

# SME 701 Issues in Science, Mathematics, and Technology Education

Syllabus for Fall 2004

**Course Title:** Issues in Science, Mathematics, and Technology Education

**Course Credit:** 3 hours

**Course Description:** Study of issues related to curriculum, instruction, assessment, and research in science, mathematics, and technology education

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## Objectives:

The purpose of this course is to analyze the reform in science and mathematics education as it relates to curriculum, instruction, and assessment in K-12 classrooms. The course will also examine the role of technology in reforming science and mathematics instruction and the emerging place of technology education in school curricula.

The specific objectives of the course are:

1. To examine science and mathematics education reform movements and how they are changing science and mathematics instruction in K-12.
2. To share ideas, insights, and experiences of teachers and administrators in the way the new standards influence science and mathematics teaching in the schools.
3. To discuss how research contributes to the understanding of school science and mathematics instruction.
4. To analyze the paradigm shift in science curriculum, instruction, assessment, and research brought about by advances in cognitive science research and studies on brain and learning.
5. To analyze the factors that contribute to the unsatisfactory performance of US students in the TIMMS and its implications to the quality of administration and management of programs relating to science and mathematics instruction
6. To examine the role of technology in reforming science and mathematics education K-12.
7. To establish the rationale for the inclusion of technology education in K-12 curricula.

## Course requirements:

1. Class participation as a seminar leader
2. Completion of *Views on the Nature of Science* pretest and posttest
3. Two exams (midterm and final)
4. Critique of research papers (at least 3)
5. A meta-analysis paper on one issue in science, mathematics, and technology education
6. A multimedia presentation on addressing the issues in science, mathematics, and technology education

**Schedule of Activities:**

- August 23 Course Orientation  
The Reform Movements in Science K-12:
1. *The National Science Education Standards* (all six)
  2. *Benchmarks for Science Literacy*
- Readings:** The CSMEd resource room contains copies that may be read in-house or signed out. Alternatively, the books are “browsable” at the following addresses:  
For the National Science Education Standards:  
<http://www.nap.edu/readingroom/books/nses/htm/>  
For the Benchmarks for Science Literacy:  
<http://www.project2061.org/tools/benchol/bolframe.htm>
- August 30 Issues on curriculum: research-based curriculum, content emphasis, pedagogical principles, and evaluation. Some examples of curricula to examine are FOSS, Science, Technology For Children (STC), BSCS, and Math Trailblazers. These programs are in the resource room.
- September 13 The influence of cognitive science research on curriculum, instruction, and assessment in science, mathematics, and technology education  
**Readings:**
1. How People Learn: Brain, Mind, Experience, and School: Expanded Edition (2000)
  2. Knowing What Students Know: The Science and Design of Educational Assessment
  3. Learning Science and the Science of Learning
- September 20 Reform in Mathematics Education K-12: NCTM Standards  
Principles and Standards for School Mathematics  
Issues on implementing the NCTM Standards  
Other issues in math education
1. Math wars
  2. Constructivist theory applied to math education
  3. Use of handheld technology
  4. Various math courses taught in high school and teacher assignments. This means a teacher teaching algebra, geometry, or calculus for several years then being shuffled to teach different math subject to a different grade level.
  5. Use of manipulatives
  6. Equity issues in math classrooms
  7. Other issues contributed by students based on reading or firsthand experience or shared knowledge from peers

1. **Readings:** There are several copies of the Principles and Standards for School Mathematics K-12 in the CSMEd resource room that students can borrow.

September 27

Issues in mathematics and science education research  
Types of research: quantitative, qualitative and action research  
Research in mathematics education. Graduate students will read and discuss a research article in mathematics education.

The discussion should include the following:

1. Statement of the problem
2. Design or procedure (including target population, research design, methods of data collection)
3. Data analyses and findings
4. Conclusions
5. Contribution to knowledge in mathematics education

October 4

Library time to complete requirement # 3. This assignment will have four parts.

Part 1. Select three research papers exemplifying the three types of research: quantitative, qualitative, and action research. Use the APA Style Manual to write the citations of the selected research papers.

Part 2. In 300 words or less, write an abstract of each research.

