



Research-Based Curriculum Development in Physics

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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!



Different instructional models can produce better conceptual gains*

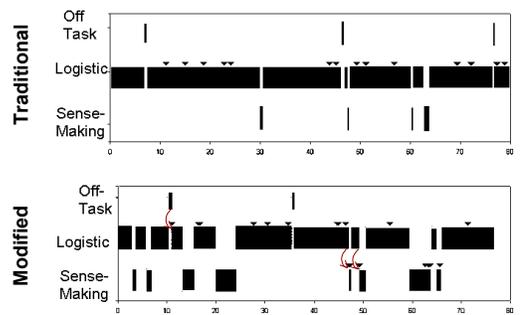
Some research-based instructional environments in physics

- 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.*



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



R. Lippmann and E. F. Redish, AERA, 2002



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.

** Priscilla Laws, Workshop Physics Activity Guide (John Wiley & Sons, 1997)*



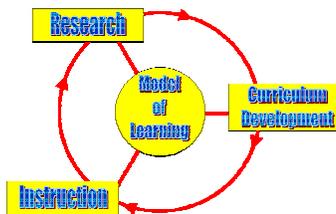
SCALE-UP / Studio Physics

- 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 a research-based curriculum may be tested and refined a dozen times



References: Some Sources for Materials

- *RealTime Physics*, David R. Sokoloff, Ronald K. Thornton, and Priscilla W. Laws, (John Wiley & Sons Inc., New York NY, 1999).
- *Workshop Physics: Activity Guide*, 3 volumes, P. Laws, (John Wiley & Sons, Inc., 1999)
- *Physics by Inquiry, Vols. I and II*, L. C. McDermott and the Physics Education Group at the University of Washington, (John Wiley & Sons Inc., New York NY, 1996).
- *Tutorials in Introductory Physics*, preliminary edition, L. C. McDermott, P. S. Shaffer, and the Physics Education Group at the University of Washington (Prentice Hall, Upper Saddle River NJ, 1998).
- *Peer Instruction: A User's Manual*, E. Mazur (Prentice Hall, 1997).
- *Just-in-Time Teaching*, G. M. Novak, E. T. Patterson, A. D. Gavrin, and W. Christian, (Prentice Hall, 1999)
- *Cooperative Group Problem Solving*, K. Heller and P. Heller, <http://www.physics.umn.edu/groups/physed/>.
- *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.umn.edu/per/>.