TE 991A Special Topics in Science Education
TEACHING AND LEARNING SCIENCE WITH TECHNOLOGY

Fridays, 12:40-3:30 PM, Room 133E Erickson Hall
Spring 2006

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Course Overview

In this seminar, we explore relationships between learning technologies, teaching, and science learning. In particular, course participants will obtain a critical and in-depth understanding of learning technology research and theory through course readings, discussions, software reviews, and projects. Course themes will include:
(a) understanding the purposes, advantages, and drawbacks of technology in education
(b) exploring different types of technology use in science education—e.g. web-based learning environments, simulations, models, handhelds, probes, and video cases;
(c) studying relationships between technology, student learning, and teaching; and
(d) understanding issues around technology, policy, and equity in science education.

Course Objectives

Our society is changing – students need to become lifelong learners, prepared for a technology-laden society. As our scientific knowledge is increasingly stored and accessible in digital form, and as the cost of information technology drops while the cost of traditional laboratories and media rises, it is inevitable that science classrooms will become increasingly dependent on information technology for representations of phenomena, simulations, access to data, virtual laboratories, handheld devices, etc. Furthermore, scientific and engineering practices are now fundamentally based on information technology through such aspects as data analysis and modeling. As a result, learners must be technology literate in order to be scientifically literate.

What potential do these various tools have for enhancing teachers’ teaching and students’ learning? When and how are they possibly inappropriate substitutes for real experience with phenomena and when do they conceal reasoning rather than revealing it? When and how do technology-enhanced programs succeed? Where does technology fit in the curriculum? How can the “digital divide” be bridged?

This course will address these and other questions, including providing you with opportunities to:
1) Address a core aspect of education – technology is necessary and important in our society and is also a university and college-wide initiative. As the 1997 report to the president on the use of technology to strengthen K-12 education in the U.S. states, “While information technologies have had an enormous impact within American’s offices, factories, and stores over the past several decades, our country’s K-12 educational system has thus far been only minimally affected by the information revolution. ... Few colleges of education adequately prepare their graduates to use information technologies in their teaching.” This course aims to help you become better prepared.

2) Address a core aspect of teacher education and of the learning sciences

3) Read and discuss research papers about the forms and uses of learning technologies in science education, students learning and technology in science education, teaching and technology, technology implementation and systematic change, and technology, diversity, and equity in science education

4) Learn about and use education software tools in K-16 science education

5) Advance your own research via a technology related project by incorporating technology into your own undergraduate teaching (e.g. education courses), writing a literature review, designing software, or analyzing data related to technology work you are currently engaged in (e.g. on-line case studies)

Course Requirements and Grading

Readings and Discussions (25% final grade)
You are expected to read and be able to thoughtfully discuss the papers throughout the semester. You will also be in charge of leading the discussion related to the readings for one class during the semester. This entails preparing a set of questions and discussion activities as well as distributing a one page critical summary for each paper. You will be able to sign up for the week you choose to present. We will be happy to provide feedback on your ideas for the class discussion and activities beforehand.

Required readings: Various papers posted on our course Angel site, and the Jossey-Bass reader on Technology & Learning (to be purchased – ISBN#07879-52826 for roughly thirty dollars.)

Software Explorations (25% final grade)
In this assignment, you will explore and present two pieces of educational software or technology in pairs to the other members of the class. In your presentation, you will need to demonstrate key elements of the software or technology and discuss its affordances and limitations from both learning and teaching perspectives.

