Physics teacher education: An international conversation

Dr. Carl J. Wenning
Physics Department
Illinois State University
Normal, IL U.S.A.

Physics Teacher Education at ISU

- One of four sequences within the department:
  - Physics
  - Engineering physics
  - Computational physics
  - Physics teacher education

- Key personnel:
  - Kenneth Wester, Director (2008-present)
  - Carl J. Wenning, Director (1994-2008)
- National (NCATE) and state accreditation

PTE Plan of Study

- Broad field science preparation model
- Science teachers - Physics designation
- Physics teacher education major:
  - 22 sem hrs of physics content courses
  - 12 sem hr of physics teaching methods
  - 17 sem hrs of astro, chem, geo, and bio
  - 12 sem hrs of professional education courses
  - 3 mathematics and 11 general education courses
  - 50 days of student teaching
  - 100 hours of clinical experiences

Science Content Courses & Math

- 107 - *Frontiers in Physics*
- 110-112 – *Physics for Science and Engineering I-III*
- 205 – *Origin of the Universe*
- 217 – *Mathematical Methods of Physics*
- 220 – *Mechanics I*
- 240 – *Electricity & Magnetism I*
- 270 – *Adv. Lab I*
- 370 – *Adv. Lab II*
- *Physics Methods*
- *Bio, Chem, & Geo*
- *Calculus I-III*

Physics Teaching Methods Courses

- PHY 209 - *Intro to Teaching High School Physics*
- PHY 302 - *Computer Applications in HS Physics*
- PHY 310 - *Readings for Teaching High School*
- PHY 311 - *Teaching High School Physics*
- PHY 312 - *Teaching Physics by Inquiry*
- PHY 353 - *Student Teaching Seminar*

Notable Aspects of PTE Program

- Urban Studies Field Trip (209)
- Service Learning Project (209)
- Capstone Research Project (302)
- Whiteboarding and Socratic Dialogues (310)
- Japanese Lesson Study Project (311)
- Theory into Practice Project (311)
- Nature of Science Case Studies (311, 312)
- Social Context Project (353)
- STT Effectiveness Reporting System (353)

Retention in Teaching Field

- 75 PTE graduates since 1995
- >88% are still in the teaching field
  - 65 +/- 1 are teaching physics
  - 1 is a high school principal
  - 1 in a university teaching profession
  - 5 not in a teaching profession
  - 2 unknown

Ongoing Initiatives

- *Illinois Pipeline Project:*
  - Teacher booklet
  - Student brochure
  - Illinois Science Teaching web page

- Professional development of in-service teachers
- *Journal of Physics Teacher Education Online*
  - Professional Knowledge Standards for All Physics Teacher Educators
  - Articles that are the beginnings of a PTE textbook

Primary PTE Emphases

- Knowledge Base (content and pedagogy)
- Inquiry-oriented Instruction
- Levels of Inquiry Model of Science Teaching
- Modeling Method of Instruction
- Real-world Applications
- Nature of Science
- Teacher Candidate Assessments

Inquiry-Oriented Instruction

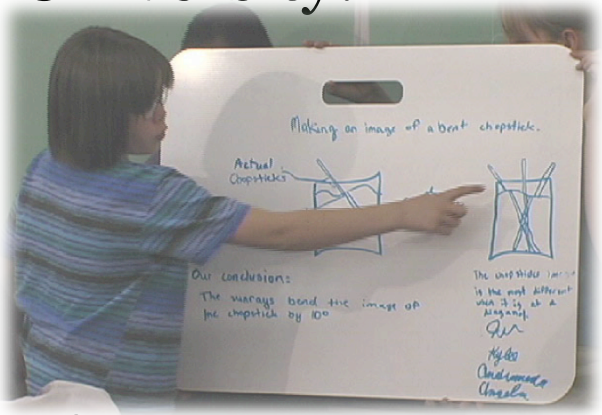
- Experiences with Inquiry (PHY 110, 111, 112)
- Introducing Inquiry (PHY 209, 302)
- Modeling Inquiry (PHY 302, 310)
- Promoting Inquiry (PHY 310, 311)
- Developing Inquiry (PHY 302, 311)
- Practicing Inquiry (PHY 311, 312)
- Deploying Inquiry (STT 399.72)
- Supporting Inquiry (in-service mentoring)

Levels of Inquiry Method

of Science Teaching will help teachers to systematically teach the knowledge, scientific and intellectual process skills, and dispositions characteristic of someone who is scientifically literate.

