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

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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

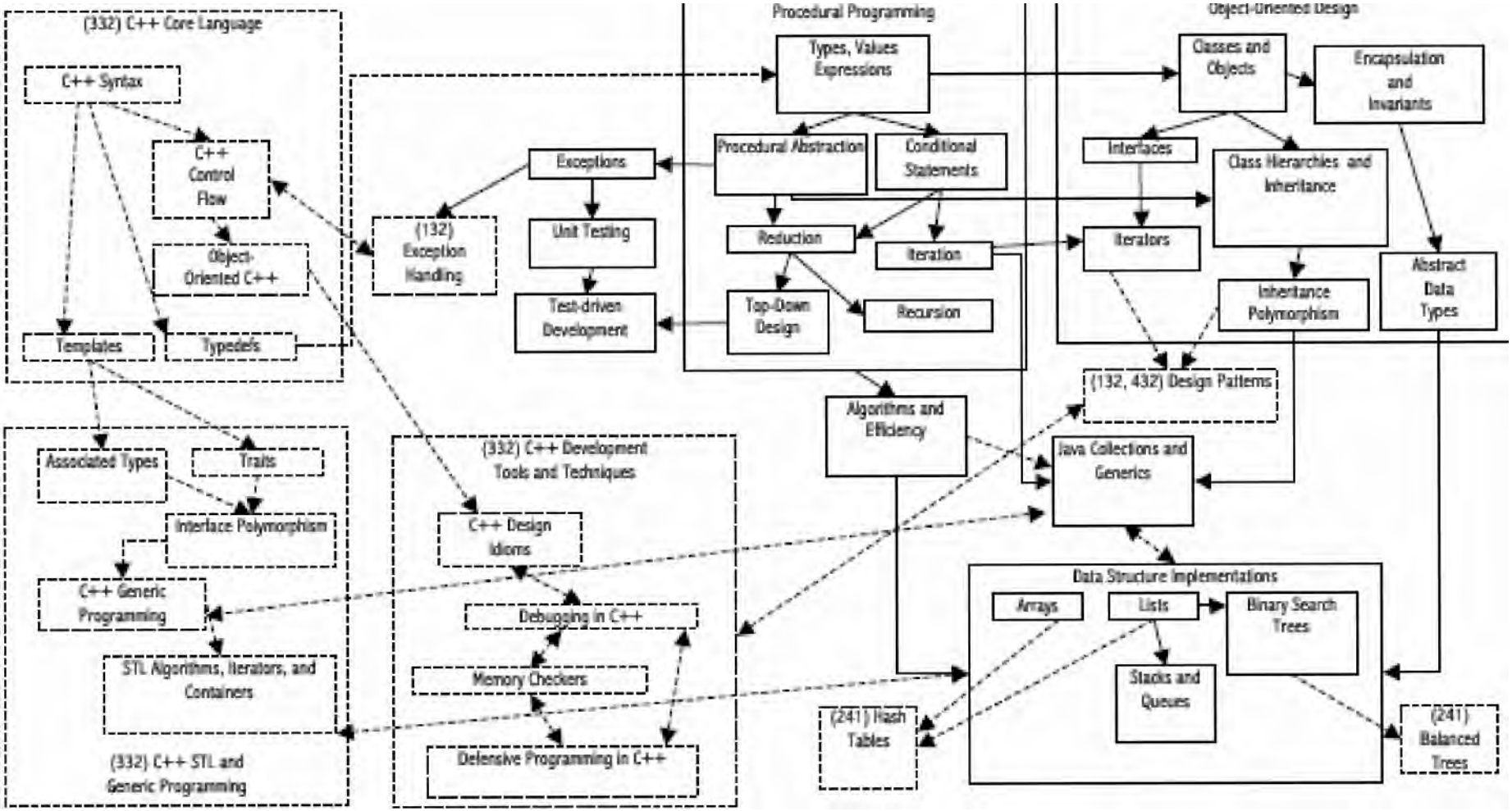

Figure 1: Topics in CSE **131** with dependencies and relationships to selected topics in other courses. Solid boxes and lines are from CSE **131.** Dashed boxes and lines show relationships to other courses., with course numbers noted, Some topics (procedural programming, etc:) are expanded to show 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

Well structured	**Open ended**
One right answer	Many potential solutions
	More interaction
	Higher interdependence
Discussion focuses on getting it right	More exploratory discussion

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 on learning
- Feedback is more effective if it's given throughout the learning process, not only at the end