the research team. Additionally, we found that some participants did not think they had extracted a clear, actionable message from the game. We thought that the debriefing intervention might focus players on either taking action or learning more.

**Methods**

Participants were randomly assigned to three groups: a game-only group, a game-plus-debriefing group, plus an alternative-game control condition that we included to control for the potentially biasing effects of repeated assessment on the participants. Participants recruited from the local area were invited to a laboratory to play an iPad game of an undisclosed nature. Participants’ knowledge of water scarcity and attitudes regarding participation in water-scarcity-related activism were assessed using a pretest, post-test and delayed post-test one month after they first played the game. As control variables, we also profiled our participants in terms of demographics and prior civic experience.

**Anticipated Results**

Data collection is complete but analysis of the results of the larger study is ongoing. However, based on the pilot results, we anticipate that participants with relatively high prior knowledge of the issues will not show much change in terms of their attitudes and knowledge. Players with little prior knowledge but who have an interest in social justice and global issues may shift in terms of knowledge, their ratings of the importance of water scarcity and their attitudes towards advocating for access to potable water. We also expect that the larger study will reveal a gender difference in how effectively the game promotes awareness of its two major themes: gender inequality, and water scarcity. Prior civic experience also seems likely to influence how participants respond to the interventions. We hypothesize that people with prior civic experiences will be especially likely to attend to the civic content and follow up by learning more. We hope to discuss the findings from the control trial with other attendees and contribute to the larger conversation about how and for whom casual civic games promote learning.

**References**


A Tale of Two Schools: 
Terrain and Resources in Virtual Games and Physical Communities

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Abstract: Our research focuses on the use of wearable activity monitors to motivate behavior change and increase adolescents’ health and physical fitness. Youth participants wear Fitbits that sync with a video game, thus connecting their physical and virtual experiences. This poster presents two case studies: an urban middle school and a suburban junior high school. In a gamification of our research methods, we describe the “terrain” (a community’s affordances for physical activity) and “resources” (a community’s access to technology and funding) of our two case studies alongside the terrain and resources in the online game.

Introduction

Our research team studies middle-school youth in Northern California who wear Fitbit activity monitors and play a video game we created. The game draws data from the Fitbits, providing a tangible connection between physical and virtual experiences. Our design-based research approach focuses our thinking about technology and students’ beliefs and behaviors within an ecological framework that considers aspects of the community wherein activity takes place. Ecological models are found in health behavior research (Sallis, Owen & Fisher, 2008), sociological examinations of health relative to the built environment (Booth et al, 2005; Burdette & Whitaker, 2006), and educational technology research (Zhao & Frank, 2003). We examine differences in the use of Fitbits and games between income communities.

As described in this poster, the communities’ similarities and contrasts include “terrain” (a community’s affordances for physical activity) and “resources” (material and financial assets, as well as access to technology), which we present alongside a description of the virtual terrain and resources in the video game. By using game features to shed light on community features, we gamify our research methods.

Terrain in the Game

In the narrative of Terra, players are recently landed space explorers setting up individual domed bases on a desolate planet. Their goal, completely terraforming the planet, must be completed within a limited number of weeks so more people can come settle the new world. It is essentially a tile-based game: users explore “foggy” tiles one at a time and then populate those tiles with terrain features. As the game progresses, the landscape of the world players create becomes an aggregate visual representation of their physical activity during the game campaign, with each player’s landscape reflecting not only strategic in-game decisions but also their daily fitness.

Terrain in the Community

One of our case studies is a middle school in an urban area of a major city; the school is located on a street with busy traffic due to a highway interstate and industrial factory nearby. The students are limited in their ability to walk or bike around their neighborhoods, and from home to school, because of safety concerns. The other case study is a junior high school on the edge of a small town containing a large research university; the school rests off a moderately busy street with several greenbelt and bicycle routes connecting the school and surrounding neighborhoods. Consequently, students often walk or bike from home to school and around their neighborhoods; the major barrier to exercise for these youth is their own busy schedules. Our poster includes images of both communities.

Resources in the Game

Terra players’ in-game resources depend on their real-world activity. The students’ objective, to terraform the planet, requires resource use for planting crops, mining materials, constructing buildings, and exploring their areas. Each of these actions requires the students to make decisions about how to use their daily allotment of energy points. In addition to a base number of energy points, for every 1000 steps a student took in the real world the previous day, they receive an additional energy point. Thus, real-world activity boosts in-game resource availability.

The players also have access to a dashboard in the game that summarizes their daily steps, calories, and activity types. This dashboard also provides an overview of their game statistics, i.e., tiles explored and available food,
ore, and energy. Finally, there are also a series of leaderboards that allow the students to compare their efforts with their classmates, often resulting in healthy competition. The dashboard connects the game and real life, and facilitates thinking about and quantifying the students’ daily activity more concretely.

Resources in the Community

At the middle school in a large urban city, access to technological resources in the classroom was an initial concern. Students had access to laptops and the internet at school; however, we found that these computers had many technical limitations. The power cords in the media cart didn’t charge the computers consistently so the research team brought bags of chargers and charged the computers before students arrived. We also found that 85% of participants reported accessing a computer at home, 67% reported internet at home, and 40% reported having smartphones.

While the students in the first case study were participating in an after-school program, the other case study participants were students in a formal curricular class. This school was located in a small, well-resourced town. Students were in a technology classroom with desktop computers and internet access for each student. The computer lab also boasted a CNC machine, 3D printer, and a workshop. With this group, we found that 98% of participants reported accessing a computer at home, 96% reported internet at home, and 85% reported having smartphones. Most students carried around smartphones at school, and several choose to sync their Fitbits using the smartphone app.

In addition to technology resources, the two communities offered different opportunities for physical activity. For example, in the urban middle school, students had few opportunities to participate in after-school sports or teams, while many of the suburban junior high school students were involved in both extracurricular and school-sponsored sports and teams.

Conclusion

Through playing Terra, students soon learned that the game terrain they could terraform depended on their in-game resources. While energy points could be obtained through successful game activities, they also largely came from daily activity, which was tracked by the Fitbit. In this way, the terrain and resources of the real world impinged upon a student's game experience. Due to this link between the virtual and extant worlds, community resources shaped the choice of technologies in this project. The game Terra was designed to run in a web browser and require minimal Internet speeds, so that students in schools with poor connectivity could still play the game. Currently, the game works on computers, so students with computer access at home can use it, but the game does not work on a smartphone or tablet browser. Our research design was shaped by considering the interaction of terrain and resources in the communities of our participants.

