Tutorials in the upper-division: Learning advanced problem solving skills

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Overview of Tutorials

• Weekly optional session
• 1-credit co-seminar course
• Taught by instructor and LA
• Group work with whiteboards
• Weekly pretest (15-minutes online) to elicit ideas
• Junior-level courses required of majors
• Typically taught using traditional lecture
• Tutorials give an additional chance to wrestle with difficult concepts
Tutorials in Junior Electricity and Magnetism:

- Developed by STF, instructor, and LA
- Inspired by efforts elsewhere*
- 12 tutorials, 3 review tutorials (for exam weeks)
- Focused on conceptual understanding, and the reasons underlying problem-solving techniques
- Geared to help students with next HW

Tutorials in Junior Quantum Mechanics:

- 7 tutorials developed by STF and/or instructor
- 7 from the University of Washington†
- 3 review tutorials (for exam weeks)
- Focused on conceptual understanding

* Eg., Oregon State University, and Ohio State
†Currently under development by L. C. McDermott, P.S. Shaffer, and the Physics Education Group at UW.
Possible benefits from tutorial:

• Instructor has close and informal contact with the students ➔ students more likely to speak up in class

• Feedback to instructor on student difficulties

• Helps students tackle “squishy” estimation, order of magnitude, general conceptual questions

• Helps students form study groups

• Help learn how to attack multistep problems

• Help students learn to verbalize explanation/defend answers/improves scientific communication
Possible tutorial issues:

- Extra time for instructors and students
- Attendance not mandatory – some students get benefits, some who need it most, don’t (see chart).
- Tutorial attendance drops as semester progresses
- Tutorials as written are too long for 50 minutes
- Pre-post tests inconclusive on conceptual learning gains
Tutorials are rated highly by students

Data from Spring and Fall 2009 E&M course (N=32)

**Overall**: Rate the Tutorial seminar overall
**Learned**: Rate how much you have learned in this Tutorial
**Enjoyed**: Rate how much you enjoyed this Tutorial
Student quotes (from tutorial FCQ):

• "It solidified concepts. I often didn't understand the material for the week until the tutorials."

• "I like the dry erase boards and working things out w/a group."

• "I think something like this should be offered for the other upper division PHYS classes - such as Mech II (3210)."

• “It helped me a great deal in building an understanding of the connection between physics and mathematics.”

• "it was extremely helpful for the hw, it really helped me understand what was going on in class."
Tutorials are rated highly by faculty

• Data from interviews with faculty who taught Junior-level physics courses with tutorials:
  – 100% would use tutorials if teaching the course again

• Quotes about Tutorials from faculty interviews:
  – “…it’s also fun for us. I enjoy the tutorials a lot. It’s really a great time.”
  – "I think it is really an efficient way of learning”
  – "they get a much deeper understanding of the quantum mechanics concepts, because they are doing something"
Conclusion

• If upper-division tutorials have great benefits,
  – Popular with students in both quantum mechanics as well as Electricity and Magnetism for 4 semesters.
  – Highly thought of by faculty who have taught tutorials
  – Help students engage with challenging material in a cooperative setting

• Why isn’t this a slam dunk?
  – Many students cannot attend this extra hour of class
  – Tutorials as written cannot be incorporated into regular physics curriculum
  – Benefits difficult to measure quantitatively