Software and technology examples will include:
- TELS & WISE (http://www.telscenter.org/index.html) (http://wise.berkeley.edu)
- CASES (http://cases.soe.umich.edu/)
- Inquiry Island & ThinkerTools (http://thinkertools.soe.berkeley.edu/index.html)
BioKids (http://www.biokids.umich.edu/)
Case It! (http://www.uwrf.edu/caseit/caseit.html)
Two modeling/programming pieces of software such as LOGO (http://education.mit.edu/starlogo/), Scratch (M. Resnick new software), Squeak (squeak.org), Model-it (http://hi-ce.org/soft_modelit.html), or Stagecast Creator (http://www.acypher.com/creator/index.html)
CSILE/Knowledge Forum (http://www.knowledgeforum.com/)
Several types of commercial software including those from places such as Riverdeep (riverdeep.net) (their light and electricity lab), Tom Snyder productions (tomsnyder.com) (science court software), and Sunburst (sunburst.com)
Probeware
Multiple on-line simulations (e.g. PHET physics simulations, (http://www.colorado.edu/physics/phet/web-pages/simulations-base.html) and other resources such as NASA data and analysis sites (http://asd-www.larc.nasa.gov/SCOOL/) (http://www.globe.gov/), lesson-plan sites (http://mscrn.educ.msu.edu/), etc.
Other forms of technology such use of audio and video

Course Project (40% final grade)
In the culmination project for this course, you will advance your own teaching and/or research by choosing among several options:
1) Incorporate technology into your own lesson plans within your undergraduate teaching (e.g. education courses) or into a K-12 piece of curriculum, and write about the rationale behind the manner of your technology integration and about expected impact on science teaching and learning drawing on the frameworks we have read about and discussed in the course.
2) Write a comprehensive literature review based on some particular aspects of technology and science teaching and learning. (e.g., gender & technology, special education & technology, etc.) Again, this review must relate to the frameworks we have read about and discussed in the course.
3) Conduct a small piece of research on some technology-related work (e.g. case-based video uses) and analyze results. Discuss those outcomes within an integrated theoretical framework from class readings and discussions.
4) Other option to be discussed with the instructors.

The write up for this project will be roughly 10-15 double spaced pages in length. We are very interested in working with you in having a final project that is both meaningful (practical and advances your thinking and research in your area of interest), and well-grounded in the research literature on technology in science education. We look forward to having all course participants share their final projects with one-another at the end of the semester.

Participation and Attendance (10%)
The success of any seminar course hinges on active participation by each member. Each member is expected to come to class ready to contribute thoughts and prepare for class each week through readings and course projects. In this way, each person will not only
benefit from his/her own efforts and experiences, but also from those of the whole community. Because it’s not possible to participate if you do not attend, your final grade will be affected by anything beyond one excused absence. Please let us know in advance if you anticipate missing a class.

Course Schedule: Course Readings & Assignments

January 13 First class

- Introduction to course; sign up for paper and software presentations.

January 20 Why technology?

Readings


- Please skim the following readings:

- Briefly review NSES technology standards (within the content standards) (http://www.nap.edu/readingroom/books/nses/html/6a.html#sts)

Software Demonstration

January 27 Advantages and Disadvantages of Learning Technologies

Readings


Software Demonstration

**February 3 Learning Theory and Design Principles for Technology Use**

Readings


Software Demonstration

Check-in #1 about final project

• 1-page double-spaced draft of ideas for project write up; be prepared to share these ideas with the class.

**February 10 Forms and Uses of Technology in Science Education**

Readings


• Davis, E. A., Smityey, J., & Petish, D. (2004). Designing an online learning environment for new elementary science teachers: Supports for learning to teach. Versions of this paper were presented at the National Association for Research in Science Teaching annual meeting, Vancouver, BC, April, 2004,
and the International Conference of the Learning Sciences, 2004, Santa Monica, CA.


Optional Reading

Software Demonstration – CASES and on-line teacher resources

February 17 Student Learning and Technology in Science Education

Readings

Software Demonstration – Stagecast Creator and/or Model-it

February 24 Student Learning and Technology in Science Education (continued)

Readings

Software Demonstration – TELS & WISE
March 3 Teaching and Technology

Readings


Check-in #2 about final project

- Bring draft write up of project to class; you will work in pairs to provide and receive feedback.

