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Design Curricula Study: Hands-On Design and the Distributed Studio

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Design Curricula Study:

Hands-On Design & the Distributed Studio

Preston K. Covey

July 21, 1987

Preface to the Ballay Interim Report
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The following material constitutes an interim report by Joe Ballay on a summer project that I commissioned.

Included are an outline of the position paper to result from the project (on strategies for introducing design as a theme, skill set, and salient component of a liberal arts or core curriculum) and appendix material.

Joe Ballay had approached me with the proposal to investigate and design software that would support design studio conditions on our distributed computer network.

The notion of, in effect, a distributed studio fit nicely with three other important Core and computing ambitions:

1. The development of design curricula for the Core, the first effort being the Pattern & Design course introduced by Achenbaum fall '86, the larger effort signaled by the January '86 Design Symposium.

2. The emphasis we wish to place on strategies for introducing hands-on learning, inquiry, and problem-solving in Core curricula, on materials, data, problems, tools and operations the students can engage and wrestle with directly -- as opposed to the typical hot-air lecture and passive restraint system of that afflicts large general education courses.

3. The imaginative exploitation of our distributed computing environment for specifically and innovative educational ends (over and above the obvious academic communication utilities).

3.a. In particular, Ballay's distributed-studio function is analogous to the Comment program being developed under the WARRANT Project as part of the Writing Across the Curriculum effort--with analogous logistical issues and educational goals. (See Kaufer's chapter for the Role of Design... volume, "Designing for the Community").

3.b. More generally, it is cognate with the interpersonal computing concept advanced at the recent two-day ITC seminar, a key to the significance of the new distributed computing environment.
In light of these important connections, the project I negotiated with Joe Baiay was to pursue the distributed studio concept explicitly within (connecting with and building upon) this framework of allied enterprises: to do a feasibility study and option plan for introducing *hands-on* design experience into curricula for a general education audience (not just the professional design students), exploring and exploiting these connections.

We met regularly to discuss and refine the shape of Joe's study and planning. Joe began with a debriefing of the faculty who taught the Pattern & Design course last fall '86. He is expanding the interview set to include other CMU faculty from across the colleges with insights and representative views on how design issues from multi-disciplinary domains could be incorporated into Core curricula. The initial interviews were taped and transcribed and will be digested and reflected in the position paper and final report for this project. This interim report contains Joe's summaries of the interviews.

**Interim Report Contents**

*Outline of Final Paper: Hands-On Design & the Distributed Studio*

*Interview Summaries* (Steinberg, Akin, Bernstein, Midani, Newell, Wright, Fenves, Morgan, Simon, H. Young)

*The Distributed Design Studio (DDS) Concept*

*The ModiForm Program: One Prototype for DDS*
INTRODUCTION AND SUMMARY

• Brief description of project
• Thanks and credit
• Summary conclusions
• Summary recommendations

I. DESIGN IN THE UNIVERSITY CORE

A. A Core in the Liberal-Professional environment
   • Liberal-Professional is not an exclusive disjunction but an
     expression or description of a complex synergy.
     • Hence the core should not be seen as torn between liberal or
       professional goals. Rather it is an expression or manifestation of that
       synergy, and design becomes a process in which this synergy can be
       encountered.

B. A collection of goal statements from various interviews.

C. Design as a viewpoint in the core.
   • Productivity as an implication of design
   • Productivity as an implicit goal of CMU

   • “The undesigned object is not worth having”? Tor F?
   • The question of how far do you go in designing the manmade world
     Hence - a concern for values

   • “We are all amateurs at most of the problems we encounter”.
   • The creation of specialized domains and experts with expertise.
     Hence - a concern for methods

   • Design as an appropriate but insufficient view
   • Parallels to proposals by Preston Covey.

D. Contributions of a hands-on design course
   • The alternative to a course about design
   • Balancing the analytical emphasis at CMU
   • Hands-on as an epistemological necessity in design
E. Problems of a hands-on course. (to be answered in further sections)
- Decisions of saturation and scope of delivery
- A system of delivery and course management
- Getting the right faculty
- A sense of relevance among the faculty
- A sense of relevance among the students

II. A HANDS-ON DESIGN CORE COURSE (HOD)

A. Some initial assumptions (derived from the previous section)
- There is a university core of some form
- There is a design viewpoint among others.
- There is a hands-on component of design.

B. How to do hands-on, some lessons from "Pattern and Design" (nuggets)
- Paradigmatic design problem areas (across many domains)
- Design problems that are in the student consciousness.
- How many problem areas/units in a semester (four)
- The right kind of faculty
- Faculty relationships and the course coordinator.
- The tendency to slip into analysis mode exclusively.

C. Two plausible models for selecting and organizing a representative sample of design problems and issues.
- The Domain Model
  - Leaders from the synthesis side, the analysis side provides context
  - Four domains
    - Verbal - designing the written (spoken?) word
    - Visual - there is a visual language too
    - Physical - the world of engineered and built objects
    - Procedural - computer programs are objects too
- The Hierarchical Model
  - The hierarchy has a nested circularity (recursiveness) to it
  - Four levels of hierarchy
    - Particle - the part as seen in the pattern of its context
    - Assembly - two or parts establish a relationship
    - Aggregate - many parts reveal other relationships
    - Context - especially the social context

- Is a Hierarchical/Domain model feasible and desirable?
  Probably it can't be avoided. It will be an empirical decision based on the exemplars that are used.
D. some pervasive issues (will fit in many places, in any model) (nuggets)
These are to be discovered as a part of the epistemology.

• The choice of representations
• Driving forces (needs), especially social forces (values)
• Satisficing; optimization locally if at all (methods)
• Diversity of solutions
• Aesthetics
• Professional arrogance

E. The Problem of Delivery
• Difficulties inherent to the hands-on environment
• Programs to simulate the environment (not programs as objects)

F. Appendix
• Summaries and transcripts of interviews

III. THE DISTRIBUTED DESIGN STUDIO (DDS)

A. Developments in distributed computing
• Personal computing, which is distributed computing with an additional social dimension.
• The distributed studio as a hands-on creative and critical thinking environment, embedded in a social context so it matters.

B. Qualities of the studio (or lab, or workshop) environment
• Long-term shared place
• Easy access to one-another's work (finished and in-progress)
• Critique as a means of evaluating and directing progress
• Output of the effort are concrete objects (not just descriptions)

C. Emulating these qualities through enhancements to Andrew.
• The "studio" function
• The "tackboard" function
• The "crit" function
• The "mat" function

D. Feasibility of the distributed design studio environment (from ITC)

E. Priorities in realizing the distributed design studio (to ITC)

F. Appendix
• Sketches for DDS interface screens.
IV. INTERFORM

A. A model of courseware for HOD on the DDS
   • Operates in the visual domain
   • Operates at the particle, assembly, or complexity levels

B. About the visual domain (why it's an appropriate domain)
   • Visual pattern processing is common to all sighted people.
   • It involves both analytical and synthetic processes
   • It involves tension between object and description
     R.L. Gregory; The Intelligent Eye, "The Peculiarity of Pictures"

C. An overview of "InterForm" (from existing specifications)

D. InterForm fit to HOD and DDS requirements
   • Hand-eye coordination is removed as an advantage
   • Student work easily produced and managed on DDS

E. Appendix
   • 19 May 1987 draft for InterForm (ModiForm)
   • 14 June 1987 Decisions to date on design concepts for (ModiForm)
   • Some InterForm images to date.
The

Distributed Design Studio

Concept
A description of the Distributed Studio concept

If distributed computing is going to make a significant impact on teaching the core disciplines in the arts, it will have to do so with a teaching method, like the studio method, that is known to be effective and well integrated with the arts. The studio method, while it may exhibit some variation with subject matter and individual teaching style, has several consistent features:

1. A long term involvement between faculty and students in a common place (studio). Three hours is a common block of teaching time; students will return to the studio on their own time to work; and a group of students may use the same studio over a period of several semesters.

2. Students have ready access to one-another's work, both in-progress and completed. Indeed, faculty will often encourage students to look at one-another's work as a means of experiencing creative steps in problem solving.

3. Reliance on faculty and student critique, the crit, as a means of checking and directing the progress of individual students or a whole class. Crits range from informal commentary to formal presentations which are the studio method's equivalent of an exam.

4. The works produced in a studio are, for the most part, concrete objects as compared to abstract or encoded representations of objects (e.g. a poster, not a specification for a poster). Consequently, studio skills include matting, a means for displaying work that allows it to be studied without the confusion of extraneous visual noise.

The goal of the distributed studio concept is to bring to computing a package of capabilities that emulate the qualities of a studio in a distributed system. As I see it, there are four components to the package that correspond roughly to the four qualities of a studio above. These are:

1. Studio - an enhancement of the networking system that allows students and their faculty to have access to one another's work. This sharing has two ways of being initiated - browse: in which a student or faculty can see the range of solutions, and direct: in which the faculty can direct one student to examine the work of one or more other students. Combining both ways yields the equivalent of a crit in which all students are directed to view the class work as a whole. The purpose of studio is to give users the sense of shared place.

2. Tackboard - a function that allows one or many solutions to be viewed in an orderly graphic display. Tackboard will have to include both the capability to pan across several solutions and zoom on a single solution.

3. Crit - allows both faculty and students to attach comments or criticism to any solution. Comments would be readable by all, consistent with the sharing described in studio.

