Physics Education Research: What it is & What it isn’t

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What is PER?

Research on the learning and teaching of physics

PER is now an established field within physics:
- About a dozen Ph.D. programs in PER -- growing
- Recognized by American Institute of Physics (AIP)
- Dedicated journal: Physical Review – Special Topics
- Annual PER Conference, peer-reviewed proceedings
- Several faculty job ads invite PER applicants

Brief History of PER

Foundations of PER (1960s – )
- Reforming curriculum e.g. PSSC - Phys. Sci. Study Committee
- Rethinking instruction e.g. Learning Cycle

Addressing Students’ Misconceptions (1970s – )
- Exploring difficulties in various topics
- Assessing understanding e.g. Force Concept Inventory
- Developing new instruction models e.g. Workshop Physics
- Facilitating engagement in lecture e.g. Interactive demos

Understanding Students’ Models (1990s – )
- Recognizing limitations of instruments
- Investigating root causes of misconceptions
- Characterizing students' thinking e.g. Model Analysis
- Attending to students’ views & expectations

Modeling Student Understanding (2000s – )
- Recognizing that not all students have ‘models’
- Seeking other frameworks to describe knowledge
- Understanding student epistemologies

“The trouble with problems in physics education is that they don’t stay solved.”
-- Melba Phillips

Where do we go from here?

PER must reach out to other fields:
- Science & Math Education Research
  - Connecting with practicing communities
- Informational Technology
  - Facilitating multiple representations & collaborative learning
- Educational Psychology & Science of Learning
  - Enhancing research design
- Emerging Science & Technology
  - Preparing citizens of tomorrow
- Cognitive Neuroscience
  - Mapping brain activity e.g. f-MRI

What We Do @ KSU

• How do students learn physics?
• What barriers do they face?
• How can we help them?

RESEARCH

• Implant them in classes
• Do these materials help?

PILOT & FIELD TESTING

• Based on research.
  • Hands-on & Minds-on materials.

CURRICULUM DEVELOPMENT
Our Research Tools

Clinical Interviews
Explore ideas that students bring from prior experiences.

Teaching Interviews
Investigate how students interact in groups to build their ideas in a mock instructional setting.

Surveys
Large scale probes.

Recent & Ongoing Projects

- Real-World Physics
  - Everyday things
  - Microscopic phenomena

- Transfer of Learning from Math to Physics
  - Trigonometry to physics
  - Calculus to physics

- Classroom Response Systems
  - IR clickers
  - Wireless PDAs

- Online Resources for Practicing Teachers
  - Synthetic interviews with experts

- "Real-World Physics"
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- "Microscopic phenomena"

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Recent & Ongoing Projects

- Problem Solving in Physics
  - Use of research-based strategies

- Modern Miracle Medical Machines
  - Positron Emission Tomography
  - X-Rays & CAT Scans
  - Human Eye

- Technology Supported Collaborative Learning
  - Tablet PCs

- Elementary & Middle-School Teachers & Students
  - Impact of reform-based courses on future teachers
  - Physics learning by elementary school students

Graduate Study in PER @ KSU

- What do PER graduate students do?
  - Design, conduct and analyze surveys & interviews
  - Develop, implement and test curricular innovations
  - Write journal articles, present talks & posters at conferences

- What do PER graduate programs do we offer?
  - M.S. or Ph.D. in Physics (with specialization in PER)
  - Ph.D. in Science Education (with specialization in Physics)

- What is the typical time for graduation in PER?
  - M.S. in Physics (with specialization in PER): 2 years
  - Ph.D. in Science Education (with specialization in Physics): 4 - 5 years

- What job opportunities do PER graduates have?
  - Faculty position in physics and/or education department
  - Work/Consult with a curriculum developer

Further Information?

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