Physics Education Research @ UTK

Stu Elston
Physics 599 Research Seminar
November 21, 2007
Physics Research versus Physics Education Research

- What’s the universe made of?
- How does that stuff interact?
- How do people teach and learn physics?
  - Where do physicists come from?
  - How do we make more?**
  - What do they need to know?
  - What do “civilians” (non-physicist folk - voters, politicians, etc.) need to know about physics?
Who is doing it?

Marianne Breinig
- UG and Grad Course/Curriculum Development (Physics 250, “Studio Physics”)
- Advanced (teaching) Labs

Debra Dandaneau
- UG Course Development

Stuart Elston
- In-service teacher programs
- Pre-service teacher programs
- Advanced (teaching) labs
- Modernizing intro UG courses ("Studio Physics")

Jon Levin
- Interactive engagement techniques for large lecture classes
- Remote delivery of intro courses for rural high schools

Jim Parks
- Advanced and Introductory (teaching) Labs
- "Studio Physics"

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Why do it?

- Physics bachelor's degrees granted in the US fell below pre-Sputnik era levels in 1999.
Figure 5. Junior and senior level physics major enrollments, fall 1989 - fall 2005.

AIP Statistical Research Center, Enrollments and Degrees Report.
Why?

RIOSING ABOVE THE GATHERING STORM

Energizing and Employing America for a Brighter Economic Future

Committee on Prospering in the Global Economy of the 21st Century: An Agenda for American Science and Technology

Committee on Science, Engineering, and Public Policy

NATIONAL ACADEMY OF SCIENCES, NATIONAL ACADEMY OF ENGINEERING, AND INSTITUTE OF MEDICINE OF THE NATIONAL ACADEMIES
Why?

What Might Life in the United States Be Like if It Is Not Competitive in Science and Technology?

Since World War II, the United States has led the world in science and technology, and our significant investment in research and education has translated into benefits from security to healthcare and from economic competitiveness to the creation of jobs. As we enter the 21st century, however, our leadership is being challenged. Several nations have faster growing economies, and they are investing an increasing percentage of their resources in science and technology. As they make innovation-based development a central economic strategy, we will face profoundly more formidable competitors as well as more opportunities for collaboration. Our nation’s lead will continue to narrow, and in some areas other nations might overtake us. How we respond to the challenges will affect our prosperity and security in the coming decades.
Premise

- The U.S. Economy can support more physicists and “hidden physicists.”
- There is a “pipeline problem”.
  - Kids grow into middle- and high-schoolers, into college students, into graduate students, into physicists.
- We don’t teach middle- or high-school.
  - But we do teach their teachers.
- < ~ 1/3 of teachers teaching physics in Tennessee high schools have a physics degree or even the equivalent course-work (24 semester hours).
In-service Teacher Programs

- CEEMS Summer workshops, summer 2003, 2004
  - Collaborative for Enhancing Education in Math and Science, funded by UT-Battelle
  - 2 years Bioscience, 2 years Physical Science, 1 year GeoScience
  - Target: Middle School Science teachers
  - 2-week-long inquiry-based, heavily hands-on workshops
  - Physical Science centered around wave phenomena
    - Light, Sound, Seismic Waves, Photosynthesis
In-service Teacher Programs
Math-Science Partnership: Grounding Content and Curriculum in Laboratory Experience

- Funded by Tennessee State Department of Ed., 3 years, 2004 - 2007
- ~45 High School & Middle School Science Teachers placed in month-long assignments with a UTK research lab or field site
- Follow-up during school year with Cognitive Coaching
The future? Studio Physics - reforming the college introductory physics course

- Inquiry driven, active engagement, interactive learning environment
- Laboratory integrated with discussion sections (lectures disappear); Students interact heavily with faculty and TA’s
- Hands-on, computer and technology-rich
- Highly collaborative (peer-teaching)
- Successful programs at NCSU, UNC/CH, RPI, MIT, RIT, ...
- Sufficiently new area with lots of unanswered questions.