4. Mat - A screen display option (a kind of window) that allows the solution to be viewed with no system information, scrollbars, etc. surrounding the image.
Studio grid is 4x4, represents a studio room with student locations. Students are identified to the right of the squares.

A selected piece, highlighted name to the right.

Selecting "Fit" arranges four pieces "across the Tackboard" by as many as needed vertically.

"A piece of student solution to a graphic design problem."
In the studio, multiple pieces can be selected by a 'drag' or by a chain of clicks.

Selecting "exit" arranges two pieces across the index board.
Studio window is reduced to show selection.

"Cen" window allows instructor to write criticism for each piece.

Students would have access to criticism in the same window.

Selecting "1 Fit" fits one piece in the rackboard.
Choosing "Black" mat turns the screen dark except in the working area of the Tackboard Window.

Zap brings the control graphics back.
Selecting "Center W." m tall turn the entire screen white except the working area of the "tackboard window and center the working area.
"Zap" returns the window to its working location and brings the control graphics back.
Interview Summaries

Erwin Steinberg
Omer Akin
Mel Bernstein
Akram Midani
Alan Newell
Paul Wright
Steve Fenves
Granger Morgan
Herb Simon
Hugh Young
Notes on the interview with Erwin Steinberg 10 Jun 87 J M Ballay

Erwin's interview was taped and will be summarized in detail after it is transcribed. These notes comprise overall impressions of the interview.

- Erwin was well prepared for the interview. He knew what he wanted to say and had handouts from the Pattern and Design course to help explain his point of view (attachments).
- Erwin's view of the Pattern and Design course is tied up, right from the beginning in the title. He interprets *Pattern* as a noun, that which is searched for, the evidence of "design in nature" for example. *Design* is taken to be a verb, the design process, what one does with the patterns one finds. So, he has both the analytic and the synthetic view of design invested in the title.
- Erwin's part of the course focused on pattern in the written word. See attachments.
- The contrast of the analytical with the synthetic view runs through much of his thinking about design. It was a recurring theme in our entire discussion, not just the part having to do with his course. He believes that this contrast of views defines a spectrum of the ways in which design, in its broadest sense, is understood and used by the variety of disciplines represented at Carnegie Mellon. For example, rhetoricians and critics of literature get primarily involved in the finding of patterns. Yes, they also devise rules and heuristics but it is the technical writer who is more concerned with the application of heuristics for clear communication. Even farther toward the synthetic side might be the engineer for whom the patterns are taught rather than discovered, and for whom accomplishment in his field consists primarily in the skillful application of rules based in those learned patterns. It's a simplified view, to be sure, but it's Erwin's pragmatic approach to creating a cross disciplinary course.
- As for a hands-on problem, Erwin would lean toward pattern finding because it can be more easily accomplished by students from a variety of backgrounds and in limited time. Then the finding should be verified by developing a succinct and useful description of the pattern – perhaps in the form of a heuristic or rule to be used in designing, with less emphasis on the design process itself.

Attachments:
- Memo to Andy Achenbaum
- Partial Syllabus
- Faculty schedule for Pattern and Design
- Excerpt on language and culture, Whorf (?)
- Excerpt from *As You Like It*, Shakespeare
- Chart from *Identity, Youth, and Crisis*, E. Erikson
- Excerpt from *The Hero With a Thousand Faces*, J. Campbell
MEMO:

TO: ANDREW ACHENBAUM
FROM: ERWIN STEINBERG
DATE: APRIL 22, 1985

For purposes of this discussion I want to distinguish (arbitrarily) between pattern (i.e., in the sense of configuration rather than template), which I shall use as a noun, and design, which I shall use, generally, as a verb. My thesis for a course would be the avowedly overly simple concept that people in some disciplines search for patterns, and people in other disciplines design solutions for problems.

Thus, again to oversimplify, physicists seek patterns in nature and literary critics seek patterns in works of literature. Engineers design solutions to problems, architects design buildings (also solutions to problems), visual artists design visual designs, poets design poems, etc. (Once these designs have been executed, however, they can be patterns for those who come later.)

In the process of seeking patterns, physicists and literary critics, of course, design methods for searching for those patterns: the physicists design scientific theories and cyclatrons; the literary critics design aesthetic and critical theories and methodologies. And, similarly, in building their designs, engineers, architects, visual artists, and poets are aware of the patterns in the work of those who went before them.

Patterns and designs, then, are two sides of the same coin—or, perhaps, stand in reciprocal relation to one another. (Again, I am using pattern to refer what's already "there" but which must be discovered and design as something which must be made: mankind is a pattern-seeking animal who designs solutions to problems.)

I would see a useful cross-disciplinary course as one which demonstrates, compares, and generalizes from that concept. The course might begin with a section on some piece of research from physics—perhaps on the nature of the electron. What led to someone positing the electron (or some other phenomenon)? How does that search stem from, fit into, fulfill a larger pattern? Was there a theory involved? How did those who sought the electron design a methodology to confirm its existence?
99-102 Pattern and Design

Partial Syllabus

Aug. 28 Introduction

Sept. 2 Sources: Word Play and Roots
Before: Read handout on definitions (passed out at initial session).
Find examples of modern uses of "pattern" and "design" especially in the context of your education and the university.
Don't think them up, find them in texts or utterances by others.
What word senses do you find? What not? Any new senses or variations?

After: None

Sept. 4 Pattern and Design in Programming Systems

After: Examine some of the programming systems you know: languages, packages, interactive systems. Identify in concrete terms the use of patterns and design in them.

Sept. 9 Converting between Pattern and Design
Before: Read articles
Sept. 11  Systematic Ambiguity in Pattern and Design
Before: None
After: Two assignments
1. Find more examples of ambiguity, where the same object, expression or artifact is viewed two ways, one of which is pattern-like and the other design-like.
   Look for examples on radically different fields and ways of life
   Look for examples where it is deliberate and where it is nondeliberate
2. An assignment to cover the section as a whole

Sept. 16  Lecture on "rites of passage" as patterns
Class discussion of contemporary rites of passage
Short Lecture on Ireland in the early 20th century (for the Joyce novel)
Before: None
After: None

Sept. 18  Class discussion of James Joyce's A Portrait of the Artist as a Young Man
Before: Read Joyce's A Portrait of the Artist as a Young Man
Short Lecture on England during the second half of the 19th century (for the Butler novel)
After: None

Sept. 23  Class discussion of first half of Samuel Butler's The Way of All Flesh
Before: Read first half of Butler's The Way of All Flesh
After: None

Sept. 25  Completion of class discussion of The Way of All Flesh as a description of a rite of passage
Before: Read second half of Butler's The Way of All Flesh
After: Comparison of the two novels as:
1. descriptions of rites of passage
2. reflections of the world and times in which the two authors lived
3. reflections of the differences in the ways the two authors saw their worlds
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<th>Date</th>
<th>Topic</th>
<th>Before</th>
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<tr>
<td>Sept. 30</td>
<td>Envisioning a new Republic</td>
<td>Read in <em>The Federalist Papers</em>: Wills, Introduction Papers Numbers 10, 23, 47, 49, 57, 70, 85</td>
<td>None</td>
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<td>Oct. 2</td>
<td>Designing a City that embodies the Constitution</td>
<td>Read Young's Prologue and Chap. 1</td>
<td>None</td>
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<td>Oct. 7</td>
<td>Midsemester reprise</td>
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<td>Oct. 9</td>
<td>Midsemester Exam</td>
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<td>Oct. 14</td>
<td>The Civil War: Patterns that burst from the Constitutional Design</td>
<td>Read Potter's &quot;The Historian's Use of Nationalism&quot;</td>
<td>None</td>
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<td>Oct. 16</td>
<td>A 20th Century Dilemma: The Meaning of Privacy in the Constitution</td>
<td>Read xeroxs of New York Times and Time Magazine</td>
<td>An assignment to cover the section as a whole</td>
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<td>Aug. 28</td>
<td>Introduction—ensemble (everyone)</td>
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<td>Sept. 2, 4, 9, 11</td>
<td>Newell</td>
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<td>Sept. 16, 18, 23, 25</td>
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<td>Sept. 30, Oct. 2</td>
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<td>Oct. 7, 9</td>
<td>Midsemester reprise—Newell/Steinberg</td>
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<td>Achenbaum</td>
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<td>Nov. 25, Dec 2</td>
<td>Midani</td>
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<td>Dec. 4</td>
<td>Finale</td>
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Tuesday and Thursday 12:00 to 1:20  Porter Hall 125C
work, as of The being's awareness of a way differently to put the concept of differences readily experienced as natural, given, the chain of meaning in different languages. 'If words stood for pre-existing concepts, they would all have exact equivalents in meaning from one language to the next; but this is not true' (Saussure 1974, p. 116). The truth is that different languages divide or articulate the world in different ways. Saussure gives a number of examples. For instance, where French has the single word mouton, English differentiates between mutton, which we eat, and sheep, which roams the hills. Jonathan Culler cites the distinction between river and stream in English in contrast to fleuve and rivière in French. In English what distinguishes a river from a stream is size; in French a fleuve flows into the sea, a rivière into another rivière or a fleuve (Culler 1976, p. 24). Some languages divide the spectrum differently from others. In Welsh the colour glas (blue), like the Latin glaucus, includes elements which English would identify as green or grey. The boundaries are placed differently in the two languages and the Welsh equivalent of English grey might be glas or llwyd (brown):

```
   green   | gwyrd
          |
   blue   | glas
          |
   grey   |
          |
   brown  | llwyd
```

(Hjelmslev 1969, p. 53)

In other words, colour terms, like language itself, form a system of differences, readily experienced as natural, given,
All the world's a stage,
And all the men and women merely players;
They have their exits and their entrances,
And one man in his time plays many parts,
His acts being seven ages. At first, the infant,
Mewling and puking in the nurse's arms.
Then the whining schoolboy, with his satchel
And shining morning face, creeping like snail
Unwillingly to school. And then the lover,
Sighing like furnace, with a woeful ballad
Made to his mistress' eyebrow. Then a soldier,
Full of strange oaths and bearded like the pard,
Jealous in honor, sudden and quick in quarrel,
Seeking the bubble reputation
Even in the cannon's mouth. And then the justice,
In fair round belly with good capon lined,
With eyes severe and beard of formal cut,
Full of wise saws and modern instances;
And so he plays his part. The sixth age shifts
Into the lean and slippered pantaloon,
With spectacles on nose and pouch on side;
His youthful hose, well saved, a world too wide
For his shrunk shank, and his big manly voice,
Turning again toward childish treble, pipes
And whistles in his sound. Last scene of all,
That ends this strange eventful history,
Is second childishness and mere oblivion,
Sans teeth, sans eyes, sans taste, sans everything.

