Innovation in Engineering Education
Case Study:
NSF WU CPATH-T Project

R. Keith Sawyer
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Washington University
NSF C-PATH Project

• No lectures during class time; if necessary, will be videotaped and available on-line

• Of fourteen required courses, 7 are foundations and 7 are studios
Foundations Courses

- Courses that were traditional, lecture-based
- Cover specific concepts through directed homework and projects
- Class time used for interactive problem-based learning, and
- Interactive critique of student work
Studio Courses

• Courses that involve long-term projects
• Focused on a particular design and implementation methodology/paradigm
• Culminating experience: End of semester public “show” judged by a panel of faculty and students
Common Threads

• More face-to-face time with professors
• More collaboration with fellow students
• More autonomy, independent choice, inquiry-based learning
• Teams bring together all levels, freshman to senior
• Goal: develop skills of design, teamwork, communication, and innovation
Modular Curriculum

- Existing courses to be factored into smaller, bounded “modules” of knowledge
- Module length: From portion of a lecture, to one-two weeks
- New course management system to track student mastery
- Existing courses may need to be factored into “foundations” and “studio” modules
Figure 1: Topics in CSE 131 with dependencies and relationships to selected topics in other courses. Solid boxes and lines are from CSE 131. Dashed boxes and lines show relationships to other courses, with course numbers noted. Some topics (procedural programming, etc.) are expanded to show internal structure.
Four Challenges

1. Identifying a good problem or design challenge
2. Support active learning
3. Fostering effective collaboration
4. Supporting the creation of shared artifacts and effective critiques
1. A Good Problem

- **Feasible**: learners can do the problem
- **Worthwhile**: the problem contains deep content that relates to what they actually do
- **Contextualized**: real-world, non-trivial, important
- **Meaningful**: Interesting and exciting for learners
- **Issue**: Do instructional designers or learners develop the problem?
## Types of Problems

<table>
<thead>
<tr>
<th>Well structured</th>
<th>Open ended</th>
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<tbody>
<tr>
<td>One right answer</td>
<td>Many potential solutions</td>
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<td></td>
<td>More interaction</td>
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<td></td>
<td>Higher interdependence</td>
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<td>Discussion focuses on getting it right</td>
<td>More exploratory discussion</td>
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2. Support Active Learning

• Learners often have difficulty identifying the relevant data, and analyzing and integrating the data to address the problem
• Learners often have difficulty developing and articulating explanations
• Learners often have difficulty justifying their decisions
• Learners often have difficulty defending their decisions using appropriate criteria and evidence
3. Collaboration

- **Collaboration enhances learning, but only if it takes a certain form:**
  - Learners ask conceptual, probing questions;
  - Learners provide detailed, elaborate explanations;
  - Learners share their thinking, rather than offering well-formed solutions.
• *Problems that foster collaboration*:
  – Require joint activity
  – Are intrinsically motivating
4. Creating Artifacts

- Learning is more effective when the activity results in an external artifact that represents what has been learned:
  - Physical models, reports, drawings, etc.
  - Artifacts should address the problem, and also make visible what learners have learned
  - Collaboration is facilitated if it is mediated by the unfolding artifact
  - The artifact should allow assessment of the process, not only of the final product
4. Creating Artifacts

- Publishing artifacts enhances understanding.
- Viewing other’s artifacts contributes to learning.
- Critique supports understanding by helping learners reflect on their learning.
- Feedback is more effective if it’s given throughout the learning process, not only at the end.