An Evidence-Based Transformation of a Computer Networking Course

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BACKGROUND AND MOTIVATION

With the prevalence of networked and mobile applications in today's society, it is important that all computer scientists have the opportunity to understand the fundamentals of building software in this "connected" environment. CPSC 317, Internet Computing, a third year elective course in computer networking, that has been transformed into a more student-centered classroom using a combination of baseline student data and input from a faculty working group.

FACULTY WORKING GROUP

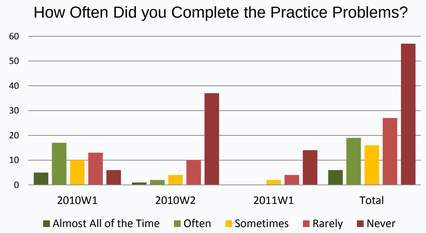
A faculty working group convened in December 2010 to begin discussions and planning for the redesign of CPSC 317. The group identified key problems with the way the course was currently taught.

1. Content was overly focused on implementation details, which are no longer required to understand the domain.
2. Course was not addressing the ready availability of application-level APIs.
3. Mismatch between course learning goals and the assignments.
4. Concerned students were missing the big picture.
5. Course was targeted only to "networking geeks."

BASELINE STUDENT DATA

We collected baseline data, including student performance data and surveys of student attitudes and engagement, over three terms from 2010 – 2011.

Course Material is Interesting vs Lecture is Engaging



TRANSFORMATION GOALS

The faculty working group articulated goals to guide their re-design efforts:

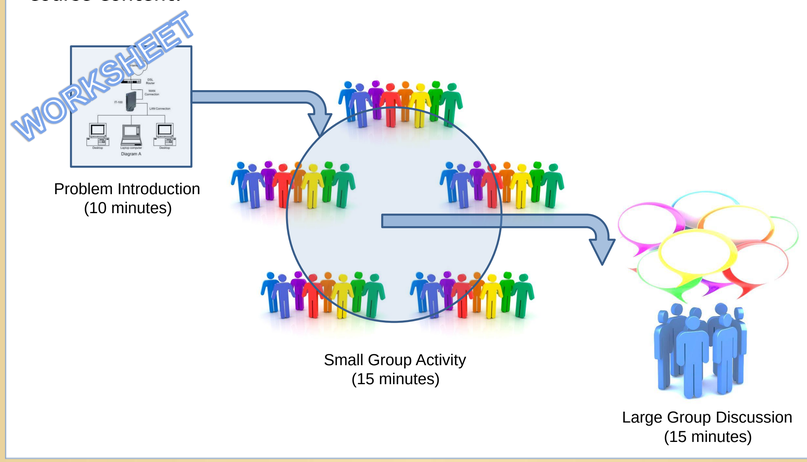
1. Networking concepts should be presented in context.
2. Assignments should have real-world authenticity.
3. Key networking strategies should be highlighted to demonstrate how/when they can be used to solve different problems.
4. Course should appeal to a broader audience and increase enrolment.

NEW LEARNING GOALS

- Modify and write programs that use the socket API.
- Determine key properties (latency, bandwidth, jitter, error rates, topology) about a network and apply the resulting information to the design of network based programs.
- Use standard application structuring techniques to design and implement network based programs.
- Specify and implement a reliable delivery protocol.
- Given a name, locate an object in the Internet.
- Explain how routing information is propagated and how that information is used to route packets.
- Describe the mechanisms, and their usage, to establish trust on the Internet.

ACTIVE LEARNING PEDAGOGY

The new course is built around a problem-based learning pedagogy using group activities to foster active learning and encourage student engagement with the course content.



DESIGN-BASED RESEARCH METHOD

Because a new course design is inherently an intervention implemented in a natural setting, we are employing a design-based research methodology (Brown, 1992) to study this complex system. We will employ a variety of quasi-experimental methods, relying heavily on formative assessments to inform and modify the design of both the course and the experimental design itself.

FORMATIVE ASSESSMENT

Two key formative assessment techniques were used during the pilot offering of the course, Spring 2012: weekly staff meetings and instructor observation/reflection logs.

Excerpt from Instructor Observation Log:

February 16	
9:38 – 10:16	I was concerned that I wasn't going to have enough material for this lecture. But, this exercise took way longer than expected, but in a good way. All the students really worked on the problem. There was good interaction between students and lots of debate … Although it went way longer than I expected, I think it was a really good activity. There was quite a bit of confusion about how GBN and SR really worked and I think this activity really allowed them to explore that.
10:26 – 10:46	The great thing about this activity was that when it was finished students seemed really interested in how to go about solving the problem. I think this might have been because they had to struggle with how to think about and organize things so they were ready to "receive" … the answer. …

Insights:

Length of time students are willing to stay engaged in an activity can have a large variance and is not always predictable.

This activity seemed to work, unlike some others earlier in the term, because it had sufficient structure to:
a) scaffold the students problem solving process and
b) support peer review and critique.

This activity really seemed to capture the students attention. At this point in the term, one key difference noted is that this activity helped students realize and struggle with the complexities of the problem. Students didn't just solve the obvious issues, but rather were able to engage and critique each other's ideas and solutions.

Resulting Course Design Changes:

- Concrete, well-defined problems in activities
- Provide more structure in activity worksheets to help students focus on the learning objectives.

SUMMATIVE ASSESSMENT

We are also collecting a variety of metrics (e.g. pre/post term attitudes survey, bi-weekly workload reports, student performance data) that will be analyzed and contribute to a summative assessment of the pilot offering once the term is complete.

We would like to acknowledge the contributions of the faculty (Bill Aiello, Norm Hutchinson and Alan Wagner), and graduate students (Mahdi Tayarani Najaran and Jonathan Schroeder) who have contributed to the design and development of CPSC 317.

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