Shakespeare, As You Like It, Act II, Scene 7
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THE KEYS

The adventure can be summarized in the following diagram:

The mythological hero, setting forth from his commonday hut or castle, is lured, carried away, or else voluntarily proceeds, to the threshold of adventure. There he encounters a shadow presence that guards the passage. The hero may defeat or conciliate this power and go alive into the kingdom of the dark (brother-battle, dragon-battle; offering, charm), or be slain by the opponent and descend in death (dismemberment, crucifixion). Beyond the threshold, then, the hero journeys through a world of unfamiliar yet strangely intimate forces, some of which severely threaten him (tests), some of which give magical aid (helpers). When he arrives at the nadir of the mythological round, he undergoes a supreme ordeal and gains his reward. The triumph may be represented as the hero's sexual union with the goddess-mother of the world (sacred marriage), his recognition by the father-creator (father atonement), his own disincarnation (apotheosis), or again—if the powers have remained unfriendly to him—his theft of the boon he came to gain (bride-theft, fire-theft); intrinsically it is an expansion of consciousness and therewith of being (illumination, transfiguration, freedom). The final work is that of the return. If the powers have blessed the hero, he now sets forth under their protection (emissary); if not, he flees and is pursued (transformation flight, obstacle flight). At the return threshold the transcendental powers must remain behind; the hero re-emerges from the kingdom of dread (return, resurrection). The boon that he brings restores the world (elixir).
Thomas Hardy
1840-1928

HAP
(1895)

If but some vengeful god would call to me
From up the sky, and laugh: "Thou suffering thing,
Know that thy sorrow is my ecstacy,
That thy love's loss is my hate's profiting!"

Then would I bear it, clench myself, and die,
Steeled by the sense of ire unmerited;
Half-eased in that a Powerfuller than I
Had willed and meted me the tears I shed.

But not so. How arrives it joy lies slain,
And why unblooms the best hope ever sown?
—Crass Casualty obstructs the sun and rain.
And diceing Time for gladness casts a moan . . . .
These purblind Doomsters had as readily strown
Blisses about my pilgrimage as pain.

ROBERT FROST
(1874-1963)

Design

I found a dimpled spider, fat and white,
On a white heal-all, holding up a moth
Like a white piece of rigid satin cloth—
Assorted characters of death and blight
Mixed ready to begin the morning right,
Like the ingredients of a witches' broth—
A snow-drop spider, a flower like a froth,
And dead wings carried like a paper kite.

What had that flower to do with being white,
The wayside blue and innocent heal-all?
What brought the kindred spider to that height,
Then steered the white moth thither in the night?
What but design of darkness to appall?
If design govern in a thing so small.
Notes on the interview with Omer Akin

Omer's interview was taped and will be summarized in detail after it is transcribed. These notes comprise overall impressions of the interview.

Approaches to teaching Design

- On the Pattern and Design course, Omer was very positive in his assessment of the course. I was surprised that for an architect - one who deals in built reality - he was so satisfied with a non hands-on approach to design.
- When it came to considering a hands-on course he became very cautious - maybe even defensive. In particular, he was unwilling to suggest a possible problem for a hands on course. His argument was that he couldn't make a responsible suggestion without knowing more specific goals and context of the course - who were the students?, what year?, how much time would they have on the problem?, what were they expected to accomplish?, etc. He seemed to be saying that it was improper to consider such a course from anything but a top-down approach, particularly if this was to be an advanced course.
- Eventually we reached an agreement that it was, in the early stages, appropriate to consider devising a new course by the more holistic (chaotic ?) approach I was using. With this understanding, he was able to suggest two very useful ideas, with the further understanding that they were pertinent at an introductory level and probably wouldn't be right for advanced students.

- 1. The regular Intro. to Architecture course is built around four components: Exercises, Analysis, Design/Build, and Representation. The first three are components of the Freshman studio course, the last is handled in a separate but coordinated course taught by Doug Cooper. These four strike me as a decent way to organize a design course in any discipline and for any audience. These four components are major issues in any constructive endeavor I know about. Each issue can be reinterpreted in a particular domain and yet not lose it's place in the over all design process. For example: Exercises are related to the skills issue; Analysis also involves skills or tools but emphasizes observation; Design/Build is the reality testing via the making or wroughting aspect of constructive endeavors; and Representation deals with observation again but with the motivation of translating into particular representations for particular audiences. (Maybe there's a knowledge matrix that drops out of this??.)

As a footnote to the above, Omer suggested that it would be a good idea to interview Doug Cooper about the idea of translating representations and how important that is to designing.
2. In the Architecture summer program for High School students, they give the "Kit of Parts" problem. It is like children's building blocks in a way, but considered from a more sophisticated plane. The things that are designed and built from the kit are examined with respect to the issues of Elements, Assemblies, and Human Habitation. Again, maybe with the substitution of Human Use, that is another useful way of organizing one's thinking about the design process. I can easily imagine those categories, or closely parallel ones, being understandable and useful to students from many disciplines. Being provided in a kit, Omer believes it avoids the problem of students coming from very diverse backgrounds, and with very different levels of skill and experience. While the age and experience of our target audience is greater, perhaps the approach is worth considering.

Attachment

- Architecture Module from Pattern and Design
Pattern and Design:  
Module of Architecture Module 
by Omer Akin 
August 22, 1986 
October 29

This course module will introduce patterns that are used in the generation, evaluation and synthesis of architectural objects. The first lecture will deal with introduction of concepts and definition of issues. The three lectures that follow will focus on generation of design patterns, evaluation of designs and the synthesis of designs from patterns.

Lecture 1 (November 4): Introduction of issues  
Reading (Bookstore): Rapoport, A., House, Form and Culture  
Assignment: Selection of functional pattern

Lecture 2 (November 6): Generation of design patterns  
Reading (Reserve, Hunt Library): Steadman, J.P.  
Assignment: Generation of formal patterns

Lecture 3 (November 11): Evaluation of designs  
Reading (Reserve, Hunt Library): March, L.,  
Assignment: Evaluation of formal patterns

Lecture 4 (November 13): Architectural Synthesis  
Reading (Reserve, Hunt Library): Alexander, C.  
A Pattern Language, Oxford University Press, New York, 1977. p. XLI and more of your choice  
Assignment: A design
Mel's interview was taped and will be summarized in detail after it is transcribed. These notes comprise overall impressions of the interview.

Some general thoughts about a University Core.
• "Design" is a heuristic theme for devising a core in what he considers to be an inflexible environment. He seems to think it's a worthwhile effort, citing the asymmetry of our current situation in which engineering and science students have a variety of H&SS courses that can provide a "core" for them but H&SS or CFA students do not have a similar choice out of CIT or MCS. Changing that seems to be where the inflexibility arises.

On the Pattern and Design Course
• It was a reasonable experiment, worth doing, probably worth doing again.
• The course had too many components for one semester. About four units would be better. Mel is concerned about a watering down of a specific subject; you can't get to the serious (engineering?) issues.
• Instead, he operated at a more general level. He treated design as a verb (reference: Edward O Wilson, "the Drive to Discovery") and focused on fundamental laws of nature. As an example, the laws of thermodynamics give us the concept of entropy - a pattern of increasing disorder which is associated with the currently hot topic of defining chaos as a special kind of order (reference: Angrist & ______, Fundamentals of Thermodynamics?).
• He would use case studies as a way of getting students involved in the subject matter (is this a possible alternative or companion method to the hands-on approach?).
• In Mel's discussion, there was a repetitition of an analytical point of view, suggesting that something like "pattern finding" is at the heart of the design-as-a-verb idea.

Problem suggestions for a hands-on course.
• The symmetry of things at the particle level - in theories, materials, what else... - emerged as an interesting topic. This would seem to be appropriate for computer representation in a future version of Pattern and Design or a hands-on course.
• There was talk around the idea of identifying / analyzing a structural unit vis-a-vis its whole (no specific problem). The idea could be found in computer architecture, communication theory, and failure analysis.