References


Abstract: Museums exhibits are often considered passive experiences that do not engage their audience, especially with younger students. However, to provide a more engaging learning experience, museums have begun re-inventing themselves by creating interactive exhibits that are supplemented with mobile technology. The objective of our study was to determine whether the design of Play the Past facilitated engagement and learning among the students who participated. To do this, our analysis used data that was collected from the mobile devices that were used by students. We hypothesized that students would be highly engaged with the activity and that they would learn how to negotiate profitable trades, which would allow them to complete the Fur Trade hub in Play the Past. Our study found that many students were not highly engaged with the game, and that successful mastery of the trading mechanic in the game did not predict completion of the Fur Trade.

Introduction

Museums exhibits are often considered passive experiences that do not engage their audience, especially with younger students (Hall & Bannon, 2006). To provide a more engaging learning experience, museums have begun re-inventing themselves by creating interactive exhibits that are supplemented with mobile technology (Hall & Bannon, 2006). To determine whether people are engaging with and learning from these new types of exhibits, museums have utilized a variety of qualitative methods, such as observations, interviews, and surveys (Hall & Bannon, 2006; Wilde & Urhahne, 2008; Yiannoutsou, Papadimitriou, Komis, & Avouris, 2009; Sung, Hou, Liu, & Chang, 2010). Although these methods are effective for assessing how a small number of museum attendees interact with an exhibit, they do not capture the range of behaviors exhibited by a large number of attendees. Thus, there is a need to collect and analyze the data generated from mobile devices that are used by people within exhibits, which allow us to examine the behavior of many attendees inexpensively.

Despite the novelty of these large-scale data collection and analysis techniques in the museum field, they have been used in Human-Computer Interaction (HCI; Drachen, Sifa, Bauckhage, & Thurau, 2012) and Educational Data Mining (EDM; Stenerson, Salmon, Berland, & Squire, 2014; Halverson, & Owen, 2014; DiCerbo, 2014) research for years. The current study capitalizes on these methods to study Play the Past (“Play the Past”, 2015); an augmented reality game that has been embedded into an exhibit at the Minnesota History Center. This exhibit was designed to enhance engagement and facilitate learning of historical content by incorporating principles of inquiry-based learning.

Inquiry-based learning in museums

As a result of the prevalence and effectiveness of inquiry-based learning usage in the classroom, many museums have been influenced to transform their exhibits into interactive learning environments (Kaptelinin, 2011; Sung, et al., 2010; Wilde & Urhahne, 2008). This movement has also triggered museums to re-define the learning objectives of visiting a museum exhibit (Hein, 2002). Instead of concentrating on the student’s ability to recollect specific pieces of information after experiencing a history museum exhibit, the focus has shifted to motivating students to engage in role-playing as historical figures or actively manipulating historical content through the exhibit (Hein, 2002).

Play the Past

While participating in Play the Past, students explore Minnesota history by exploring three distinct hubs; the Fur Trade, Sod House, and Iron Range. For the purposes of this study, we will be focusing on the Fur Trade, where students enter the world of an 1807 fur trading post in Minnesota. At the beginning of the Fur Trade, students use their iPod to gather beaver pelts or purchase items from the store by scanning Quick Response (QR) codes. Afterwards, students are encouraged to trade with each other to simulate the interaction between hunters and trading post clerks during that time period. Overall, the activities in Play the Past were designed to provide students with an opportunity to engage in inquiry-based learning with historical content, instead of passively viewing the content within the museum. Although Play the Past was designed to facilitate learning and engagement, there is only anecdotal evidence that students are playing the game as was intended.
**Current Study**

To determine whether or not the inquiry-based learning design of *Play the Past* facilitated engagement and learning, we focused on students during their participation in the Fur Trade. We chose to focus on the Fur Trade because the tasks required of the student were the most complex and challenging within this activity, thus we expected to find a wider variety of behaviors. The analysis used data that was collected from the mobile devices used by students in the exhibit.

**Methods**

The sample consisted of 7,129 4th to 6th grade students from local elementary schools who participated in *Play the Past* between September 1, 2014 and June 4, 2015. The *Play the Past* application collected behavioral data on each student by logging the tasks that they complete while interacting with the exhibits.

**Preliminary Results**

Based on our preliminary findings, the Fur Trade hub within *Play the Past* could benefit from a re-design to improve engagement and ensure that the mechanics of the game that the students are supposed to be learning are directly tied to success in the game. This type of redesign should be expected though, because many other inquiry-based learning environments accompanied by technology require several iterations to properly blend a complex learner-centered instructional method with novel technologies (Edelson, Gordin, & Pea, 1999). However, it is important that museums that use mobile technology to enhance the attendee’s experience take advantage of the behavioral data that can easily be collected by the device itself to ensure the exhibit is providing the experience it was designed to produce.

**References**


When Good Games Promote Good Programming: Scratch Camp FTW

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Abstract: This study presents an overview and summary of the initial results of encouraging and evaluating novice programmers, in this case young girls, by tasking them to create their own video games in the Scratch environment. The structure included an open-ended, but authentic task allowing them to explore several challenging abstract programming concepts such as variable manipulation and conditionals. This paper describes the ways in which we are analyzing student's programming processes in terms of the tasks they were given. The goal is develop analytics for the projects that describe the student's grasp (or lack thereof) of computer science concepts.

Introduction

For many years educators and researchers have been challenging kids to learn computer science skills by helping them create their own video games. Some of the goals behind this movement involve helping kids learn organizational systems and programming with an authentic, open-ended task (Denner, Werner, & Ortiz, 2011). These types of tasks can lead to sustained engagement in programming (Kafai, 1995), but one major challenge to educators is evaluating what kids are learning when the projects look wildly different.

We took on this challenge by engaging kids in a week-long, 30-hour “Scratch Camp” where 25 girls in grades 5 through 8 participated in the development of their own original multimedia content creations. Each day, the girls were given a project with goals designed to give visibility to increasingly difficult programming concepts such as loops, events, variables, and conditionals as the camp progressed. These projects culminated in creating their own interactive video games.

