Adaptations of the *Physics by Inquiry* Curriculum

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What is Physics by Inquiry?

• A physics curriculum developed at the University of Washington by Physics Education Group (McDermott et al.)
• A guided-inquiry lab-based curriculum requiring only low-tech, inexpensive equipment.
• Emphasizes evidence-based reasoning and model development
What is Physics by Inquiry?

• Text is published by Wiley
• Topics include Properties of Matter, Electric Circuits, Magnets, Astronomy, Heat and Temperature, Kinematics, etc.
• Originally developed to help underprepared students succeed in introductory physics. Now used to train pre- and in-service K-12 teachers (esp. elementary).
Perceived barriers to adoption

- Laboratory-nature of class requires low student:staff ratio (UW uses graduate TAs).
- Course is JUST for elementary teachers.
- Highly interactive curriculum can be intimidating to plunge into.
- Developing good questions and problems is time consuming.
Goals of our collaboration

• Investigate topics that could be used in a one semester course.
• Develop models for teaching the course to larger classes (> 40 students), without graduate TAs.
• Explore ways to integrate Pbl with other content addressing various state standards.
• Develop materials for instructors to increase efficiency of adoption.
Possible solutions

• Undergraduate Teaching Assistants
  – Replacement for graduate TAs
  – How to select? train? pay??

• Cooperative group techniques
  – Increase efficiency of groups, reduce need for help from instructor
  – How best to implement?
Test environments

• Jack Taylor (Baltimore City Community College)
  – Two-year community college
  – Large fraction of ethnic minorities (83% Af.-Am.)

• Class characteristics:
  – 10-15 students (elementary education majors)
  – 1-2 undergraduate TAs

• Local challenges:
  – How to recruit and fund teaching assistants?
  – How to integrate curriculum with state standards?
Test environments

• Karen Cummings (SCSU)
  – Urban state university (8400 students)
  – Large fraction of students in education-related majors

• Class characteristics:
  – 20 students (elementary education majors)
  – 1 undergraduate TA

• Local challenges:
  – How to integrate curriculum with state standards?
  – Goal is to raise class size to ~36 students.
Test environments

• Leon Hsu (University of Minnesota-General College)
  – Large research institution (50000 students)
  – Unit at UMinn serving underprepared students

• Class characteristics:
  – 45 students (non-science majors, a few El Ed)
  – 3-4 undergraduate TAs

• Local challenges:
  – How to survive a sabbatical?
  – How to increase efficiency with cooperative grouping techniques?
Cooperative group techniques

• Heterogeneous groups (rotated every 5 weeks)
  – Student assigned to groups on the basis of attitude survey/test scores.

• Groups self-assess performance
  – What are two ways in which your group functioning works well/could be improved?

• Interdependence
  – 20% of each exam is based on a group question
  – If group exam average is \( \geq 80\% \), then each member receives 5% bonus.
  – Group members grade each other on contribution to group learning (5% of grade).
Is the course working?

- Administratively, yes (now in its 6th semester).
- CLASS survey
  - In Fall 2004 and Spring 2005, students showed large positive gains in a number of categories, including Problem Solving Sophistication and Conceptual Understanding
  - No significant gains were seen in Fall 2005.