Attachments
• A Modest Proposal, Patterns in Nature
• Proposed "Patterns and Design" Module
• Partial schedule for Patterns and Design
• E.O. Wilson, "The Drive to Discovery" (bulky, not attached)
A most familiar observation in nature is that of symmetry e.g. in the appearance of minerals, snowflakes etc. This view of nature is seemingly consonant with the concept of order and seemingly at odds with the apparent converse, disorder or chaos.

These concepts have formed the basis of much of science and technology from the arcane field of thermodynamic equilibrium, which requires disorder (entropy) to insure order; to classical and modern materials, whose development and subsequent properties have depended in large part on the proper use and understanding of symmetry, order and disorder elements.

Possible topics to consider:

I. Why symmetry in nature? Are the laws inviolate? What are the consequences of a breakdown in symmetry of natural events and phenomena. Is this related to a breakdown in order? The origin and impact of these concepts on the classical laws of physics, chemistry and mathematics.

II. The extension of symmetry elements and operations to the design of materials. Effects on growth, properties and applications of metals, ceramics, polymers and combinations:
   Successful applications:
   Unsuccessful applications.

III. A search for technology paradigms based on these principles. Student involvement:

* Significant background reading, likely at the level of Scientific American, will be required.
* Symmetry lends itself to graphical representation and it should not be difficult to develop schema to explore, via computer graphics, the origin of symmetry and its effects of properties, such as thermal conductivity, strength etc. I take it back! This probably will be difficult, but we do have some rudimentary packages as a beginning.

* It would be very interesting to have students from different backgrounds explore the impact of symmetry and order (which are not the same), as they relate to art, science, technology etc. How to do this is not clear to me at this time (or perhaps ever).
In this 2-3 week module, I intend to explore the relationship and sequential interactions of patterns and design as they are manifested in the physical laws of science. Two examples or paradigms will be developed through readings and classroom discussions. A third will serve as a "test" to the students as they attempt to design either an electronic device from given structural and logic patterns, or a new material given the role of symmetry on properties and examples of prior knowledge. The necessary degree of sophistication will be such that solution will be attainable for students from all colleges (I hope).

FIRST WEEK

We will explore the differentiation between order (identifying patterns) and chaos (or homogenization), the two fundamental physical laws of nature. The first lecture will be tutorial, but the second will be interactive as students will be asked to relate such concepts to technology, culture and life processes. Possible topics include irreversibility of process; disorder and ignorance; geometrical and cultural similitude etc.


SECOND WEEK

Two relevant examples, whereby the recognition of patterns were used to develop design strategies will be analyzed. The first will be the transmission and interpretation of information and the second will be crystal growth in nature and in the laboratory. Each of these depends on recognizing and exploiting the correspondence of different patterns. Particularly for the example related to information, the interdependency between physical laws and human response will be explored. If appropriate, this can take us into discussing cybernetics, the establishment of control procedures.

Readings - The Human Use of Human Beings, Norbert Wiener; Selected article on Symmetry Crystal Growth and Properties; on the level of Scientific American.
THIRD WEEK

Teams of students will be given parametric pattern information and constraints and asked to design a simple device or material. The former is an example of hierarchical design, using simple algorithms, while the latter will use a rudimentary knowledge based expert system. There is existing software for both but they are too complex for this level of pedagogy; a lot of distillation will be required. Keeping in mind the exploratory nature of all this, it should be an interesting experiment. "Deep knowledge" in both topic areas is available; for the former, from VLSI (Very Large Scale Integrated Circuit) or CAE (Computer Aided Design) research in ECE and for the latter from a Robotics Institute project, dubbed Aladin, on how to use knowledge-based expert systems to design modern materials. Simply put, this entails gathering large amounts of prior knowledge and art and "asking" an artificial intelligence program to identify patterns from which common design rules can develop. I will be the tempering influence to moderate the technology intensiveness of the subject matter.
Oct. 21
Before: None (Subject to change)
After: Develop from some recognizable observations of some simple laws of nature or behavior.

Oct. 23
Thermodynamics: Correlating Order and Chaos through Equilibrium and Entropy
Before: Read handout from S.W. Angrist and L.G. Heplen
After: None

Oct. 28
The Origin and Role of Symmetry
After: Prepare a list and associated explanations of at least three properties that relate to identified patterns in natural or man made systems; e.g. series and parallel electrical circuits.

Oct. 30
Using Patterns to Design: From Information Theory to Advanced Materials.
After: Develop paradigms and strategies to design a simple device, material or manufacturing process. The form of the assignment to be decided.
Notes on the interview with Akram Midani 10 June 1987  J M Ballay

On devising a university core program around the "Design" idea
• It's a major pioneering effort; we must test whatever program is developed in model form before launching the idea onto student "guinea pigs"
• Even with its recognized difficulties, we can't throw away the interdisciplinary approach in teaching design in such a core. Genuine interdisciplinarity has the effect of "universalizing" design and keeping it meaningful (as opposed to trivializing it, which has been the concern of some). It does this by bringing in a multitude of approaches and using the course as a forum for their comparison.
• There should be two major goals for a core design course: 1) improving a student's relevance and ability in his own field, and 2) providing a comparison with other fields.

Talking about the "Pattern and Design" course
• I was there for a pre-session and then two times - Nov. 25 and Dec. 2.
• I talked about design in the context of the dramatic form - that is, one actor confronting or answering another - and then showing how redundancy, repetition, modification, etc. fit in by playing upon that theme. It derives from Aristotelian theory of the origins of the dramatic form - the storyteller (one person) becomes an actor and his story becomes a drama by the introduction of a second actor/character.
• The students read Sophocles' Oedipus Rex as a context for discussing these ideas.
• The reason for dealing with such a fundamental design principle - i.e. "duality" - is because it translates easily and meaningfully across disciplines.
• Regarding the principle of duality itself: It is the beginning of seeing things in relation to each other. The "Pattern of Two" has enormous possibilities for multiplication and personal reinterpretation.

as a personal reconnection, I am reminded of recently hearing Michael Kalil describe the splitting of a cell into two as the beginning of our individuality. Perhaps duality indeed has the potential to represent the most fundamental of personal interpretations.

• There is another possible teaching pattern for the Pattern and Design course (rather than having many teachers from different disciplines). Perhaps we should consider one teacher and a multidisciplinary class where the multidisciplinary aspect comes from the students, not the teacher. Presumably there would still have to be multiple sections and their respective teachers would probably come from several disciplines.
What students appeared to get out of the course:

- 20% understood the universal aspect of design
- 30% saw the pertinence to their own field
- 50% enjoyed it as a smorgasbord

- The smorgasbord form is not bad, but also it's not sufficient. It's lack of structure is risky. It can be good if it's a sequential sampling (like seeing combinations of many distinct colors). It can be bad if it is mixed all together chaotically (like mixing all those colors together to get a muddy gray).

A problem for a hands-on design course:

- How do two unrelated things become related?
- It's based on the "Pattern of Two" model - two shapes in graphic design - two notes in music - two actors in drama, or - in Architecture - given a cube and a sphere, tell me how to get them to relate. See Palladio and Islamic architecture for some examples.
- "The design is in getting the two to go together". The "going together" can be in any field. It's not a problem that comes out of any one discipline. So, the important point for the pedagogy is that there isn't any difference / dilution / condensation (or condescension) for any audience.

Qualities of the studio - for the distributed studio concept.

- A studio has to have the right kind of faculty who can interact in a studio situation.
- Design is a translation of a concept into an artifact - it can be seen, either visually or metaphorically. So, it needs teachers who can take concepts and visualize them for the student audience - as opposed to "linear lecturing". For example, with the Palladian pattern in architecture - I can talk about it forever, but until I bring in an example (a visualization) the opportunity for multiplication (for a multitude of interpretations) is not evident.

Some summary comments about teaching, design in particular.

- You want students to discover things for the first time - it is a first time for them - even if the things are 2300 years old, like Oedipus Rex.
- There is something appealing and fundamental about revealing the complexities available in simple things.
- A linguistic analogy: Let us say we have decided to teach a language course to students who come from a variety of linguistic backgrounds - French, Arabic, Catalan, etc. The most difficult decision will not be what to teach. There is ample research to show these languages share common characteristics. Rather, the question will be "In what language do we teach?" It is not a problem of message, but of medium. In our case we have a design course to be taught to engineers, architects, musicians, etc. What language do we use? Is there even a "design lexicon" which is
sufficiently universal to be a candidate? Perhaps Carnegie Mellon is the place to invent such a universal lexicon.

The parallel of music as a "universal language" comes to mind. Is visualization or visual notation enough of a language and universal enough to qualify. Perhaps it is if the notation excludes those which are both visual and verbal. The problem is, verbal-visual components make up a significant part of our visualization, at least in industrial and graphic design.

Attachments
- Definitions
- On the Origins of Drama from Poetics; Aristotle
- The Evolution of the Dramatic Form; Fickinger, T.S.Eliot
- Game and Ritual; Claude Levi-Strauss
- Two Plans for the Classical Theatre; Vitruvius
Definitions:

**Agon:** contest

**Actor:** a doer; an answerer

**Epic:** an extended narrative poem celebrating episodes of a people's heroic tradition, typically developed by oral composition within a standard formulaic diction and set of metrical and narrative conventions, a final version being transcribed after the introduction of writing.