In this poster we explore the results of encouraging kids’ programming efforts by tasking them to create their own games within the Scratch environment. It can be a challenge to engage kids in creating good games when they are novice programmers, especially given the high quality of video games many kids play in their leisure time. Further, games typically involve relatively abstract programming concepts difficult for novices, including the use of conditionals and variables. Learning these concepts is one reason why educators often use video games as a reason for programming, but with short amounts of time available, many students often do not use these programming concepts in sophisticated ways (e.g. Denner et al, 2011).

In this study we sought to engage and evaluate novice programmers (girls in this case) in learning more sophisticated programming through making simple but authentic video games. We took advantage of games’ “endogenous” qualities (Squire, 2006) by allowing the students to play and “cheat” four starter games. Most students figured out how to manipulate variables by bumping up their health instead of subtracting from it or by jacking up their score in bigger intervals. The rest of this paper describes the ways we are developing to analyze students’ programming processes in ways that are authentic to the game design task. One overarching goal is to develop computational analytics for students’ projects that show their learning (or lack thereof) over time. This poster represents our first step in qualitative analysis toward building an analytics for evaluating open-ended video game designs.

Productive Programming in Scratch

Through an iterative analysis process we qualitatively coded students’ games several different ways to understand what they changed and what they were learning hour by hour. Data included hourly collection of projects over two days which allowed us to see changes in their design and programming decisions. As a result of this process, we developed a rubric based on the requirements for the challenge presented to the girls for their interactive video game project. The rubric categorizes each game component as the following requirements: 1) create an instruction screen, 2) develop a user interface, 3) use two or more character sprites, 4) create two or more “levels”, 5) create a “game over” screen, 6) use logic to change level condition by some sensing or other means, 7) use variables. Using a tool (Table 1) in our post-design evaluation, we were able to categorize the degree to which the students were able to accomplish the tasks on a scale, and then dig into their Scratch code to connect to a range of programming skills.
Table 1: Example of rubric health variable execution evaluation.

One challenge for novice programmers is understanding how to use variables. At a very basic level, using variables to count values such as health and score provide feedback to players about the game. However, we found that many kids started using variables in more sophisticated ways, for instance using score and health to trigger events in the game. One student, Genevieve, created a game *Kitty Catch!* where player had to catch zombie kitty-heads descending from the sky in a basket (see Figure 1). Over time she developed ways to use increasing score values to trigger more advanced levels where the zombie kitty-heads fell faster and faster. She also showed the player their “lives” in a tangible way, changing the image for lives as the player lost one after the other (see the hearts in upper right of Figure 1). While this may seem simple, it was a non-trivial task for a novice.

The ability to manipulate variables to trigger events or state changes in the game became evident in many different forms across kids’ projects after outlining the requirement in the rubric. The full poster includes specific examples of Scratch code that relate to programming triumphs accomplished by students during the camp as they worked to satisfy, improve on, and often go above and beyond each requirement for their games.

![Figure 1: Kitty Catch! Score in upper left, animated “Lives” bar in upper right.](image)

**Implications and Next Steps**

This poster shares the early stages of a project to develop and analyze student-created video games not only on a rich qualitative level but also at a computational-analytical level. One goal is to use this rubric to develop analytical measures that can track a larger group of students (75 over three camps) at more frequent time intervals (every 2-3 minutes) to see exactly when students introduce concepts such as variables and in what ways. In the full poster we compare our analytical results to our qualitative measures that better capture the aesthetics, play, and nuanced decisions of game-making. We are trying to apply this not only to games but to a variety of programs in Scratch including stories and music videos. Developing ways to authentically evaluate students’ programming alongside game design could be productive for educators and researchers in other fields as well.

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The Fate of the World is in Your Hands: Exploring The Educational Impact of a Climate Change Game

David Waddington, Concordia University
Thomas Fennewald, Concordia University

Abstract: In this poster we present findings from two studies that evaluate player learning from and perception of Fate of the World (Red Redemption, 2011), a comprehensive climate change simulation game in which players assume the role of an autocratic world leader charged with selecting political policies and maintaining global political, ecological, and economic stability during the 21st and 22nd centuries. In our first study we interviewed participants (n=6) about their experiences during game play, and recorded gameplay decisions through saved games. In our second study, participants (n=33, experimental n=18, control n=15) completed an extensive survey with standardized batteries as well as specialized questions we designed to investigate how the game might have impacted learning and opinions about specific political policies related to climate change mitigation. Participants were also interviewed.

Introduction

Simulations have been use in classrooms far longer than digital tools have been available. For John Dewey (1900/1990), detailed social simulations (e.g. colonies, mines, farms) were one of the key tools which he used to implement education through occupations, which was a system intended to help children develop an understanding of the complex sociotechnical systems which comprised their society. However, Dewey’s classroom simulations were only a qualified success, as teachers found them to be labor-intensive and difficult to replicate. Yet today, Dewey’s vision is much more viable, as computer simulations offer an easier, more efficient way to help citizens develop understandings of key socioscientific challenges.

One of the most urgent areas where this kind of comprehensive socioscientific understanding needs to be developed is climate change, and the recent development of an award-winning climate change simulation, Fate of the World (henceforth abbreviated FOTW), provides for an exciting educational opportunity. In the pilot study that we describe below, we began to examine the question of whether playing FOTW could help participants develop a Deweyan appreciation of the complexity and seriousness of the climate change challenge.

The Game

In FOTW, the central conceit is that the player has been appointed as the head of a new worldwide agency with quasi-dictatorial powers to enact sweeping political, environmental, and economic policies. Most of the game’s scenarios involve trying to slow climate change against a background of resource scarcity, environmental destruction, and economic instability.

One of the aspects of FOTW that makes it particularly worthy of study is how complex and difficult a simulation it is. Resource shortages and adverse climatic events, along with the economic and political consequences linked to them, make the simulation challenging for the player to manage, and simplistic solutions are seldom rewarded. For example, if a player decides to ban coal in a particular region without having transitioned the region’s economy away from the use of coal, he/she will trigger a severe economic contraction in that region, unleashing political unrest and causing a sharp dip in the tax revenue necessary to pay for implementing new policies.

In order to succeed in the game, it is necessary to monitor a number of variables within the game’s underlying model. Above all, players need to monitor CO₂ emission levels, which are by far the most important outcome in the game, but they must also keep a careful watch on political stability, economic growth, deforestation, population growth, education levels, energy stockpiles, and energy generation mechanisms. FOTW is not a forgiving game, and failure to understand the game’s model, which is constantly accessible to the player via a “stat telemetry” screen, is invariably punished by an inexorable simulated global disaster.

