Research-Based Curriculum Development in Physics

Joe Redish
Department of Physics
University of Maryland

Wingspread Conference on Geosciences Education July 9, 2002

Different instructional models can produce better conceptual gains*

Some research-based instructional environments in physics

- Lecture
  - Interactive Lecture
  - Demonstrations (Sokoloff & Thornton)
  - Peer Instruction (Mazur)
- Recitation
  - Tutorials (McDermott et al.)
  - Group Problem Solving (Heller & Heller)
- Laboratory
  - RealTime Physics (Laws, Thornton, & Sokoloff)
  - Problem Solving Labs (Heller & Heller)
- Full Studio
  - Physics by Inquiry (McDermott et al.)
  - Workshop Physics (Laws)
  - Studio Physics (Wilson & Cummings)
  - SCALE-UP (Beichner & Risley)

* See reference list at end of talk.

The Lab / Tutorial Classroom (N = 20 - 30)

- In a laboratory room
  - the students’ attention is focused on their workbench
  - students work together
  - teachers / facilitators interact with one group at a time
  - intellectual engagement is possible – in principle!

Small changes in the lab can make big differences in what the students actually do.

The Traditional Classroom (N = 20 - 600)

- In the traditional classroom
  - the teacher is the center of attention
  - students are isolated – they do not interact with each other
  - students are passive – they are rarely intellectually engaged
  - students rarely know how to obtain useful information from lectures.

Workshop Physics*

- In a WP room
  - Students use powerful computer tools for observation and modeling.
  - guided inquiry model of instruction.
  - can flexibly restructure groups.
  - instructor in the room’s center can see all computer screens at once.
  - class can easily switch from small to large group discussion.

SCALE-UP / Studio Physics

- At NC State, the workshop model has been scaled to handle hundreds of students — 99 in a class at a time.
- Similar models have been developed at RPI and MIT.

The research / redevelopment cycle

- Elements in the research-based curriculum may be tested and refined a dozen times.

References: Some Sources for Materials

- SCALE-UP, R. J. Beichner et al., http://www2.ncsu.edu/ncsu/pams/physics/Physics_Ed/.

For general links to the Physics Education Research Community, see http://www.physics.umd.edu/perg.