**Antagonist:** one who opposes and actively compete with another; adversary.

**Protagonist:** the leading character in Greek drama and any other literary form.

**Dithyramb:** a Greek choral lyric originally connected with the worship of Dionysus, sung by a 'circular choir' probably of fifty singers.
Aristotle (384-322) on the Origins of Drama from his Poetics:

"Tragedy as well as comedy having arisen at the beginning through improvisations (the former due to the leaders of the [choral poem] dithyramb, the latter due to the leaders of the phallic songs which even today are continued by the customs in many of our cities), then grew by small steps, advancing until it became what it appears today. And tragedy went through many changes, stopping when it had attained its nature. First Aeschylus (525-456) brought the number of performers from one to two, lessened the number of melodies, of the chorus and rendered speech the primary contestant. Sophocles (496-406) then brought the number of performers to three and introduced painted scenery ".

"Tragedy is an imitation through action rather than narration ".

"Every tragedy must necessarily have six elements according to which the quality of the tragedy is determined: plot, character [indicants], thought, spectacle, diction, and music ". 
The Evolution of the Dramatic Form

"In the prehistrionic period a series of lyric questions and answers between chorus and leader was the nearest approach to a dialogue that was possible. With the invention of the first actor this interplay of question and answer, still lyrical in form, could be carried on by the actor and the chorus (including its leader). Such a duet which came to be known as a *commus* continued in use as long as the chorus lasted.

Side by side with this there quickly developed a non-lyric interchange of spoken line between actor and leader. But not until the second actor was added did true dialogue in the modern sense become possible.

Yet the poets (dramatists) could not at once make full use of these simple resources. Moreover, priority of usage constrained the playwrights to give the actor-leader dialogue over actor-actor dialogue. They seemed unable to weld the two types together with a technique which would employ all three persons at once.

In the three-actor period the embarrasement of riches made their helplessness the more striking. 'A' might engage in a dialogue with 'B' while 'C' remained inactive; then with 'C' while 'B' was silent; and finally 'B' and 'C' might converse, with 'A' remaining passive.

A half-step in advance consisted in the silent actor interrupting the dialogue with some electrifying utterence".

R. C. Fickinger

*The Greek Theater and Drama*

(1918)

The Three Voices of Poetry: "The first is the poet talking to himself—or to nobody. The second is the voice of the poet addressing an audience, whether large or small. The third is the voice of the poet when he attempts to create a dramatic character speaking in verse; when he is saying, not what he would say in his own person, but only what he can say within the limits of one imaginary character addressing another imaginary character".

T. S. Eliot

*The Three Voices of Poetry*

A lecture delivered on 19 November, 1953.
GAME & RITUAL

"Games appear to have a disjunctive effect: they end in the establishment of a difference between individual players or teams where originally there was no indication of inequality. And at the end of the game they are distinguished into winners and losers.

Ritual, on the other hand, is the exact inverse: it conjoins, for it brings about a union (one might even say communion in this context) or in any case an organic relation between two initially separate groups, one ideally merging with the person of the officiant and the other with the collectivity of the faithful.

In the case of games the symmetry is therefore preordained and it is of a structural kind since it follows from the principle that the rules are the same for both sides. Asymmetry is engendered: it follows inevitably from the contingent nature of events, themselves due to intention, chance or talent.

The reverse is true of ritual. There is an asymmetry which is postulated in advance between profane and sacred, faithful and officiating, dead and living, initiated and uninitiated, etc., and the 'game' consists in making all the participants pass to the winning side by means of events, the nature and ordering of which is genuinely structural."

Claude Lévi-Strauss
in La Pensée Sauvage
(The Savage Mind)
Fig. 42.—Vitruvius' Theatrum Latinum According to Dörpfeld
See p. 35, n. 1
Fig. 43.—Vitruvius’ Theatrum Graecorum According to Dörpfeld
See p. 16, n. 3
Due to a technical glitch, only the second half of Allen's interview was taped. These notes comprise an overall impression of the interview and will be augmented when the tape is transcribed.

Some thoughts on the academic/political environment for a core design course
- We should be cautious of a potential parallel to the writing program. There, a whole new body of faculty were talking about writing as "technical" and "rhetoric" and many of the traditional writers felt disenfranchised on their own turf. Similarly, there are several departments who have been teaching "design" for some time. It is important that they have a guiding role in creating a cross disciplinary view of design.
- The observation that "science" is not very involved in core and design discussions to date is probably a matter of self selection. Their activities are heavily analytical and they probably don't feel much attraction to the synthetic emphasis of design. They are not being intentionally excluded.

On the Pattern and Design Course
- Pattern is STATE, Design is PROCESS (of perhaps its better described as a game). There is agreement with the Steinberg model.
- A model of the course:
  - It's an exercise in being intellectual
  - Start someplace, then get involved with lots of details (domains).
  - Some examples of details: OED definitions of pattern and design, computer languages, the biological world, Song from Pacific Overture.
- While no specific suggestions were made for problem areas for a hands on design course, he was convinced that one could always find new examples within which to explore design related subject matter.
- In a hands on design course we should design several things. It isn't the importance of one domain or another. Rather one needs to have experience with the induction which transcends domains.

A paraphrase of Emerson
- "the undesigned life is not worth living" - perhaps this only applies in the areas of life in which production is a major objective.

My reconsideration of this paraphrase is that it should be:
The undesigned object is not worth having. I don't think we're trying to design all of life, but the objects (in a broad sense) that we produce in life. Which leads into Newell's following point:
Should everything be designed – No, emphatically. There are some things like love affairs which are best left spontaneous. Perhaps our objective is to explore the appropriate application of design. This might be begun by tackling the problem of creating a “taxonomy of all things” – admittedly an impossibly large task, but one through which the dimensions of appropriate application of design might begin to emerge.

On the potential for the Distributed Studio

Allen was most enthusiastic about the concept. A system like Andrew already has many of the qualities we are looking for – a sense of place, it deals with objects (in the sense that programs are objects), people exchange messages about those objects and other things too. It was suggested that we concentrate on the ways in which Andrew is not a good design environment and see if these can be corrected – essentially, that’s my Distributed Studio proposal.

The Distributed Studio was used in the “interpersonal Computing” workshop, on 8 July, as an example of an attractive computing environment for future development. It adds a social dimension (see notes from the workshop).

Attachments

Newell’s notes from his segment of Pattern and design and several things which are too bulky to include here:

- P and D Material prior to the course
- P and D Outline of section 1, 2, 4, 9
- Pattern and Design definitions from OED
- P and D Example: The Blossom Falls on the Mountain
- P and D Assignment for first section: Chrysanthemum Tea
Definition

1. Definitions are not to be taken at face value
2. Definition are big fuzzy things
3. What sort of a concept is a word concept?
   - Concept 1 = predicate: true of false
   - Concept 2 = prototype: (1)
   - Concept 3 = family resemblance ( Wittgenstein) game
      = population (evolution)

4. The English habit of verbng nouns & nounng verbs.
5. Select out: pattern = what you see
   - see
   - design = what you do
6. Can see the way this definition breaks out
   - pattern (sth) 11 = gymnastics
   - pattern (sth) 12 = parking sth's along
   - pattern (sth) 13 = becoming an ideal
   - design (sth) 5 = bad sense
7. It almost appears: pattern & design interchangeble (both vs sth)
   - But then design (sth) = plan
   - because it picks up intention & not regularity
Questions about definitions & words:

1. What did you find?
2. What is the pattern of the definitions?
   Are word definitions 'designed'?

3. Something to puzzle over:
   \[
   \text{pattern: pattern} \quad \text{design: ?}
   \]
   I can't find anything. Why not?

4. Last there, I gave pairs of words:
   - pattern - design
   - capital - community
   - energy - structure

   Steinberg complained:
   - What are good pairs? And? Why?
   - Is there a pattern?

5. Something to puzzle over:
   Can say:
   - The pattern of pattern
   - The design of design

   Analysis (analogy, thought of thoughts)
   - Metaphor of metaphor
   - Related to talk

   - The book of books
   - The holy of holies
   - The chief chief

   La crema de la crema.

[See C on word grams]
pattern: design :: syntax: semantics

But there is a triple:
syntax - semantic - pragmatics

production uses application

Another example:
Phil Haase: Scientific truths that were beyond changing

1. The Sun is a star
   The earth is a planet

2. Scale counts

3. What is the pattern?
   Does it seem incomplete?

Hypothesis: Extreme simplicity, from which deep scientific truth follows its moving conceptual parts.
⑦ cont'd.

What is relation to design?
Logic to find others — to cast scenes in the way

Powerful idea

[short, sweet, pregnant]

Debugging is a powerful idea
The idea of a powerful idea, is a powerful idea
Every biological organism is a pattern-design device

Examples:

1) Leopard & Antelope.

Leopard: Track the path, design its own

Antelope: Randomize: Zip-zap.

2) Sometimes: Sense the pattern of attack & design flight

  Because they are forced to live together.

2) Insects: Bee's

Detect the pattern of the flower.

Von Frisch: Communication: The pattern of the dance
The design of the flight

3) Bacterial world (one-celled)

Immunology: Recognize the pattern of the invader.

To attack

What is the design? Evolution

4) Ethologists (Tinbergen)

Stickleback (small fish)

Red spot on the belly releases courtship behavior

Pattern → action / release
Due to his schedule of moving, Paul was unavailable for an interview in person. Instead, we had an impromptu telephone interview. This is a transcription of my notes of that conversation.