Methods

In the first study, we recruited six adult participants with some prior turn-based strategy game experience to play two scenarios of the game. After receiving a one-hour training session, participants were given one month to successfully complete two game scenarios. The amount of time participants played the scenarios ranged between 10 and 32 hours. No participant successfully completed either of the game scenarios on the first try, but all of the
participants eventually successfully completed at least one of the scenarios. After participants had completed their gameplay, 1 and 1.5 hour long semi-structured interviews were conducted. We are currently analyzing a second study in which we explore prior knowledge and changes in player attitudes towards environmental problems more closely.

Results & Discussion

The first study revealed a number of themes. Perhaps most saliently, many of the participants indicated (and this was backed up by the saved games data) that they began to develop the kind of systemic understanding of social problems that so interested Dewey. P2 offered the following remark: “And it did affect my perceptions... it’s just a simplified version of what’s really going on... So I think I would maybe retreat from some of my stances on policy.”

Most of the players developed a robust understanding of the game’s underlying model and made interesting connections to reality. Yet, this understanding did not always take place in the way in which we anticipated: some of the participants understood the game’s model, but were also highly skeptical of it.

Still, this understanding did not always take place in the way in which we anticipated: some of the participants understood the game’s model, but were also highly skeptical about the correspondence between the game and reality. P3 commented that the game was “preachy” and noted that he “made no emotional connection with the game. It was a number of systems and that was it.” Although P3 noted that he learned about a number of factors that might trigger an increase in global temperatures, he was skeptical about the correspondence between the game and reality. P6, meanwhile, found the game to be unduly depressing and actually hacked it so as to reduce all of the policy costs to zero. She commented:

Almost no matter what I did, the world blew up or war broke out or mass famine... I don’t really see the world that way. I see the world more positively, more optimistically, and I think we need to promote that also because the more positive and optimistic a person feels, the more likely they are to do more positive actions.

Clearly, a major obstacle to realizing the game’s educational mission is participants’ unwillingness to (a) enter the game’s interpretive frame and (b) accept the accuracy of the game’s representation of climate change and global economics the social problem it simulates. The second study, currently under way, offers a closer examination of possible links between participants’ prior beliefs and their responses to the game and also examines the effect of the game on players’ attitudes toward environmental and social policies (e.g., coal bans, one-child policies). Participants are taking a survey examining perceptual and attitude shifts. It is anticipated that playing Fate of the World will increase players’ level of understanding of climate change, increase their concern about the problem and make them more favorable towards aggressive policies to combat climate change.

References


Keeping it Old School: Classic Video Games as Inspiration for Modern Student Programs

David Weintrop, Northwestern University
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Abstract: The rise in low-threshold, media-rich introductory programming tools has made it possible for video game design and creation to be an early activity for novice programmers. With this creative flexibility, it is possible for learners to draw inspiration from and recreate their favorite games. Our analysis of 82 programs written as part of a high school programming class found that, despite the popularity, diversity, and ubiquity of modern mobile and console video games, learners more often draw inspiration from classic video game titles than from today’s most popular games.

Introductory computer science classes are increasingly turning to programming environments that make it easy for learners to author multimedia programs that incorporate audio and visual components alongside basic programming instructions. Tools like Scratch, AgentSheets, and Microworlds Logo, make it easy for novice programmers to upload images, draw backgrounds, and include sound effects as part of creating a program to give it a desired look and feel. Using tools like these, introductory programming courses are increasingly including open-ended assignments that give learners the freedom to author video games and interactive stories of their own design as part of the curricula. This approach has been found to be an effective way to engage learners with the practice of programming early in their budding computer science careers (Maloney et al. 2008; Peppler & Kafai, 2007).

The rise of multimedia introductory programming tools coincides with a growth in popularity of video games. Where video games were once largely an activity for adolescent boys, they are now being played across age, gender, racial, and socio-economic groups (Lenhart et al., 2008). Given the increasing popularity of video games, one would expect that when given the chance to author their own video games, high school students would draw inspiration from the most popular current titles. In this paper, we report on a study that finds the opposite. When given the opportunity to create a video game as part of an introductory programming course, students were more likely to draw inspiration from classic video games, games released 20+ years before their first experience with video games, than recreate more contemporary games. An analysis of 82 student-authored games found that when students chose to recreate an existing video game, they were four times more likely to draw inspiration from a game that could be played on an Atari or in an ’80s arcade than on an Xbox or PlayStation.

Methods & Participants

We analyzed the final projects of students participating in a study comparing blocks-based, text-based, and hybrid blocks/text programming tools. The data was collected during the first five weeks of a yearlong programming course. Students used modified versions of the Snap! programming environment (Harvey & Mönig, 2010) as an introduction to basic programming concepts including variables, conditional logic, looping logic, and custom procedures. The five-week graphical introduction to programming culminated with a weeklong project that allowed students to design their own games or interactive stories, with the only requirement being the need to incorporate the topics covered during the previous four weeks.

A total of 90 students (67 Male, 23 Female) participated in the study. The classes were 43% Hispanic, 29% White, 10% Asian, 6% African American, and 10% Multi-racial—a breakdown comparable to the larger student body. The classes included one student in eighth grade, three high school freshman, 43 sophomores, 18 juniors, and 25 high school seniors. Due to issues with data collection, we were only able to analyze 82 of the 90 final projects.

Findings

Each final project was coded as either a re-creation of a classic video game, a re-creation of a contemporary video game, an original video game, or not a video game (which included interactive stories and trivia games). Games were coded as being re-creations of existing games if they shared a title with the game or if students uploaded images from that game along with implementing similar game play mechanics. Table 1 presents the result of this coding.
Project Type | Count | Classic Game | Count | Modern Game | Count
---|---|---|---|---|---
Classic Game | 20 | Space Invaders | 6 | Flappy Bird | 3
Contemporary Game | 5 | Pong | 4 | Plants vs. Zombies | 1
Original Game | 40 | Frogger | 3 | Dance Dance Revolution | 1
Non-Game | 17 | Pac-man | 2 | | |

Table 1. Final project classification.