March 10 – Spring Break. No class.

March 17 Teaching and Technology (continued)

Readings


- Please skim the following paper:

Software Demonstration

March 24 Implementation and Systemic Change

Readings


Software Demonstration

**March 31 Technology, Diversity, and Equity**

**Readings**


Software Demonstration

**April 7 – NARST & AERA. No class.**

**April 14 Technology, Diversity, and Equity (continued)**

**Readings**


**Check-in #3 about final project**

• Bring draft write up of project to class; you will work with peers and the instructors to receive feedback.

**April 21 Choice Papers (Pick one or two papers to read or other you find)**

• Gender differences chapters in Jossey-Bass reader (9 &10) and the AAUW report on “Educating girls in the new computer age.”

• Learning disabilities and technology chapter (13) in Jossey-Bass reader.
• Distance learning papers including Zhao et al, TCR paper (2005) and Gunawardena & McIsaac handbook chapter (2004).

Software Demonstration

**April 28 – Last day of class**

• Final projects due. Class sharing.
**Reading and Critical Summaries**

First, a few important notes:
- Please write the citation of your paper at the top of the critical summary and write your name in the header so people know who wrote the summary.
- Do not feel compelled to write full text in your summary. Bulleted points are often easier to read and use when referring back to the summary.
- Keep your summaries concise! They should be no more than 1-1.5 pages. (Remember, they are summaries.) You can always refer back to the page numbers in the text if you need more detail.

Developing understanding of a reading involves answering the following questions:
1. What is the author trying to say?
2. How does what the author is trying to say relate to writings of other authors? How is the author positioned in the field?
3. How would the author explain or interpret events related to science learning and teaching?
4. How does the author’s understanding compare with yours?

Critical summaries will help begin our dialogue about the first two questions. A critical summary explains the main idea(s) of an article and expresses a particular point of view. A summary should clearly note that the information being conveyed is not your own. To be clear about who originally wrote the material, always begin your summary with the author’s name and the title of the piece (i.e., book, article, web page, etc.).

A critical summary does **not** address any of the following questions:
- Do you like the article?
- Do you agree with the author?
- Is the premise realistic?
- Do the assertions reflect your personal experience?
- Is this kind of research useful for your doctoral dissertation?

A critical summary may address any of the following questions:
- Is the research method appropriate to the claims?
- What significant factors have been ignored in the analysis?
- What perspective does the article fail to account for?
- What counts as evidence? What doesn’t count?
- What rhetorical strategies make the argument compelling, provocative, and/or weak?
- How does the article advance our understanding of what constitutes research? What are the epistemological and/or political implications of this research approach?
Guidelines for Project Paper

• **Demonstrate critical thinking and/or analysis.** The paper should make a clear point that is more than description or narration. The critical analysis should be your own original contribution, not simply a summary of other peoples' ideas.

• **Acknowledge multiple viewpoints.** Your paper should give evidence that you understand and appreciate more than one perspective on an issue. This does not mean you should be wishy-washy. Make a clear point by showing that you have considered alternate views.

• **Situate the argument in the field.** Your paper should make it clear to the reader which conversation in the literature you intend to join. The paper should draw from current literature, explain how others have addressed your issue, and state explicitly how your piece makes a contribution (e.g., synthesizes, emphasizes someone else’s findings, compares viewpoints, and changes the question).

• **Draw from course materials.** Your paper should give evidence that you are taking this course. You do not need to agree with any of the readings or presentations, but your paper should show you have considered the course materials thoughtfully.

• **Support assertions with evidence.** Assertions or claims in your paper need to be supported. Evidence can come from the readings, discussions, and your personal experience, as long as the kind of evidence is pertinent to the claim.

• **Challenge assumptions.** The paper should show that you have learned something by doing this paper. There should be evidence that you have been open to changing your mind.

(Thanks to Lynn Fendler for critical summary and paper guidelines.)