Comments on the Pattern and Design course:

• The lectures were excellent; he attended three besides his own.
• It was too much effort for a small number of students. There was the recognition that we could not afford such a senior faculty intensive course on a continuing basis.
• If you could get the same faculty to talk to all the freshmen it would be a fantastic thing. The students talked about life, not just design. Paul sees this course as a kind of freshman orientation thing: “I thought the core objective was to integrate the Arts and Sciences and bring out ‘patterns’ that are common. This can only be done (forced) at a beginning level”, implying that many students, once into their majors will be less willing to abide a ‘breadth’ course of this kind.

  This strikes me as a negative, though perhaps accurate, assessment of our students or of the typical breadth course, maybe both.

• This course has a unique delivery problem. That will have to be solved if it’s to grow into a permanent part of a core. Over all, Paul’s response to the course seemed to be that it was a great experiment, but he was very skeptical about finding workable solutions to the economic, scheduling and delivery problems, which would be needed to make it a sustainable core course.

On specific problems for a hands-on course:

• The Carnegie Mellon Buggy Race is an excellent model for a hands-on experience. It captures the imagination of a broad range of students; part of that is the competitive aspect of Buggy (I’m reminded too of the design competitions run by Woody Pirtle at MIT). Whether you are a mechanical engineer or not, you can appreciate the problem issues – strength versus weight, etc. It’s not an esoteric problem; rather, it’s well known in the Carnegie Mellon context. It is also a classic design problem in that the solution requires integrity in the face of many and conflicting constraints.
• Another possible problem, which he has given in similar circumstances, is to design a toy for a three to five year old child. 98% of the class will design something which responds to an adult fantasy. Only later, in critique of their toys and actual commercially viable toys, do they begin to understand the requirement that needs drive the design process (not facility with design algorithms). In this case the three to five year old needs to be captivated by one idea, and usually a simple idea. Again, the problem deals with multiple constraints – structure, mechanics,
manufacturing, cost, safety, etc. - and in addition it requires some understanding of the personality of the consumer - the student must "get inside people's skin"

• For either problem, there is no need to reinterpret it for different student audiences. Anybody can succeed - some will be able to go into further detail because of domain specific knowledge or skills - but anybody can succeed.

**Dialogues in the context of a design course:**

These dialogues would be part of any such course he would teach. They complement the hands-on part of the experience.

• Countering the tendency toward "engineering arrogance" - a discussion of some of the great engineering failures. The Titanic and the Concorde come to mind - examples of engineering designers paying attention to the wrong issues.

• Talk about "form follows function" in a broader, more theoretical / philosophical sense. For example, we might look at chairs - perhaps in connection with a project to design a special chair. How are chairs formed by forces other than mechanical function - e.g. by social impact, by the constraints of manufacturing, by aesthetics.

    *It occurs to me that this describes exactly what we do in a junior or senior level industrial design studio.*

• We would talk about cultural aspects, for example: saunas as a means for people to isolate themselves from society. The main point is for them (the engineers) to see that the social dimension should drive and often does 'drive the (promethean) engineering equation writing (see: concorde).

**On delivering a hands-on design experience**

• In his experience, Paul has done such problems (the toy) in two weeks of class meeting and outside work, for classes of approximately 50 students. Usually students work in pairs. The required output is a drawing (for a project of this scope) though some teams have done models.

• Paul believes the things we discussed can be experienced through a computer. The notion of modeling a design problemsolving situation on a computer "makes a lot of sense". Andrew could also be the environment in which students could read and think about design "dialogues" (i.e. crits).

• A key requirement will be to find someone with imagination, intelligence and charisma as the teacher. He/she will have to meet with students, impress students with the possibilities, and lower their fear of failure. On this last point, Paul is concerned about the students who would not willingly to take a course outside their domain because it puts their QPA at risk. In fact, if done right, some experience in professional risk-taking could be one of the primary benefits of this course.

*No attachments*
Nove. 18 The Design Engineer

Sources: Conceptual Blockbusting - J.L. Adams
Before: Read this text and think about the steps in your creative processes.

After: Be alert to the design of products and how simple domestic items or toys work. Think about new ways to exploit the mechanisms or techniques.

Now: 20 Art and Automation: The Two Cultures
Before: Read hand-out from lecture of same title and consider the thought-processes you use personally in problem solving.

After: None
Notes on the interview with Steve Fenves 7 July 1987 J M Ballay

The tape of Steve's interview was flawed and essentially inaudible. These notes of overall impressions constitute the only record of the interview.

Some general concerns
• Steve is in favor of a core program - in the abstract - but he has some concerns about the way it may be implemented. In general, the concerns have to do with capturing information and attitudes which are realistic and practical in the CIT context. These concerns became more explicit as we discussed design was the right theme for the core.
• A design course has to keep in mind two problems that engineers face. One - design engineers only produce specifications. They don't have the artists luxury of producing and experiencing the thing they have designed (it's an expression of the "designer-maker-user division"). Two - the feedback loop is very long and involves secondary effects which are unforeseen (social effects etc.) largely because so much abstract modeling is used as the basis for engineering decisions.
• So, the production/evaluation phase would have to be a part of the course. The problem is that serious production or evaluation go far beyond what could be accomplished in a core course. There would need to a focus on technological evaluation - stressing again the analytical aspects of design.
• Occasionally Civil Engineering has courses in which students build balsa models of structures and evaluate their performance. Importantly, the models are made for "visualization" and these courses are seen as "motivational" rather than analytical and they are often the ones taught outside Civ E. - e.g. to architects. These projects are an example of the deficiency in serious analysis.

Hands on design experiences which might be done successfully
• There are two plausible scenarios for a hands on design course - as a motivational vehicle early in the students career - or (and much preferred) a course in which analytical methods are also used.
• It is possible that the latter course could be achieved through computer simulations. There is some interest in creating such simulations - it's already being done to some extent for more traditional student audiences. It must be recognized that these simulations are big and difficult tasks. There may be a problem (solvable) in the reward structure to encourage faculty to take on such projects.
• In any case, it is preferable to do a simulation of a simple, actual experience rather than to say that a computer program (a most abstract object) stands in for all other design problems. For example (from the EE area) it would be possible to design and simulate on a computer the logic for a simple traffic controller.
On the issue of Visualization

- Visualization is important to engineering design and it is used in two ways - visualization of what is already visible, but at a different scale or from a new perspective (this is the domain of systems such as Alias), and - visualization of what cannot be seen, for example, forces (this is the domain of most computer simulations).
Notes on the interview with Granger Morgan 16 July 1987 J M Ballay

Granger's interview was taped and will be summarized in detail after it is transcribed. These notes comprize overall impressions of the interview.

E&PP's involvement in cross disciplinary courses

• Most of our discussion revolved around the several efforts E&PP has made to attract students from other departments - the technology and society short courses, upperclass project courses (which are the most design related), and especially the new CIT freshman course: 19-100 "Technology and People". Some lessons emerge from earlier experiments with courses like Technology and People; these assume, as Granger does, that such a course will be taught to freshmen.
• Freshmen need to have the course material well packaged. In advanced courses, students will know how to search for and extract relevant information out of a potpourri of technical reports, letters, articles, etc. Freshmen get lost in the information (a methods issue). We might expect that there will be a similar effect when students cross disciplines, even at an advanced level, because they don't yet have a feel for what's relevant.
• Freshmen need frequent refocusing on the issues when a professor is laying the groundwork information for what will later become an important problem. In other words, they need messages like "this is important because..." or "remember, we are looking for information about..." Again, it's a problem of recognizing relevance for the novice; and we might expect it to some degree in advanced students too.
• From E&PP alumni, Granger gets a clear message that courses of this sort - that require making sense out of a mess of information, often from fields out of the individual's area of expertise - are the ones which have prepared them the best to deal with the realities of professional life.

On the possibility of actually having a core curriculum.

• Carving space and time for a core out of a professional curriculum is going to be a very difficult problem, at least within CIT. Faculties feel they are up against the wall on professional accreditation requirements and can't give there. Granger thinks we should tell the accrediters that if they don't like our core based curriculum they can go..., but that isn't likely to happen unless the highest levels of the administration are willing to take a strong pro core stand and accept its advantages and costs - not a likely prospect. On the other hand, CIT likes what it's getting in breadth courses from H&SS and others and doesn't want to sacrifice those.
• Granger believes that a "January Term" is a viable resolution to this dilemma. Based on some of their Technology and Society short courses, he believes that it would be very effective to get a lot of people involved
across disciplines for a short time, and it has the advantage of being a time of exclusive concentration on one set of issues.

Redoing "Technology and People" as a University core course
- Technology and people could be a good core course but remember, it's still just being tried out within CIT. More important, there is a delivery problem just in getting it to approximately 400 CIT freshmen (they are doing two semesters of 200 each in a lecture/recitation format). Who would pick up the cost of delivery to 1000 students.
- Such a course would have to be redone for a different audience. Yes, distributed computing could help to solve some of the problems but this won't be easy. The technology is just now getting to where it's useful and developing specialized software is a long and expensive task. The development of Technology and People is "coming out of our hide, that won't work as a motivation outside the faculty's professional reward system.
- In short, there isn't likely to be anything new in the way of a core unless the University administration is willing to accept the cost of development and reward faculty for involvement in it.

Attachment
- Course description for 19-100 Technology and People
Welcome to "19-100: Technology and People". This semester's course is a pilot version of a new required core course for all CIT freshmen. We think it should be challenging, intellectually stimulating, and allot of fun. Since the course is an experiment we'd like to ask you to help us with suggestions for how we can modify or improve it. We'll pass out questionnaires from time to time, but if at any stage you have ideas please write a note and give it to one of us or come visit us in our office.