Modeling Method of Instruction

- Uses resources of Arizona State University:
  - Curriculum guides
  - Instructional materials
  - Whiteboarding with dialogues
  - Multiple representations

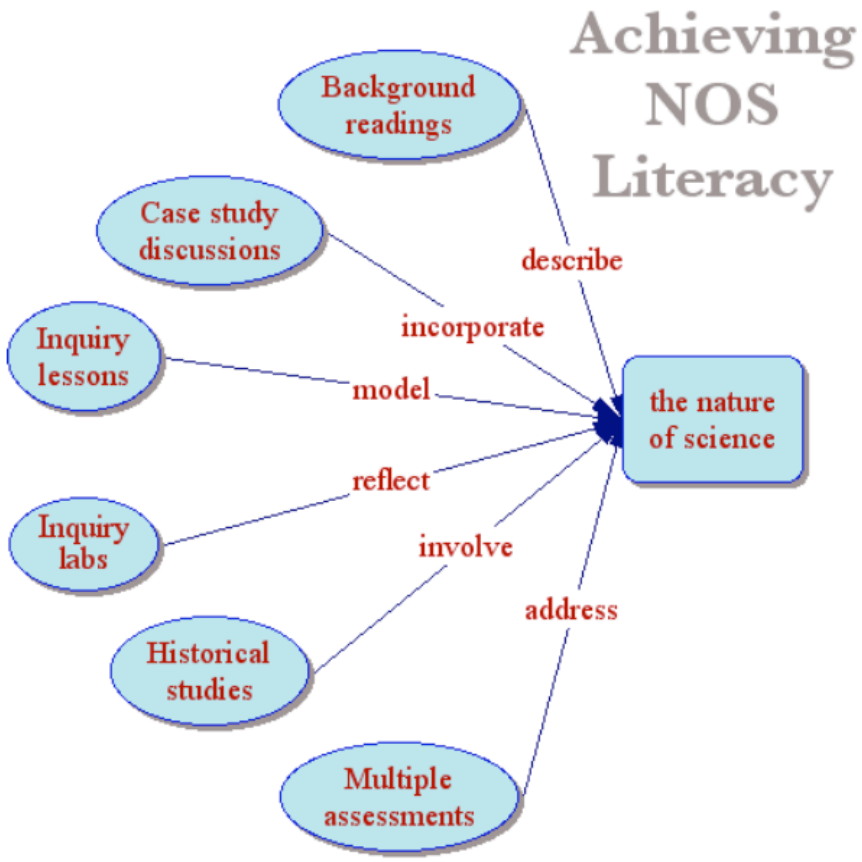


- Not promoted as the ideal form of inquiry-oriented teaching due to its failure to include real-world applications, social issues, nature of science, history of science, and so on.

Real-world Applications

- Problem-based learning
  - Low level nuclear waste dumps
  - Nuclear power plant
  - Wind farm
  - Energy futures
- Project-based learning
  - Trebuchet
  - Rube Goldberg machine

Nature of Science



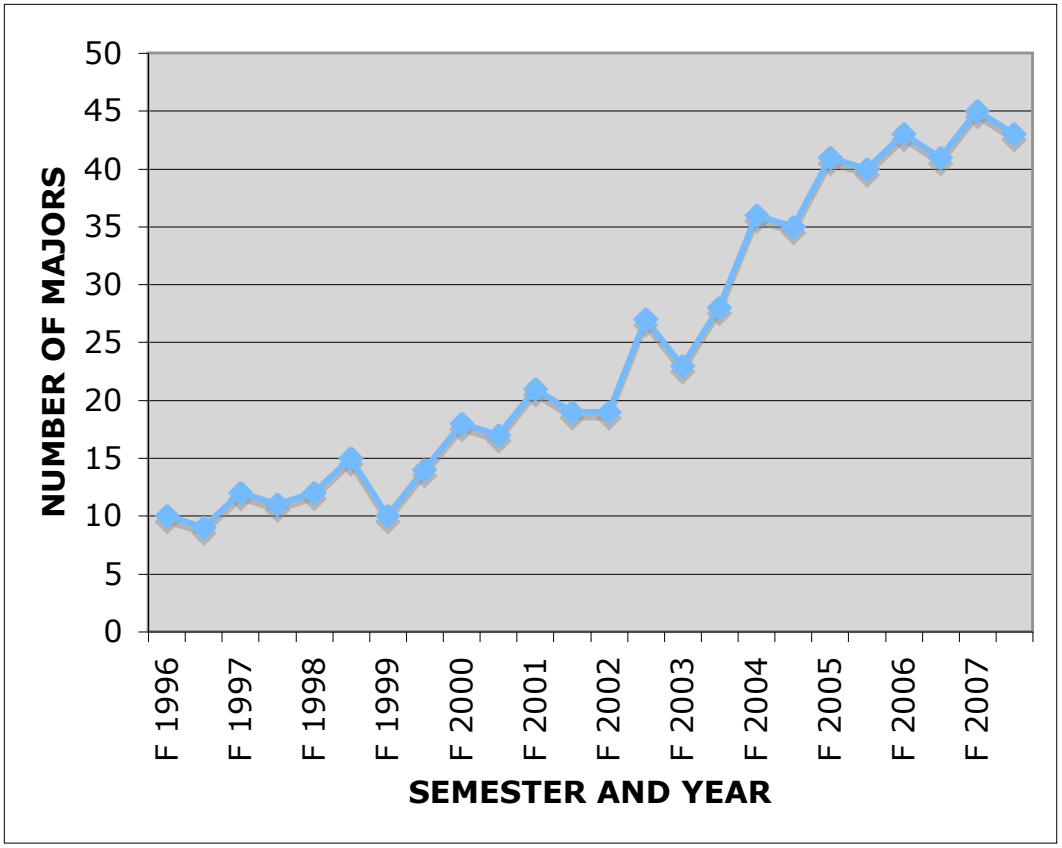
Teacher Candidate Assessments

- Assessments are:
  - authentic
  - continuous
  - varied
  - multiple
  - aligned with standards, objectives, and activities