Table 2. Classic games breakdown

Table 3. Contemporary games breakdown

Tables 2 and 3 show the breakdown of games that were re-creations of either classic or contemporary games. Of the 82 student projects analyzed, 20 projects were re-creations of classic video games while only 5 games drew inspiration from games released in the last 15 years. The 20 classic games projects covered nine different titles, while the five modern re-creations drew inspiration from three different games, two of which are mobile games and a third that is an arcade game. No student recreated a modern console game. There are a number of possible explanations for the higher frequency of classic games relative to more recent titles, including the simplicity of the game mechanics of classic games being easier to recreate, the graphics of newer games being harder to incorporate, or simply a preference for creating and playing classic games. Initially, we were inclined to think the first explanation most likely; that classic games like *Space Invaders* and *Frogger* are easier to implement than contemporary games like *Halo* or *League of Legends*. However, increasingly popular mobile games often utilize simple mechanics that are well suited for such introductory programming tools, with games like *Flappy Bird* and *Subway Surfers* being examples of games that can be easily recreated in Snap!

Regardless of the explanation, the frequency of classic arcade games authored by students who were not yet born when these games were at the height of their popularity suggests that classic video games may have found new life in introductory programming classrooms. With more and more novices learning programming through the creation (or re-creation) of video games using multimedia programming tools, it is possible that the next generation of great video game developers draw as much inspiration from the classics as they do from modern blockbusters.

References


Designing a social skills serious game for individuals with autism

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Abstract: Individuals with autism often have difficulties understanding eye gaze cues. We propose that serious game technology might be especially useful for helping adolescents with autism learn about and develop social skills. To this end, we developed a detective-themed serious game to scaffold learning of social skills for adolescents with autism. The educational goals include learning to use eye gaze information to solve problems in social contexts. Seven adolescents with autism participated in the initial usability testing. Results from the usability testing suggest that this game is feasible and enjoyable for the individuals with autism.

Introduction

Autism is a neurodevelopmental disorder characterized by impairments in social and communicative behaviors. A core symptom for individuals is a deficit in nonverbal communication, such as the use of eye gaze cues. Research suggests that individuals with autism spend less time looking at the eye region of faces than their typically developing peers, from early childhood thru adulthood (Papagiannopoulou et al., 2014; Klin et al., 2002). In addition, children and adolescents with autism have more difficulty using eye gaze direction cues to predict the actions and intentions of others (Ribby et al., 2013). Thus, understanding of eye gaze cues is an important target for social skills interventions.

The current study has designed a serious game to teach sensitivity to eye gaze cues for individuals with autism. While computer-based interventions are increasingly being investigated as potential tools for teaching individuals with autism (Tanaka et al., 2010; Wainer & Ingersol, 2011), very few of these previous computer-based interventions have been designed with the principles of serious games in mind (Whyte, Smyth, & Scherf, 2014). The serious game principles utilized by the current serious game include: a detective-themed storyline, long-term goals (players solve various crimes), increasing levels of difficulty, and rewards for success (successful identification of social cues lead to capturing a criminal, signaling completion of a level). Success in completion of the maze requires interpreting nonverbal social cues, including: pointing, head-turns, and increasingly subtle eye gaze (see Figure 1). The current study completed usability testing of the autism social skills game during early prototype development to examine the feasibility and enjoyment of a narrative-driven serious game for individuals with autism.

Methods

Participants

Seven children and adolescents (ages 9 to 18 years) diagnosed with an autism spectrum disorder (6 male, 1 female) participated in the usability testing. Parents provided written consent and participants provided assent prior to participation.

Procedures

Participants completed the first four levels of the ‘proof of concept’ detective themed game over the course of an hour lab usability session. In this detective-themed game, participants play a detective and are instructed to find...
criminals who have escaped into the tunnel system under the city. To navigate the maze, participants must ask bystanders for clues to prevent running into dead ends. Each maze level ends when the participant successfully catches the criminal. After playing the maze levels, participants completed the revised User Engagement Scale (UES; Wiebe, Lamb, Hardy, & Sharek, 2014), designed for assessing the usability of video games. Participants also answered other usability questions, such as: "were the controls for moving in the game (keys and mouse) difficult to use," and "what changes would you suggest we make?"

Results

Most adolescents with autism had high accuracy in identifying the social cues in the first four levels of the game during usability sessions. Mean scores for each level ranged from 98% (for easier levels) to 87% (for more difficult levels).

The mean total score on the UES was 3.7 out of 5 points. This suggests that the game was enjoyable and had moderately high usability in this early stage of game development. On the open-ended response questions, individuals with autism gave various suggestions. This included suggestions to add cut-scenes that show the criminals run away at the beginning of the maze, adjustments to the rewards at the end of mazes, and the addition of secondary goals that require picking up clues from the ground in the maze.

Conclusions

The current study evaluated the usability of a serious game designed to target sensitivity to eye gaze cues. The usability testing indicated that this game is feasible and enjoyable for the individuals with autism. Importantly, the individuals with autism were able to understand the narrative-driven goals, navigate the immersive environment, and utilize social cues for navigation of the mazes. Usability testing has led to changes and improvements in the design of the game. Future research will evaluate generalization of learning from the game to real-world social skills for adolescents with autism.

References


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What Lactose Intolerance, Peristalsis, and Chicken Nuggets Have in Common: Using Card Sorting to Inform the Content of a Digital Game

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Abstract: Down With Food is a tablet game designed to teach upper-elementary school children about systems thinking within the context of human digestion. Prior research has guided the implementation of the game’s mechanics and its interactive narrative that improves the game’s functionality and user’s experience. The goal of the present research was to optimize players’ motivation to engage with the game’s educational content. To do so we adapted a simple method of gauging users’ interests known as card sorting. Preliminary analyses show that the most popular topics were either personally relevant to children’s lives or were situationally-framed problems that drew on new knowledge. Future directions of our research along with limitations of card sorting in educational game design are discussed.

Introduction

Down With Food is a game designed to teach children ages 7 to 9 about the human digestive system. In the e-book layer, the game’s main character, Zyme, takes users through a virtual tour of the various digestive organs. Each organ is associated with a mini-game to teach players about that organ’s role during digestion by utilizing systems thinking—the ability to understand cause and effect. For example, the stomach game requires players to think about cause and effect as a system that can be nonlinear. Players must activate enzymes that digest food in the stomach by increasing the stomach’s acidity, but the increased acidity also damages the stomach’s inner lining, and so they must protect the stomach with a layer of mucous. To complete the mini-game, players must understand that increasing acidity may have multiple effects on the body and thus need to balance food digestion with the levels of acidity and the mucous barrier.