The overall goals of this new course are to help you develop:

1. some sense of the breadth and excitement of the field of engineering;

2. some appreciation of the diversity of the strategies and tools which engineers adopt, and at the same time of the underlying similarities in the "world view" of engineer's;

3. some sense of the complexity of the role that technology plays in our society including such questions as the extent to which technologies serve society and the extent to which technologies shape society;

4. a sensitivity to the fact that the practice of the profession of engineering carries ethical implications and responsibilities;

5. some understanding that issues in technology and public policy can be subjected to rigorous systematic analysis, and that the concepts and tools of such analysis are a subject that warrants the serious attention of engineers and other professionals; and

6. an improved ability to engage in critical reasoning and spoken and written communication on problems in the area of technology and public policy.

That's allot! It's pretty clear to us that the way to achieve these goals is not by lecturing to you about abstract ideas but
to dive in and take a good hard look at some real engineering problems. While the course involves problems in technology and society, it’s an engineering course. Hence, the course will be on TECHNOLOGY-and-society not technology-and-SOCIETY.

After two introductory lectures on the nature of engineering the bulk of the course will consist of five units, each exploring a very different problem in engineering:

- "Product Design: A case study in computer and communications", taught by Marvin Sirbu who has appointments in Electrical and Computer Engineering, Engineering and Public Policy and The Graduate School of Industrial Administration (the Business School);

- "Lead in the Environment" taught by Cliff Davidson who has appointments in Civil Engineering and Engineering and Public Policy;

- "Security and Privacy in a Computerized World" taught by Granger Morgan who has appointments in Electrical and Computer Engineering and Engineering and Public Policy where he is Department Head;

- "Research in Technological Innovation: Characterization and Design of Composite Materials" taught by Henry Piehler who has appointments in Metallurgical Engineering and Material Science and Public Policy;

- "Safety in Design: A comparison of the design histories of commercial jets and nuclear reactors" taught by Indira Nair who has an appointment in Engineering and Public Policy where she is also Associate Department Head.

The final few course sessions will be devoted to some general topics related to engineering careers.

An approximate week-to-week outline of the course is attached. Most weeks will involve two lectures and one recitation. The recitations are an important part of the course that will involve discussions and problem solving activities not covered in lectures. Our three recitation leaders, Daryl Ditz, Kathryn Jackson, and Guhanand Rai are all advanced Doctoral students in Engineering and Public Policy who have substantial technical and policy backgrounds.

As you will note from the attached schedule, there will be a normal in-class mid-term and final. Grades for the course will be based 30% on weekly quizzes and unit tests, 30% on homework, 10% on recitation participation; 10% on the midterm and 20% on the final exam.
Herbs interview was taped and will be summarized in detail after it is transcribed. These notes comprise overall impressions of the interview.

Fundamental motivations
- Herb has spent a lot of time thinking and talking about the concept of a core (whether it's called core or something else). So a large part of our discussion was a recounting of his position which he has written about in much greater detail. We began with a brief overview of the development of modern core curricula including that of Chicago.
- Hopefully, breadth in a university education comes through the contact and discourse among a diverse student body. Under these conditions, the role of a common core is to provide common subjects for discourse besides the weather, sports, and sex.

There has been a shift in that position. Of major concern now is the heavy emphasis on the analytic side of almost every subject matter - most notably engineering and the social sciences. An analytic view is good but it's important to maintain a sense of balance with the synthetic view. After all, we are supposedly doing all this analysis so that we can be better at the eventual synthesis of goods and services. Now it appears that an additional role for the core is to help restore this balance.

The analytic/synthetic balance seems to be a more satisfying description of the situation than a liberal/professional balance. This latter terminology is really a made-up term to describe a wholistic view of education as manifest at Carnegie Mellon. I take this as encouragement for focused development of what may become a synthetic, hands on component of the core.
- Perhaps the most pragmatic and durable motivation to emerge from the conversation is that we are all amateurs at most of the problems we encounter in our private and professional lives. What better reason for a cross disciplinary, hands on design course in the core than to facilitate the transcendence of skills for productive living.

Some practical suggestions
- Despite a fundamental preference for an integrated core curriculum, it may be more realistic at Carnegie Mellon to achieve the core idea through a series of alternative, elective core units which are organized to have certain features in common - sort of like distribution requirements with a more coherent organization. Thus any design course would likely be one of a series of design courses.
- There should be no worry about how to distribute hands on experience through distributed computing. Computer programs are perfectly good objects. They exhibit the properties of other designed objects and can be easily manipulated through the computer medium.
Notes on the interview with Hugh Young  8 July 1987  J M Ballay

Hugh's interview was taped and will be summarized in detail after it is transcribed. These notes comprize overall impressions of the interview.

On analysis and synthesis
• The discussion with Hugh emphasized the bias toward analysis which exists in the sciences. The bias seems to be a legitimate one. It is true that scientists design experiments or experimental apparatus and design theories, but these seem to be activities which are pretty far from the involvement of an undergraduate student.
• This is not to be taken as a vote against a breadth core. Physicists are probably among those who are most concerned with the need for breadth in one's world view. There is a question of how a synthesis, hands on course would fit in with the mission of undergraduate science. Perhaps the proper positioning of it is as breadth experience outside the usual concerns of a science curriculum.

Hands on in the Lab environment
• Physics lab used to be a major part of the introductory course, but it got lost in the process of curriculum redesign several years ago. The redesign has since been undone but they haven't been able to get the labs back. Hugh thinks it's a net loss. The advantage to the labs was to underscore that the mathematics by which we express physical laws involves simplifying assumptions. The hands on experience with an actual physical experiment confronts the student with the resultant discrepancies in results and forces him to account for them. The discrepancy between actual and theoretical is a basic and important lesson which seems to be best learned hands on.
The ModiForm Program:

A DDS Prototype
"ModiForm" is an instructional program for two-dimensional basic design. It provides experience with the perceptual structure of a simple graphic plane and the placement of graphic elements in that plane. It allows for both giving order to the plane and then disturbing that order.

At this early stage in its development, it seems that ModiForm and MetaForm could be a complimentary pair of 2-D instructional programs; the former operating in the form world of inorganic geometry, the latter in the world of organic geometry. We will confer with Chris Carlson to determine the extent to which ModiForm and MetaForm can and should share conventions.

Two levels
The user of ModiForm will experience the graphic plane at two levels - the structural level and the visual level. At the structural level he will be able to define and display the "structure" of the graphic plane. The structure is visualized as a flexible grid of points, which can be connected by lines in order to make the structure more visually apparent. Initially this structure will be modifiable by linear graphic transforms. Eventually the range of transforms will be increased to include the nonlinear and perhaps user-defined custom transforms.

At the visual level he will be able to place graphic elements on the points. Initially the element will be a filled circle of variable size, centered on a point. Eventually the shape, color, texture, position, and orientation of the elements will also become variables. ModiForm will be able to display either level, or both levels simultaneously.

Two design strategies
Principally for pedagogical reasons, the user of ModiForm will be able to employ the two levels to design the graphic plane by either the structural-to-visual strategy (sort of "top-down") or the visual-to-structural strategy (sort of "bottom-up").

It is a major pedagogical goal of ModiForm to enable student users to experience both strategies - individually in separate assignments or alternately in one assignment - in order to experience and internalize the strategy's effect on graphic design results.

Of the two strategies, the structural-to-visual is currently the best understood and is described in some detail below. It seems that the other, the visual-to-structural, will have to return some analytical description of a graphic structure for any user defined set of visual elements (or the point locations they represent). It isn't clear to me how to do that in a way which isn't too computationally intensive and yet is not structurally simplistic. For example, creating an irregular rectangular grid of least area with
horizontal and vertical lines through each element/point seems easily programmable but analytically simplistic. In order to avoid, for now, the other extreme of what might become AI programming, it might be necessary for the user to provide some fuzzy information about which elements are considered to be related to one another.

At the structural level

ModiForm operates on sets of points in 2-D space. These points will initially be arranged in a square grid (equal spacing, right angle orientations), where each point (vertex) is associated with four lines (edges) which link to other points in rows and columns. Each point on the boundary of the grid will have one or more lines which are unconnected (free).

By convention, the size of a grid of points will be measured by the number of points (not by spaces between points) in the columns and rows. For example, a "4 X 5" grid would be four points wide and five points high and would suggest an area comprising 20 square "cells".

A grid may vary in size from a minimum of 1 X 1 to a maximum of 100 X 100. Unequal grids (e.g. 3 X 18) are permissible, but not fractional grids (e.g. 3.33 X 18.5), and no "free" points (not a part of the grid) are definable inside or outside the boundary of the grid. However, it must be possible to redefine the size of an existing grid by adding or subtracting whole rows or columns. While "size" describes the number of points in a grid, "scale" may describe the area over which that grid is displayed.

The positions of the points, selected individually or in subsets, can be modified by transform operators. Regardless where any given point may be moved, it maintains its original line relationship to its neighboring points (I still have some question whether this is the most useful way to represent point-to-point relationships).

Selecting

Points will be selectable in typical Mac fashion - by marquee, by, lasso, by pointing to individual points or to sets of points with the shift key.

Operators / tools

Structural transformations will be accomplished by a set of tools, probably represented by tool icons. If the complete set of transformations (basic transforms x orders) remains small (about ten or less), each transform will have a unique tool and icon. If the set becomes large, we may employ a keystroke (e.g. option) to signal, perhaps, a higher order of transform.

