Peer-led instruction for a qualifying exam preparatory course or:
How I learned to stop worrying and love the Ph.D. qualifying exam

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Background on ISU Qual Exam

- All Ph.D. candidates are required to pass a comprehensive, written exam by the end of their second year of graduate school
- Two four-hour exams administered on a Tuesday and Thursday in August
  - Classical
  - Modern
- Tests may be passed in separate years

Previous qualifier prep course

- Before the creation of this course…

There was nothing.

- A constant source of student frustration
- Initiative for this course was to address the complete lack of assistance for students preparing for the exam

Course goals

- We want to help students pass the test.
  (the primary goal is NOT to teach physics)
  - Discuss of problem-solving techniques
  - Close mentoring by experienced exam takers
  - Practice very specific test-taking strategies
  - Focus on the most important physics topics

Course goals

The working assumption is that in order to pass, you must know and/or learn physics…

BUT

learning physics is a by-product of doing the things that are necessary to pass.

What does that mean?

- Graduate student perception: One can learn physics by reading textbooks…

  BUT if you only read textbooks you are NOT going to pass the exam.

  - Let's have a race!!!

Warren: Read all the latest journals and books about proper swimming form and technique

You: Swim everyday!

What does that mean?

- Graduate student perception: One can learn physics by reading textbooks…

  BUT if you only read textbooks you are NOT going to pass the exam.

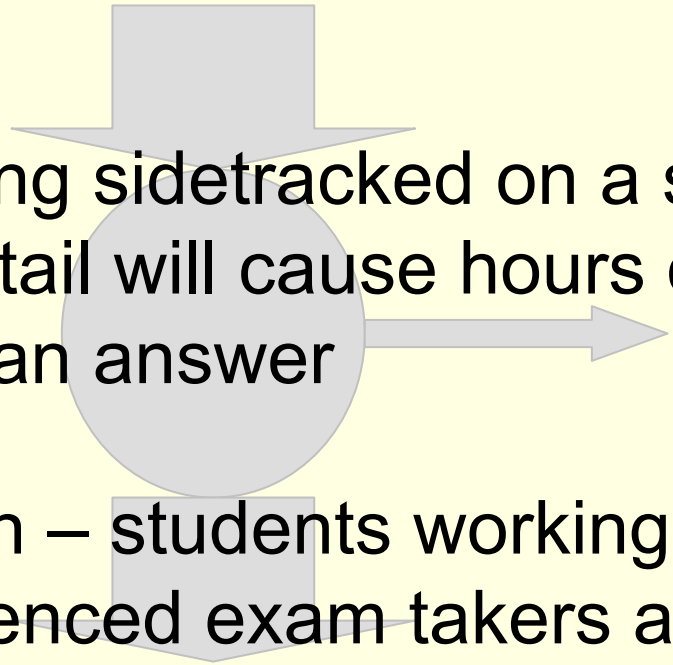
  - Let's have a race!!!

- Our course focuses almost exclusively on students working qualifier-level problems, because that will help them pass the test.

Not JUST working problems…

Issues with efficient studying

- Doing difficult problems independently can be inefficient
- Often, getting sidetracked on a single problem detail will cause hours of digression looking for an answer
- Our solution – students working in groups with experienced exam takers acting as TAs



Weekly Schedule

- 1st meeting (one hour)
  - overview of the weekly topic (20 minutes)
  - students work actual qualifying exam problems in groups (40 minutes)
  - ≈ four problems are assigned as homework to be presented at the second meeting
- 2nd meeting (two hours)
  - Students take turns presenting assigned problems at the board

Not *JUST* working problems in groups…

Class Activities Inspired by Physics Education Research (PER)

Course Theme: Students working through problems in small groups, with a strong focus on qualitative analysis and reasoning

Class Activities Inspired by Physics Education Research (PER)

- Class activities designed to address key issues identified in PER literature
  - problem solving techniques
    - structured problem-solving method
  - conceptual framework
    - anchor specific problem solution in broad context of fundamental physics principles
  - multiple representations
    - e.g. graphs, diagrams, “verbal”, etc.
  - alternative solution methods
    - explore different solution pathways
- During the 2nd meeting students must address new questions and ideas and are forced to think on their feet

Passing the exam

- Practice Exams
  - four full-length exams of equal quality and complexity as the actual exams that we pieced together from various books
  - taken in a classroom with other students at 8 a.m. on Tuesday and Thursday mornings

> "*They were quite helpful in forcing me to sit through a full exam early in the morning in cramped conditions. The practice exams were also useful in that by the time the real qualifying exam came by, it was old hat and I was quite relaxed, which helps.*"