An important component of the research-based design of this educational game was to facilitate an intrinsic motivation to learn. Our research was guided by the expectancy-value framework (Wigfield & Eccles, 2000), which posits that students are motivated to learn if they expect that their efforts will lead to success and if they value the activity. Here we used card sorting to understand what digestive topics children may already know, what they are not interested in discovering, what they are most interested in discovering, and why they were interested in such topics.

Method

Rooted in cognitive psychology, card sorting is a user-experience development method used frequently by website designers. Researchers ask participants to sort cards that represent different topics into predefined groups and then the participants are asked about their reasoning for their sorting choices. Card sorting has shown to be especially useful when designing games for children because their knowledge and mental schemas differ considerably from those of adults (Joly, Pemberton, & Griffiths, 2009). Here we used this card sorting to understand children’s interests in biological processes so that the content of the game could be aligned with their curiosity.

We gave groups of eight- and nine-year-olds (n=7) a deck of 30 cards with questions related to the digestive system such as, “What is peristalsis?” and, “What would happen if you swallowed your chewing gum?” They individually sorted each question into one of three piles: 1) I Want to Find Out; 2) I Do Not Want to Find Out; or 3) The Question Doesn’t Make Sense to Me. We then asked why they were interested in the questions placed in the “I Want To Find Out” pile. For instance, their justifications could stem from interest in a new word (e.g., “I have never heard of that word before and it sounds interesting!”), relevance to their lives (e.g., “My sister isn’t able to eat ice cream and I want to learn why that is”), or prior exposure to a situation (e.g., “Sometimes, you just have a certain thought like, ‘I want to eat chicken nuggets.‘ I want to know why you suddenly want to eat that certain food!”). Similarly, we also asked participants for their reasons for placing cards into the “I Do Not Want To Find Out” pile. Questions placed in the third pile were clarified by researchers, after which the participant was able to sort it into one of the other piles.
Following the individual sorting task, each participant chose the top three questions from their “I Want to Find Out” pile. The group of participants was then asked to come together and to combine their top-three questions. They were then asked to discuss which three of the top-three questions that were overall most interesting. Researchers concluded the session by providing answers to the overall chosen questions. Card sorting sessions were videotaped and conversations were transcribed and analyzed.

Preliminary Results

Although data collection is still in progress, patterns have emerged from our early participants. We found that participants had various reasons for sorting cards into the “I Don’t Want to Find Out” pile. For example, one subject thought that the topics were “too gross,” and others already knew answers to the questions. They made use of prior knowledge and formed connections to what may have seemed familiar to them. One participant who placed “What happens when we choke?” in the “I Don’t Want to Find Out” pile reasoned, “I think, the food, when you swallow it, it goes down the esophagus. So it might go to another place inside your body and then you choke.”

We found that questions pre-designated by researchers as “fun fact” questions were most likely to be sorted into the “I Want to Find Out” pile (e.g., “How long can you go without eating or drinking?” and “What would happen if you swallowed your chewing gum?”). This revealed how important framing is to appeal, since these questions were framed in a way that made digestion topics situationally interesting. Participants were also intrigued by words they were unfamiliar with, such as the digestive term “peristalsis.” Other participants were also interested in learning about topics they had a personal connection or prior exposure to (e.g., “My sister is lactose intolerant; I want to know why”).

Discussion

We found card sorting to be effective in our game design and would recommend other designers and researchers to consider adapting the method for their needs. The method is robust, allowing researchers to ask pointed questions that reveal why participants are interested or not interested in certain topics. Our extension of card sorting, asking participants to collaborate in a group, gave us a better understanding of children’s interests as a whole, which is especially important for participants of this age group. For example, after hearing the answer to one of the final cards they chose, participants in one group applied their understanding to themselves, actively and enthusiastically discussing how long each one of them could go without eating or drinking anything.

As patterns in card sorting results become more pronounced, we will incorporate participants’ responses into the content of the game by including these facts into the narrative or the e-book and framing them in ways that will optimize their appeal. Data collection is still ongoing and we are looking forward to seeing if the observed themes continue to hold across a greater number, and more diverse pool, of participants.

References


Project NEO: Assessing preservice teacher science content knowledge with a video game

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Abstract: The need for STEM majors for our future workforce is growing, yet fewer students are choosing to major in STEM areas, and many are underprepared, in part because elementary school preservice teachers (PSTs) are also underprepared. This NSF-supported project developed and tested the first of several planned modules of a video game based on the Next Generation Science Standards. Results suggest that PSTs who play the video game demonstrate improved science content knowledge. The study also found that PSTs had positive attitudes toward video games as instructional tools. Science content progression and PST education relating to games and science education are discussed.

Introduction

The number of science, technology, education, and mathematics (STEM) majors needed to meet the expected needs of our future workforce will grow, yet fewer students are choosing to major in STEM areas, and those who do may be underprepared (Broussard, S.R., et al., 2007; Langdon, D., et al., 2011). This has led many to suggest that middle school students should be targeted for improving STEM competency and career interest, yet evidence suggests that their teachers are themselves underprepared (Darling-Hammond, L., 2000; Llewellyn, D., 2002). Further, middle school students can only benefit if they have the foundational STEM knowledge from their elementary school years, which is often not the case (Ball, D. L., et al., 2005; Wu, H., 1999). Unlike middle school and high school science teachers, who must meet credentialing requirements to ensure competency in their disciplines, elementary teachers teach all subjects and are not credentialed in any subject. Therefore, interventions planned for the middle school level must be preceded by interventions for elementary teachers (Hill, H., et al. 2005), and they must begin during preservice teacher (PST) education, before teaching habits and philosophies are formed.

Project NEO

The goals of Project NEO were to see if a game built around the next generation science standards (NGSS Lead States, 2013) could A) improve PSTs’ attitudes toward science; B) improve science competency for PSTs; C) improve PSTs’ attitudes toward games in the classroom, and D) improve PSTs’ attitudes toward teaching science. This phase I project, funded by the NSF, designed, developed, and tested a game based on the NGSS to help elementary PSTs learn some of the more challenging content they and their future students will face.

