Physics Education Research at K-State

Website
http://web.phys.ksu.edu

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What We Do

- RESEARCH
  - How do students learn physics?
  - What difficulties do they have?
  - How can we help them?
  - Based on research.
  - Hands-on & Minds-on materials.

- PILOT & FIELD TESTING
  - Implement in classes
  - Do these materials really help?

- CURRICULUM DEVELOPMENT

Ongoing Projects (slide 1 of 6)

- CAREER Project
  - How do students understand everyday devices and phenomena?
  - What instructional strategies can we use to facilitate their understanding?
  - Devices/Phenomena Explored
    - Bicycle (Paula Engelhardt)
    - Light bulb (P. Engelhardt & Kara Gray)
    - Musical Instruments (Paula Engelhardt)
    - Everyday Electrical Devices (Jackie Haynicz)
    - Physics in Movies (Carina Poltera)
    - Microscopic Friction (Edgar Corpuz)
    - Optical devices (Mindy Gratny)

Ongoing Projects (slide 2 of 6)

- Modern Miracle Medical Machines
  - How do students understand the physics underlying modern medical devices and procedures
    - Positron Emission Tomography (Bijaya Aryal)
    - X-Rays (Spartak Kalita)
    - Human Eye (Dyan Jones)
    - Others

Ongoing Projects (slide 3 of 6)

- Transfer from Math to Physics
  - How do students transfer what they have learned in Math courses to Physics courses
    - Trigonometry to Physics (Darryl Ozimek)
    - Calculus to Physics (Lili Cui)

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Ongoing Projects (slide 4 of 6)

- Physics PATHWAY
  - Developing & Evaluating an online video database for physics teachers using Synthetic Interviews -- Collaboration with Scott Stevens, Carnegie Mellon Univ.
    - Brian Adrian
    - Mojgan Matloob

Ongoing Projects (slide 5 of 6)

- PDAs for a Classroom Interaction System
  - Developing Web-based software (Joe Beuckman)

Ongoing Projects (slide 6 of 6)

- CoMPASS
  - Using hypertext based Concept Maps to scaffold learning in a Design-based, Hands-on Learning Environment for Middle School students (Grades 6-8)
  - Collaboration with Sadhana Puntambekar, Univ. of Wisconsin, Madison

Recently Started Projects

- Physics PATHWAY - Next Generation
  - Research on how students learn using the system -- Collaboration with Scott Stevens, Carnegie Mellon Univ.

- Case Re-use
  - How students reuse solved examples to solve problems. - Collaboration with Dave Jonassen, Univ. of Missouri.

- Inquiry Courses for Elementary Teachers
  - Do students who take inquiry-based science teach differently when they become teachers? (Arifa Habib) -- Collaboration with Dennis Sunal, Univ. of Alabama

- Going WILD (Wandering Interactive Labs & Demos)
  - Using HP Tablet PCs for real-time data collection & sharing (David Van Domelen & Peter Nelson)

Overarching Themes

- Transfer of Learning
- Conceptual Development & Change
- Teacher training & preparation

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.
Model of Thinking

WORKING MEMORY

External Inputs
SENSEY FILTER

Interview Qs, Cues, Diagrams, Demos etc.

What type of knowledge? Self-made OR from 'authority.'

Activated Epistemic State

INFO, ALL SCENARIOS, LEARNER & RELATIONSHIP

ACTIVE KNOWLEDGE

Control

Priming

Epistemic Mode

LONG TERM MEMORY

Prior Knowledge

Prior knowledge, skills etc.

Redish (2004)

Two Kinds of Associations

- Assigning new information to a knowledge element.
  - e.g. The electric field in region is 2 V/m

- Associations between two different knowledge elements.
  - e.g. Integral of Electric field is the Electric potential.

Two Kinds of Transfer

- 'Horizontal'
  - Activating and mapping a pre-constructed knowledge structure to a new situation.
  - Associations between read-out information of a situation & elements of knowledge structure.

- 'Vertical'
  - Constructing a new knowledge structure to make sense of a situation.
  - Association between knowledge elements to create knowledge structure.

Theoretical Framework

Creating a new model to make sense of new information

'Vertical' Transfer

Activation & Mapping of new information onto existing model

'Horizontal' Transfer

Existing model

Redish (2004)

Transfer is the creation of associations between information read out by the learner & prior knowledge

The association is controlled by other factors e.g. learners’ epistemology, motivation etc.

Two Kinds of Transfer

- 'Horizontal'
  - Activating and mapping a pre-constructed knowledge structure to a new situation.
  - Associations between read-out information of a situation & elements of knowledge structure.

- 'Vertical'
  - Constructing a new knowledge structure to make sense of a situation.
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Theoretical Framework

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'Vertical' Transfer

Activation & Mapping of new information onto existing model

'Horizontal' Transfer

Existing model

Redish (2004)

Transfer is the creation of associations between information read out by the learner & prior knowledge

The association is controlled by other factors e.g. learners’ epistemology, motivation etc.
First… (e.g. Calculus)… mostly 'Horizontal'

In other words…
What we currently try to do…

In other words…
What we should try to do…

How can we achieve this goal?

In other words…
What we should try to do…

Later… (e.g. Physics)… mostly 'vertical'

In other words…
What we should try to do…

Optimal Adaptability Corridor (OAC)

Schwartz, Bransford & Sears (2005)

Any Questions?

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