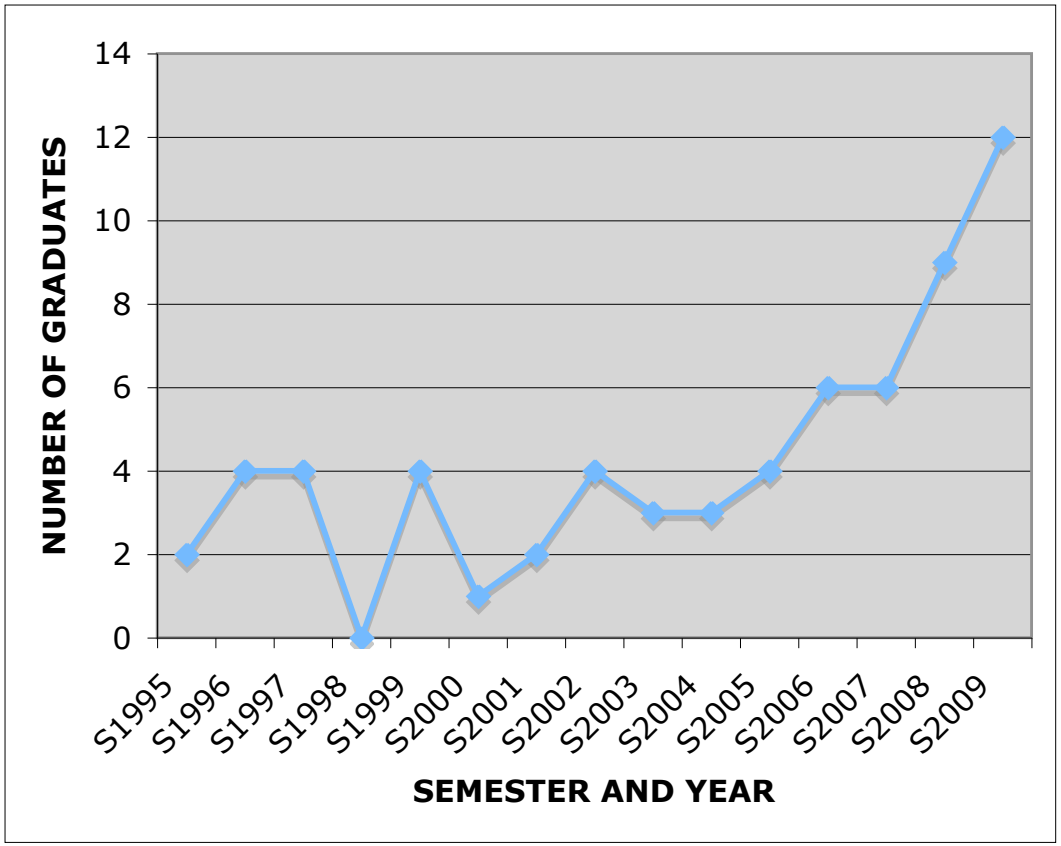
- Course syllabi show these alignments

  http://www.phy.ilstu.edu/pte/methods.html

PTE Majors by Year



PTE Graduates by Year



5 ISU Change Principles

1. *an academic leader is needed who is personally committed to improving the teacher preparation process.*

2. *an academic leader is needed who deeply understands the teacher preparation process.*

Change Principle 3

3. *an academic leader is needed with adequate "release time" for the process of properly educating teacher candidates, for incorporating external standards, and for participating in and providing professional development activities.*

Change Principles 4-5

4. *an academic leader is needed who is dedicated to and capable of quality teaching and effectively models it.*

5. *a departmental faculty is needed that understands the procedures and worth of the physics teacher education, and supports the efforts of the physics teacher education academic leader.*

Extensive Online Resources

- There is a massive repository available:
  - All course syllabi (undergraduate and graduate)
    - *Special projects*
    - *Scoring rubrics*
    - *Assessments*
  - Teacher candidate knowledge base
  - Goals and philosophy of teacher preparation
  - Conceptual framework

http://www.phy.ilstu.edu/pte/

Additional Resources

- Recent publications web page
- See especially:
  - Change principles for physics teacher education programs
  - Development of the physics teacher education program at Illinois State Univ.
  - A physics teacher candidate knowledge base

An International Conversation

- A program's description consists of more than a list of courses and a plan of study…
- Before I can make recommendations, I need to know more about your program.
- Please tell me about your program, and feel free to ask questions about mine.