The Project NEO Phase I prototype narrative finds our heroine, Talia, being recruited by a league of scientists to help protect Earth from sudden climate changes created by the villain in order to wipe out certain kinds of plant life. In the process of conducting her tests, Talia (the player) uncovers patterns related to latitude and longitude and to day and night hours that lead to a deeper conceptual understanding of the Earth and its orbit around the sun. Future modules developed in Phase II will expand on this narrative and focus on concepts like angle of inclination, axial tilt, rotation, and the interrelation of these factors as they impact geology, climate, flora, and fauna on the Earth.

Tasks are combined in a full-scale inquiry-based learning game that helps the learner solve a bigger science challenge on the interrelation of day–night, latitude–longitude, axial tilt, rotation of the Earth, and the effects on Earth’s flora and fauna and society. A mega-level narrative about a villain attempting to cause catastrophes on Earth in a variety of ways, culminating in the destruction of the Earth by an asteroid (near Earth object, or NEO) that integrates all of the science is introduced at the beginning of the unit and drives all science inquiry and learning across the full game.

Method

A mixed model within-subject pretest–posttest and repeated measurement design was used to test the impact of classroom instruction and game play on science content knowledge and attitudes. PSTs science content knowledge was measured prior to classroom instruction (pretest), again at the end of classroom instruction and before
the video game intervention (intermediate), and again at the end of the video game (posttest). Analyses examined within-subject change scores on science content measures from pretest to intermediate (effect of instruction), and from intermediate to posttest (effect of game on attitudes) and pretest to posttest on science content knowledge (long-term recall).

Sample

Twenty-four PST education majors at an Upper Midwest university were invited to participate out of a pool of 400 total PSTs. These students were enrolled in an Earth and Space science class for educators, which covered science material related to the Earth’s layers, rocks and the rock cycle, plate tectonics, weather, energy use, astronomy, planets, and the solar system. Of those, 22 (92%) students agreed to allow their coursework to be used for research purposes; all students participated in the game. Of the 22 who signed consent forms, 19 played the game, 17 completed the game in its entirety, and 14 also completed the posttest, yielding a usable data set of 64% of those who consented, which was 58% of the total class. There was one male and thirteen females with an average age of 21. All but one were White, with one non-identified, and all were elementary education majors.

Results

H1: PSTs will demonstrate more positive attitudes toward science after playing the game (intermediate–posttest).

Descriptive statistics and paired T-tests were run to examine this. Attitudes did not go up, which is not surprising given the short-term duration of the intervention. Scores on science inquiry went down by 0.40, however, which is surprising (t (12) = 3.128, p = 0.009).

H2: PSTs will demonstrate better conceptual science understanding after playing the game (pretest–intermediate; intermediate–posttest; pretest–posttest).

Eight science conceptual understanding questions were asked. Scores on Items 1–6 increased from preinstruction (3.46) to postinstruction (4.53) and postgame (4.69). Scores on Items 7–8 increased from preinstruction (2.38) to postinstruction (5.30), but decreased at postgame (4.76). Gains were generally distributed across all items. Paired t-tests showed that changes in all item scores were statistically significant from pre- to postinstruction. Scores on the same tests (totals of Items 1–6 and 7–8) after the game were also higher, although the differences were not statistically significant, with the exception of Items 2 and 7; Items 6 and 8 actually decreased.

Item 2 focuses on the conceptual understanding of the path of the sun and was directly tied to the animations of the sun in different cities within the game. Item 7 is an open-ended question focused on the relationship of day–night hours and latitude and longitude designed to assess conceptual understanding rather than factual knowledge.

Item 6 focuses on how long it takes the Earth to turn on its axis, and Item 8 assesses the strength of the learner’s mental model of how and why seasons occur in the first place. Because of modifications to the game during the design process, in which planned content had to be reallocated across future games in order to manage learner cognitive, neither of these concepts was directly represented or tested during gameplay. The NGSS and classroom activities are currently being aligned with the game. This work is subsection in which Hypothesizes C and D were also evaluated, but not here.

References


Abstract: This study examines the learning and gaming behaviors of two English-as-a-Second-Language learners who played a massively multiplayer online game. Using data culled from participant observation, interviews, and questionnaires, I describe how the students' gaming strategies and their second language skills interact to afford distinct language learning opportunities for the two students.

Introduction
Massively Multiplayer Online Role-Playing Games (MMORPGs) have recently been hailed for their potentials for second language (L2) learning. Researchers have proposed that these gaming spaces offer opportunities for the development of language and literacy skills as learner-players collaborate in gameplay and develop interpersonal relationships (Rama, Black, van Es, & Warschauer, 2012; Thorne, 2008; Zheng, Newgarden, & Young, 2012). It has also been reported that participation in MMORPGs promotes learner's willingness to communicate and encourages language experimentation (Reinders & Wattana, 2011). Despite the surge of interest in the use of MMORPGs for L2 learning, there has been limited research on individual variations of L2 learner-players, who have diverse backgrounds in gaming expertise, preferences, and second language abilities. When MMORPGs are used in L2 learning and teaching, they may offer distinct learning opportunities to different learner-players. This study examines the individual variations of L2 learning in a MMORPG.

Individual Variations in Game Play
MMORPGs have been observed to attract players with different gaming styles and play motivations (Bartle, 1996; Yee, 2007). Players with different motivations may demonstrate different gaming and languaging behaviors. For example, a player who is mainly motivated to socialize with other players may be found to be engaged heavily in interpersonal interactions; a player who is mainly motivated by in-game accomplishments may be found to concentrate on questing and information seeking; a player who is mainly appealed by the immersion experience of MMORPGs may be found to enjoy role-playing and storytelling. The individual variations in player motivations and gaming preferences imply that MMORPGs afford different languaging opportunities for different L2 learner-players.

Gaming expertise and L2 proficiency also added to the complexity of L2 learning in MMOPRGs (Rama et al., 2012). Because the game community values expertise, L2 learners who are experienced players may benefit from gaming and the MMORPG community more than L2 learners who are novice players. The case studies by Rama et al. (2012) illustrates that L2 learners with gaming expertise are able to gain access to a variety of player communities which afford rich L2 languaging opportunities. Novice players, on the other hand, are likely to struggle with the mechanics of the game and have limited interactions with other players.

