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)

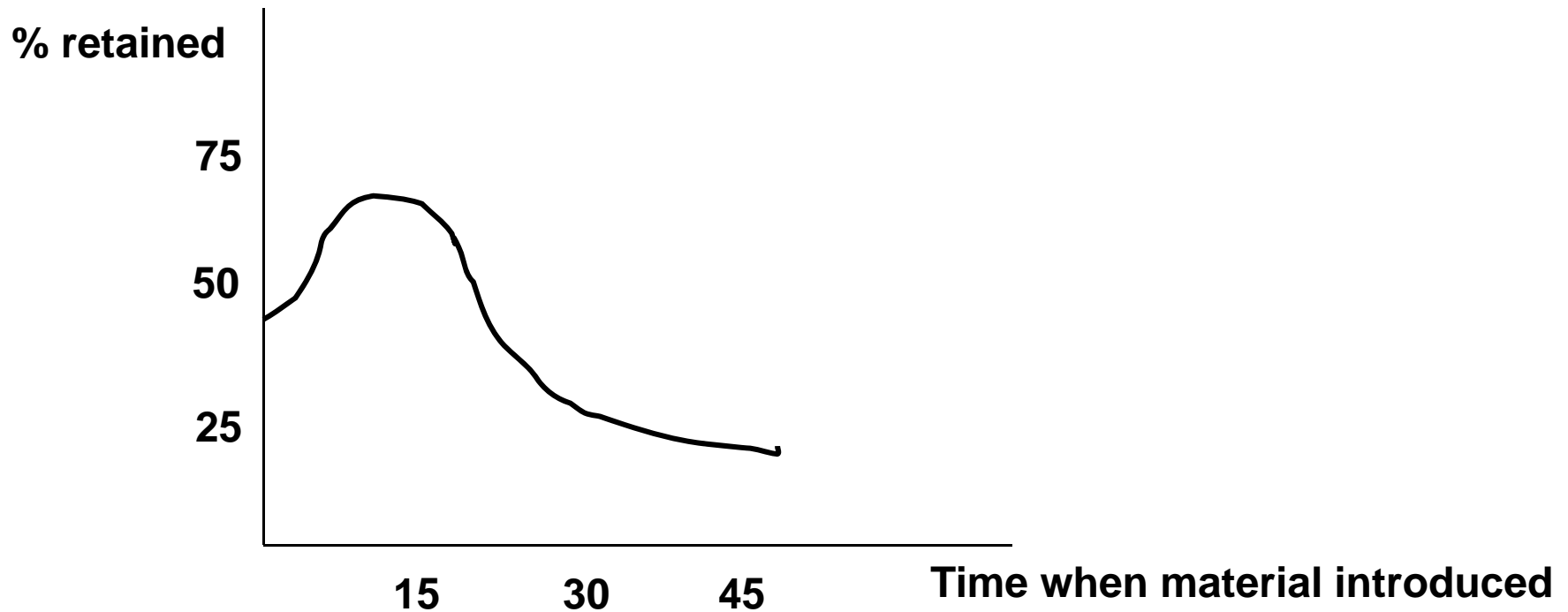# Maria's Math 104 experiment

- 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

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