The basic transform tools will be translation, rotation, and dilation; it is presently an open question whether reflection (folding) should be treated as a separate transform or a special case of rotation about two anchor points.
Orders
It is foreseen that transforms will want to be performed at three orders. Zero order = all points in a set are transformed while maintaining their original geometric relationship to one another. First order = the amount of transformation of any point in a set is linearly proportional to its distance from an anchor point. Second order = the amount of transformation of any point in a set is proportional to the square (or perhaps to a user definable power) of its distance from an anchor point.

Tacks
The user definable fixed points, or tacks, will act as anchor points to constrain the movement of selected sets of points under the control of the transform operators.

With a single tack, it is assumed that the transform is being applied beginning at an imaginary line that runs through the tack and perpendicular to the "mouse dragging vector" (or whatever).

With two tacks, the transform is applied beginning at a line connecting the tacks, and proceeds in the direction of the mouse dragging vector even if that direction is not perpendicular to the line.

At the visual level
Initially an identical shape element will be placed on each point which is selected as part of a set - from one point up to all the points.

Elements which have been placed can then be modified. While the initial version of ModiForm may be restricted to size modification, it is anticipated that the modifiers will eventually parallel the structural transforms including the concept of "orders" and the constraining "tacks". Thus a full set of modifiers will include not only dilation (size), but rotation, translation, and reflection (?); in addition there will be modifiers for color, texture, and perhaps edge quality.

Selection of points for the placement of shape elements will follow the same conventions as at the structural level.

Gradations
It will be possible to apply the shape modifiers in sequences of gradation across a selected set of elements. For example, a horizontal row of square elements may be gradually rotated or gradually colored from light to dark.

A gradation would be accomplished by selecting a set of elements, then selecting and modifying two individual elements which represent the extremes of the gradation, then indicating that the gradation should be performed.

It is an open question whether these gradations will only be applicable to a linearly arranged set of elements or whether the gradations can be easily made to follow more complex pathways.
Additions / refinements for later versions
  Triangular and hexagonal grids.
  Nonlinear transforms and user-defined transforms
  Full set of shape modifiers
  Gradations
ModiForm ought to do all this ... and more!

At the structural level:

Initial square grid and some of its transformations.

Eventually:

Triangle grid

Hex grid

Circle grid

These are from:
"Principles of Two-Dimensional Design"
by: Wucius Wong.
At the visual level

Modify selected sets of elements.

Handle varying degrees of orderliness.

Return an analysis of "bottom-up" designs.
Basic Exercises.

Selectre Modification

Grid not so obvious.

Second order effects.

Radize Symmetries.
Decisions to date on design concepts for Modiform

J M Ballay  14 June 1987

These decisions focus on the first version of Modiform only; there are many bells and whistles that have been considered for later versions. To some extent these decisions can't be evaluated until we give them a try.

At the structure level:
- To display a grid representation of a graphic structure
- Limited to a square grid, min. 1x1, max 40x40, any H:V ratio
- Manipulate individual points, regions, or disjoint sets of points
- Manipulations limited to linear move, rotate, dilate, and shear
- Structure savable as a document (independent of motif)

At the motif level:
- Choice of filled circle or filled square motifs
- Motif elements are uniformly and continuously variable in size within limits which are yet to be defined
- Square elements are always displayed square to the pixel grid
- Elements will be centered on grid locations
- Individual elements can be deleted
- Motif level document includes structure information
- Motif level also savable as a Pict document

At the display level:
- Grid, Motif, or Grid + Motif are displayable
- See screen sketches for more display details

At the hardcopy level
- Print information saved as part of document
- Limited to one sheet output (a computed image area that will fit on one 8 1/2 x 11, H or V sheet)
- Assume (for now) laserwriter output exclusively
- However, maintain device independence (some Linotronic experiments may be tried)

Screen objects: (see sketches)
- Pointer
- Tackle Box (possibly more than one box) containing:
  Two "Tacks"
  "Grid scaler"
  "Motif scaler"
  Four "Mats"
Basic moves:

With 0 tacks
Move - selected area follows the pointer, orientation and geometric relationships within the selected area are maintained

With 1 tack (representing an anchoring POINT anywhere)
Turn - moving the pointer circumferentially to the tack causes the selected area to rotate about the tack, geometry preserved.
Scale - moving the pointer radially to the tack causes the selected area to enlarge or reduce, geometry preserved.

With 2 tacks (representing an anchoring LINE anywhere)
Shear - (rotating about two points or a line) moving the pointer shears the selected area with the line of the tacks remaining stationary. More than 180° of shearing may cause the area to flip to a reflected position.

Menus:

File
New... dialog box: (same as double click on application)
  • specification of grid SIZE, 1x1 up to 40x40 (not necessarily square proportion) by scrolling counter
  • Selection of circle or square motif
Open...
Close
Save
Save as... dialog box - the usual plus:
  • a box in which to type a "Title" line which can (optionally) be printed on the hard copy (see Page Setup)

Page Setup... dialog box - the usual plus:
  • Print Title - (9pt Helvetica, centered at extreme bottom of printable area)
  • Print Crop Marks - prints a "+" at the corners of the print area for aligning multi-page output in future versions
Print...
Quit
Edit

Undo
Cut
Copy
Paste
Clear

View

√Grid - displays the structural level
√Motif - displays the visual level

∨one: Actual size - size of a hard copy
Enlarge - up to 8 x actual size by powers of two
Reduce - down to "reduce to fit"
Reduce To Fit - max image* area on screen
Paper Preview - Shows the entire paper* area

Show/Hide Page Breaks - for later versions

* There is an unresolved question of whether, for this application, "Reduce to fit" shows the max image area (to the outer edge of the mat) or the whole page (8 1/2 x 11 in this version) on the screen. Printable area yields a slightly larger image, but designers will want a WYSIWYG preview of what will come out of the printer - including unprinted border area. Will there be an unacceptable computing cost? The above is my tentative solution.

Tools

Show/Hide Toolbox
Click once on a point M with the left mouse button. Absence of the point displays it is semicircular.

Complete the segment.

The tool hints at the board, in different form.

The left mouse button is pressed.

The grid representation is printed out.

Click twice on the right mouse button to highlight and point.panes.}

The left mouse button is returned to full power.

The grid representation is printed out.

The left mouse button is returned to full power.
Selecting and dragging an area of points

- Click near one point—drag to near another point. A rubber banded selector rectangle outlines the selected points.

- If the selected area has already been distorted, the corner points will define the selected area by the connecting lines.

- Upon releasing the click, the selected points would be highlighted and the connecting lines would be dimmed.

(see sample sheet for actual grid representation)
- Click/drag anywhere in the selected area to relocate the selected points.

- The dimmed line(s) turns on.

- The selected area remains active until it is deselected. Multiple moves are possible.

- Clicking outside the selected area deselects the points.

- Lines and points return to normal weight.
- Shift-click on several points selects the points.
  - Points are highlighted and connecting lines are dimmed (adjacent selected points maintain full semantic line).

- Click/drag near any of the selected points relocates all the points.
  - Dimmed lines are rubber banded. Multiple moves are possible until de-selection.

- On de-selecting, points and lines revert to "issional."
Selecting and Turning a Set of Points (Multiple times)

- Points selected in one of standard ways.
- Tack \( \Theta \) is selected for tackle box.
- Tack \( \Theta \) sets rotation point; can be on or off the grid points. A click sets the tack. It can be set at a new click until it is deselected.

- Click drag near any selected point redefines \( \Theta \) for selected area.
- Point rotates \( \Theta \) area possible until area is deselected.
- Moving essentially circumferentially around point (points the area.
- Moving Radially away from point dilates the area.

- Don't De-Select
- Lift finger from mouse.
- Place tack back in tackle box (this does not deselect the grid).
- Click drag near point will move the selected area.
- Geometric relationship between points in the selected area will be maintained.

- De-Selecting returns to normal.
1. Select "New..." under the "File" menu - will display a dialog box.
2. Type in the number of points across and down, or scroll to the number.
   (10 or some other number will initially be displayed as a default)
   a mini-grid of dots appears in a square of approximately 120 pixels square.
3. Select ● or ■.
4. Select OK.

Grid displays at a default scale (to be decreased) in a "mat" (see below) which
is "reduced to fit".

1. Grid displays at an default scale (to be decreased) in a "mat" (see below) which
   is "reduced to fit".

2. Tackle box also appears (see below).
3. In "Reduce to fit" the Mat fits.

This is what would come out of your printer:

Selecting "Paper Preview" under "View" menu
would show the mat line relative to the selected print settings:
- Paper size in print options (Gutenprint etc.)
- Mat size:
  - Shaped like a medium rectangle
  - Grid scaled in the Tackle box.

The mat rules:
- no point can be dragged across the mat line
- motifs can cross the mat line up to their corner;
- four different mats can be selected all relative to the same line.

Not to scale of screen (what picture RP?)
- grid scale and motif scale can be keyboard controlled or scrolled.
- Two Tack only, they're either in or out of the box.
- "Handle" allows tattle box to be pushed off screen and retrieved
  as in George paint.
- Go away box and "show/hide tool menu"
Preferred graphic representation of unselected, selected and rubber band areas.

Original state

Area selected

Area moved

New state after deselection
Solution A:

Structural & Mott levels as displayed simultaneously.
Section A
Structural level