When taking into consideration gaming styles, gaming expertise, and L2 abilities, L2 learner-players are likely to take distinct learning and gaming trajectories in MMOPRGs. This study shifts the focus of analysis from the affordances of the game environment itself to the interaction between the environment and the active learner-player.

Methods
This research project involved eight English-as-a-Second-Language (ESL) learners who played Guild Wars 2 (ArenaNet, 2012) in an afterschool English gaming club and at home for eight weeks. To examine the distinct experience of individual learner-players, I focus on two participants: Lynn, who is an advanced ESL learner, and Troy, an intermediated ESL learner. These two participants form a nice contrast because of their differences in English abilities and gaming backgrounds. Following the convention of case study research, data of this study came from several sources, including a questionnaire about game-mediated languaging behaviors, interviews, observations, and the participants' gaming journals. To analyze how the two learners engaged with game-related texts in English, I first examined the participants' responses to the questionnaire and then conducted a thematic analysis of the interview transcripts and their gaming journals.

Results
The responses of the focal participants are presented below in Figure 1. Apparently, Lynn mainly interacted with
texts embedded within the game (embedded game discourses), such as quests, conversations between NPCs, and descriptions of items and skills. She did not have much interaction with other players (emergent game discourses), even less with the player community (attendant game discourses). In contrast, Troy had a more balanced interaction with various types of game texts. He not only read texts embedded within the game (embedded game discourses), but also actively interacted with other players in the game world (emergent game discourses) and engaged with texts created by the player community (attendant game discourses).

![Lynn and Troy's engagement with texts within and around Guild Wars 2.](image)

**Discussions**

Thematic analysis of the interview transcripts and the participants’ gaming journals reveals four reasons that may attribute to the distinct L2 language patterns of the two learner-players: previous gaming experience, social norms of the player community, in-game levels, L2 learner status.

**Previous gaming experience**

Before the project, Lynn, the advanced ESL learner, had not played any video game in English. Although she had played MMORPGs, she played with her Chinese speaking friends. When she played GW2, she had difficulties with embedded and attendant game discourses due to her lack of game-specific vocabulary. She also had no interaction with other players in the game world except with the other participants of the study, whom she knew in real life. In contrast, Troy, the intermediate ESL learner, had not played MMOPRGs before but he had played several games in English, including multiplayer strategy games. When he played GW2, he had little difficulties with the embedded and attendant game discourses. He also actively reached out to other players in the game world.

**Social norms of the player community**

Both participants found it hard to join the pre-established groups of players, both in the game world and in the online player communities. This limited their interaction with other players.

**In-game levels**

Congruent with the findings of Rama et al. (2012), higher level players have more languaging opportunities than lower level players, mainly through expert-novice interaction. Within the group of participants of this study, for example, Lynn gained a relatively higher level than the other participants. During the cause of the project, she gave a presentation to the other participants where she used a lot of game-specific language to explain the rules and strategies of a game task.

**L2 learner status**

Being L2 learners, the participants often made deliberate effort to engage in language learning and language use during gameplay, even when it’s not useful for gameplay. But at the same time, they also experienced anxiety when interacting with perceived native speaking players.

**Conclusions**

The findings presented in this poster are useful in advancing research of L2 learning in MMORPGs. The more we know about how individual factors affect the gameplay experience and learning process, the better we will be at effectively integrating video games into learning environments.
References


Acknowledgements

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A Day in the Life of Winslow Homer: An Interactive Tour of Primate Behavioral Ecology

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URL: WinslowHomerDay.net

Abstract: A Day in the Life of Winslow Homer is a map-based web application, where players can see real data, pictures, and descriptions of a group of wild capuchin monkeys collected by field primatologists. We aim to develop the app into a helpful educational resource about primate behavior and evolutionary ecology.

Learning Objectives

A Day in the Life of Winslow Homer (abbreviated as Winslow Homer Day) is a web application which teaches players about wild primate behavior, shows the selective environmental pressures that drive the evolution of primate intelligence, and gives players insight into the scientific study of primate behavior. We aim to provide an engaging interface to allow users to explore real, detailed observational data collected by the Lomas Barbudal Monkey Project.

Design

Players can follow a day in the life of Winslow Homer (Figure 1), a real, wild baby capuchin monkey. Winslow Homer Day aims to teach players about primates by telling a story about his life and giving players a character they can relate to.

Figure 1: Winslow Homer, on the left, is groomed by his aunt Dante.

Winslow Homer’s GPS track is plotted on an interactive map for players to follow along (Figure 2). Players can click on colorful icons to see real observational data in the categories: Food, Friendly, Infant, Grooming, Play, Sex, Submission and Fear, Aggression, Coalitions, Vocalizations, and Miscellaneous (Figure 3). Players can also see pictures of the monkeys, and read informational snippets about capuchin behavior and its evolutionary context.

Figure 2: Map interface with GPS track, behavior icons, pictures, and text boxes.
About the Lomas Barbudal Monkey Project

Followed by researchers for over 25 years, the capuchins of the Lomas Barbudal Monkey Project have become one of the most widely studied wild monkey populations in the world. Researchers collect rich observational data using a system of codes for statistical analysis, along with demographic data, non-invasive hormone and genetic samples, and audio and video recordings.

Long-term field studies of primates give us important insight into primate conservation, ecology, evolution, and human origins. The project has focused its research most intensively on social dynamics, communication, social traditions, development, life history strategies, and educational outreach.

Usability Challenges and Future Work

The map is saturated with a glut of data about Winslow Homer, but casual usability tests show that players have a difficult time accessing and navigating through all of the information; some test subjects report being overwhelmed.

To smooth out this problem, we are working on ways to give players a clearer overview of Winslow Homer’s life at the very beginning. We plan to implement an easier way to take a “tour” through the map, such that a player can click a “next” button or use a slider-bar widget to move through the information. This new, more directed, navigation mechanism should also help us improve our storytelling.

We are working on designs for a feature that would allow players to quickly drill down to see information about specific topics they are interested in, maybe using a free text search or an organized list of tags.

Initially developed for larger screen sizes, we are working to improve the experience of Winslow Homer Day on mobile devices to broaden our potential audience. We’ve started developing a responsive design that adapts to smaller screen sizes, and we continue to make performance improvements on lower-powered devices.

Once the project has matured, we would like to translate Winslow Homer Day into Spanish to make it accessible to a wider audience, including people in Winslow Homer’s home country of Costa Rica.