Teaching a Problem Course; Interdisciplinary Teaching

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Outline

• Problem course:
  – My definition of a problem course
  – An example from UBC

• Teaching interdisciplinary courses
  – Engineering and Society (Princeton)
  – Science One (UBC)
  – Integrated Experience (HMC)
Problem course

- Required course
- History of student complaints
- Poor teaching evaluations for almost all instructors
CPSC 220

- Discrete math for CS majors
- First math course requiring proofs
- Teaching evaluations routinely poor even when taught by good profs
Beliefs about reasons for problems

• Students:
  – Why do CS majors need proofs?

• Instructors
  – CS majors don’t see need for proofs
  – Grab bag of topics (logic, induction, graphs, algorithms)
  – Lack of connection to programming
Ideas (mostly copied)

• Assignment 0
• Weekly quizzes
• Math cartoons
• In-class team activities
• Challenging problems
• Feedback surveys
• Programming assignments
• Food
outcomes

• Good teaching evaluations thereafter
• 80 – 20 split on whether “fun” activities were a useful addition
• Expectations of instructor and students influence teaching evaluations
Teaching interdisciplinary courses

• Single instructor
  – David Billington, Engineering and Society
  – Few people can do it

• Multiple instructors
  – Science One
  – Integrated Experience
  – Integrated Science
Benefits of multiple instructors

- Multiple perspectives
- Instructors model scientific dialogue
- Spawns teaching development and creativity
- Builds connections across departments and disciplines
Disadvantages of multiple instructors

• Expensive
• Heavier workload for instructors
• Heavier workload for students
• Not for everyone
Questions or comments
Why I’m teaching calculus …
or what I had heard …

• Student, alumni and parent concerns
  – Poor teaching
  – No connection with applications
  – Exams are too hard
  – Loss of confidence and interest in mathematics

• Instructor concerns
  – Mixed preparation
  – Students don’t work hard enough
  – Students don’t ask questions or interact in class
School of Engineering concerns

• 15 - 20% attrition from BSE program in first two years
• Attrition rate from women and minorities up to twice that for white males
Standard Calculus at Princeton

• Math 103 (derivatives, limits, intro to integration)

• Math 104 (integration techniques, series, polar coordinates, complex numbers, intro to differential equations)

• Math 201 (multivariable calculus)
Calculus at Princeton

• 3 hours of lectures per week
• Several small (10 – 20 students) sections for each course
• Senior faculty member as course coordinator
• Common midterms and exams
• Biweekly lunch meetings of instructors
• Weekly review session open to all sections
• Office hours (instructor and TAs), tutors, residential advisors
But…

• Students encouraged to place out of as many courses as possible
• Primarily taught by assistant professors and senior grad students
• Assistant professors hired without interviews
• 0% tenure rate in math department (hence teaching seen as unimportant by assistant professors)
Maria’s Math 104 experiment

• Students have more fun
  – Food in every class
  – Calculus cameo in every class
  – Assigned to challenge teams of 4 or 5
  – Ice-cream social

• Emphasis on active learning, different learning styles, feedback, etc.
Maria’s Math 104 experiment

• One of nine sections
  – Same exams, biweekly instructor lunches, etc.
• 35 students (half BSE, half AB)
• Students spend more time
  – Two two-hour classes per week
  – Extra homework (challenge problems)
  – Extra 90-minute team problem-solving session each week (with TAs)
Active learning

- Richard Felder, Chem. Eng., NC State
  - [http://clte.asu.edu/active/felder.htm](http://clte.asu.edu/active/felder.htm)
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