Passing the exam

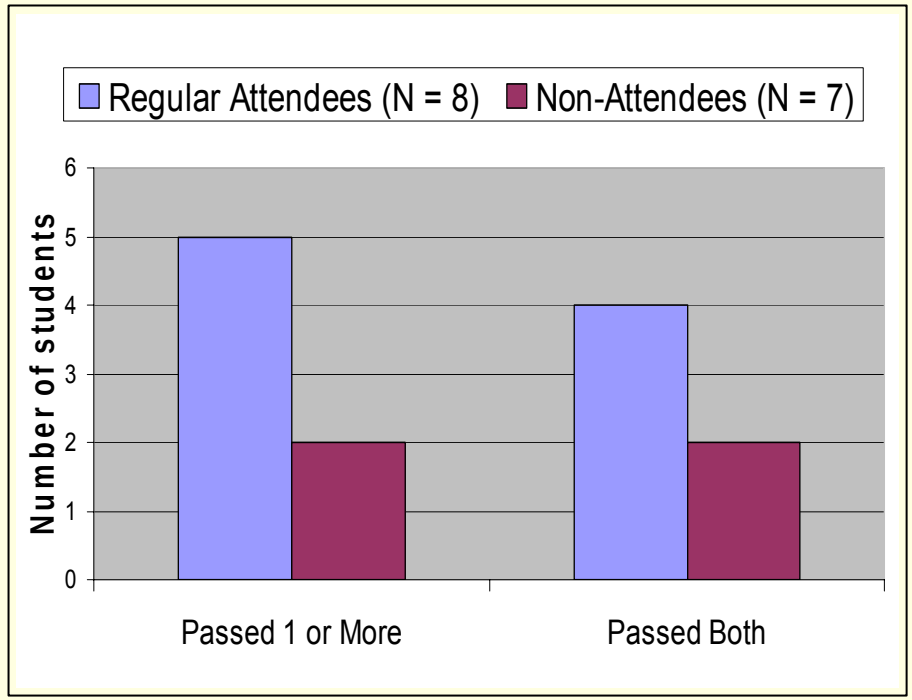
- Practice Exams
  - four full-length exams of equal quality and complexity as the actual exams that we pieced together from various books
  - taken in a classroom with other students at 8 a.m. on Tuesday and Thursday mornings
- Focus only on **exam topics** at the *appropriate* level; *not* all of physics

Exam Score Data

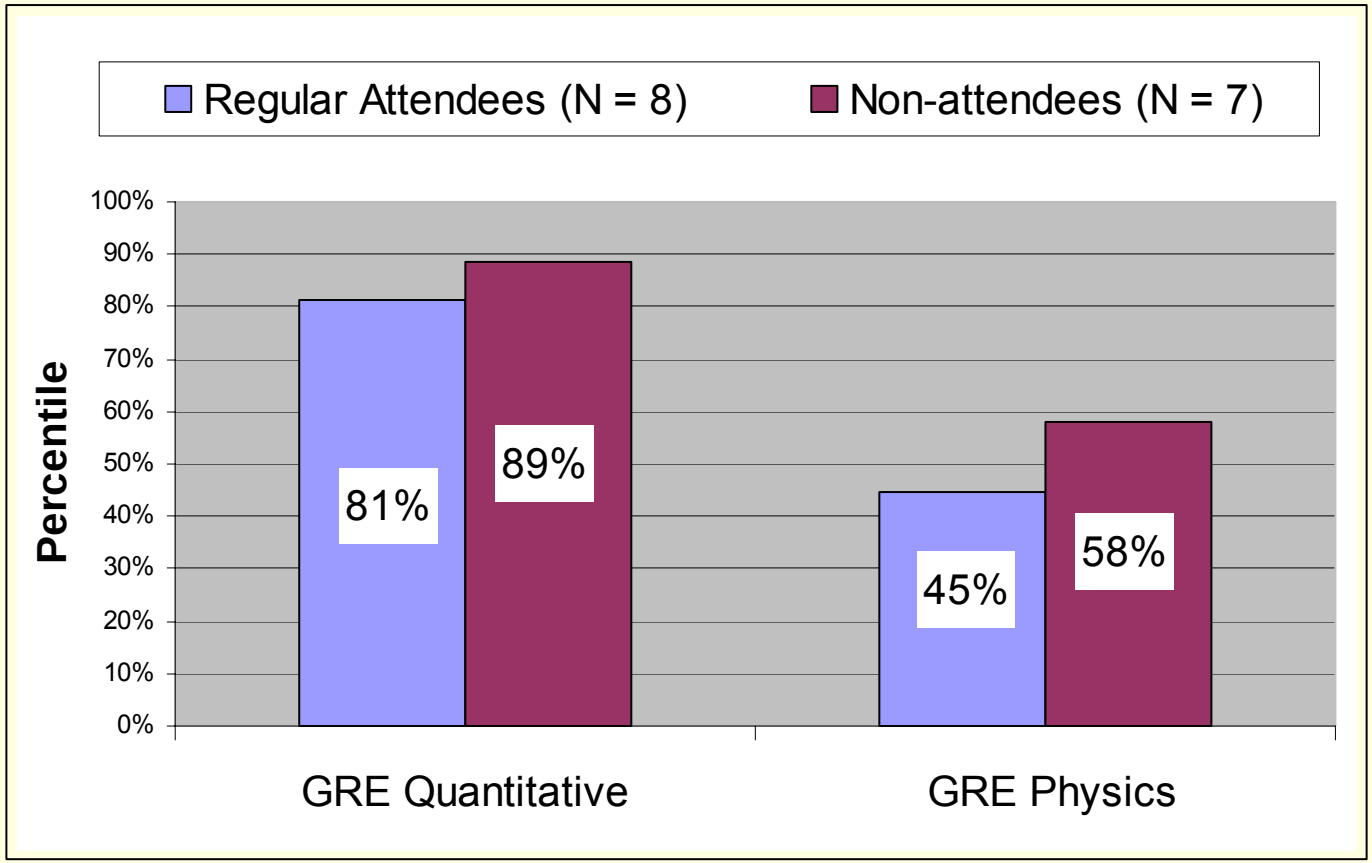
- 37 total students took the exam
  - 17 first-year students
  - 5 only had to pass one

⇨ **15** in the sample

- 8 regularly attended
- 5 out of 8 passed at least one exam
- 2 out 7 for non-attendees



Pre-instruction advantage?



Although the pass rate for attendees is much higher, it's likely that our students did not possess any pre-instruction advantage.

Conclusions

- We created and implemented a non-traditional course for qualifying exam preparation, using pedagogical innovations that we strongly feel are helping students pass the exam and learn physics.

- Feel free to visit the website:

http://www.public.iastate.edu/~wmchris/qual.html

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