



## 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

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## Brief History of PER

- Foundations of PER (1960s – )
  - Reforming curriculum e.g. PSSC – Phys. Sci. Study Committee<sup>1</sup>
  - Rethinking instruction e.g. Learning Cycle<sup>2</sup>
- Addressing Students' Misconceptions (1970s – )
  - Exploring difficulties in various topics<sup>3</sup>
  - Assessing understanding e.g. Force Concept Inventory<sup>4</sup>
  - Developing new instruction models e.g. Workshop Physics<sup>5</sup>
  - Facilitating engagement in lecture e.g. Interactive demos<sup>6</sup>

<sup>1</sup>(PSSC, 1960)    <sup>2</sup>(Karplus, et. al., 1967)    <sup>3</sup>(Aarons, 1978; McDermott, 1984)  
<sup>4</sup>(Hestenes et. al., 1992)    <sup>5</sup>(Laws, 1991)    <sup>6</sup>(Sokoloff & Thornton, 1997)

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## Brief History of PER (cont'd)

- Understanding Students' Models (1990s – )
  - Recognizing limitations of instruments<sup>7</sup>
  - Investigating student models<sup>8</sup>
  - Challenging traditional models<sup>9</sup>
  - Addressing student epistemologies<sup>10</sup>
- Model-based learning<sup>11</sup>
  - Recognizing that not all students have 'models'
  - Seeking other frameworks to describe knowledge<sup>12</sup>
  - Understanding student epistemologies<sup>13</sup>

*"The trouble with problems in physics education is that they don't stay solved."*

-- Melba Phillips

<sup>7</sup>(Huffman & Heller, 1995)    <sup>8</sup>(Redish, 1994)    <sup>9</sup>(Bao, 1999)  
<sup>10</sup>(Halloun, 1997)    <sup>11</sup>(Saul, 1998)    <sup>12</sup>(Hammer, 2000)    <sup>13</sup>(Elby, 2001)

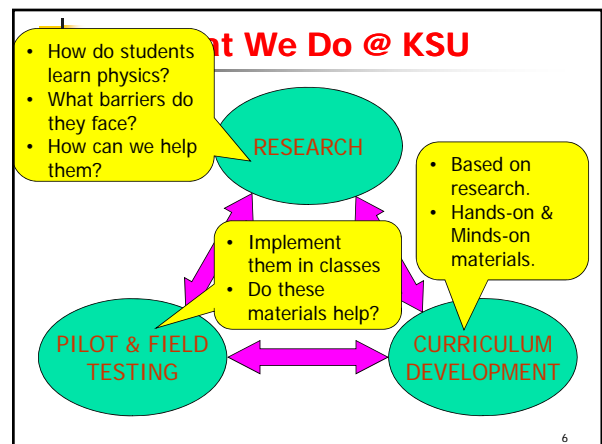
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## Where do we go from here?

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

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## 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.



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## 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

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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

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## 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 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) : 2 years
  - Ph.D. (in Physics or Science Education) : 4 - 5 years
- What job opportunities do PER graduates have?
  - Faculty position in physics and/or education department
  - Work/Consult with a curriculum developer

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## Further Information?

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