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 PbI 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 ≥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.