Part 3. Write a synopsis of the article not to exceed 6 pages. The synopsis should include the salient points of the research such as:

- A. Statement of the problem
- B. Design or procedure (including target population, research design, methods of data collection)
- C. Data analyses and findings
- D. Conclusions
- E. Contribution to knowledge in science, mathematics, and technology education

Part 4. Write a paper comparing or contrasting the three researches using your own parameters or criteria. The paper should not exceed 6 pages and should be written as a publishable viewpoint article in a journal with appropriate title, headings, and proper grammar and mechanics (punctuations, capitalization, etc.).

You may choose research from science, math, and technology education. **This assignment is due on October 18.**

October 11

The nature of research in science, math, and technology education  
**Readings:**

1. Scientific Research in Education (2002) by Richard Shavelson and Lisa Towne

2. Science, Evidence, and Inference in Education: Report of a Workshop by Lisa Towne and Richard Shavelson
3. Investigating the Influence of Standards: A Framework for Research in Mathematics, Science, and Technology Education by Iris Weiss, Michael Knapp, Karen S. Hollweg, and Gail Burrill

October 18

Mid-term Exam

October 25

Standards for Technological Literacy  
Technology in the science and mathematics classrooms  
Examples of technology curriculum in grades K-12

**Readings:**

1. Standards for Technological Literacy
2. Technically Speaking: Why All Americans Need to Know More About Technology by Greg Pearson and A. Thomas Young

Nov.1 & Nov.8

Issues on instruction: Teaching for conceptual understanding, inquiry teaching, teaching controversial topics

**Readings:**

1. How People Learn: Brain, Mind, Experience, and School. Expanded edition (2000)
2. Excerpts from Teaching Science for Understanding: A Human Constructivist View.
3. Inquiry and the National Science Education Standards: A Guide for Teaching and Learning
4. Teaching About Evolution and the Nature of Science

Nov. 15 & Nov. 22

Issues on assessment: classroom assessment, student learning, performance-based assessment, student work, high stakes/standardized testing. Implications of “No Child Left Behind”

**Readings:**

1. Knowing What Students Know: The Science and Design of Educational Assessment
2. Classroom Assessment and the National Science Education Standards
3. Selected articles e.g. Ayita Ruiz-Primo

Nov. 29

Issues on the professional development of science, mathematics, and technology teachers (preservice and inservice)

**Readings:**

1. Educating Teachers of Science, Mathematics, and Technology: New Practices for the New Millennium
2. Educating America’s Teachers: A Report by the Commission on Teacher Education

### 3. The National Council of Accreditation for Teacher Education

December 6

Issues on equity: gender, multicultural, and disability conditions

The Impact of TIMSS: What did we learn from the results of TIMSS?

**Reading:**

1. Global Perspectives for Local Action: Using TIMSS to Improve US Mathematics and Science Education (1999)

December 13

Class presentation of meta-analysis papers

Multi-media class presentation: Addressing the issues in science, mathematics and technology education

Final Exam

## SME 701 Fall 2004 Reading List

National Research Council. National Science Education Standards. (1996). National Academy Press. Washington D.C.  
(<http://www.nap.edu/readingroom/books/nses/htm/>)

American Association for the Advancement of Science. Benchmarks for Science Literacy (1994). AAAS. Washington, D.C.  
(<http://www.project2061.org/tools/benchol/bolframe.htm>)

National Council of Teachers in Mathematics. Principles and Standards for School Mathematics K-12.

International Technological Education Association. Standards for Technological Literacy. ([www.iteawww.org](http://www.iteawww.org))

Scientific Research in Education (2002). Committee on Scientific Principles for Education Research by Richard J. Shavelson and Lisa Towne, *Editors*, National Research Council. 204 pages. National Academy Press: Washington, D.C.

National Educational Technology Standards for Students: Connecting Curriculum and Technology (2000). International Society for Technology in Education (ISTE) and the U.S, Department of Education.

National Educational Technology Standards for Teachers (2000). International Society for Technology in Education (ISTE) and the U.S, Department of Education.

Learning Science and the Science of Learning (2002). Bybee, R. ed. National Science Teachers Association Press.

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Technically Speaking: Why All Americans Need to Know More About Technology (2002). by Greg Pearson and A. Thomas Young, *Editors*, Committee on Technological Literacy National Academy of Engineering, National Research Council. National Academy Press: Washington, D.C.

Investigating the Influence of Standards: A Framework for Research in Mathematics, Science, and Technology Education (2001) by Iris Weiss, Michael S. Knapp, Karen S. Hollweg, and Gail Burrill, *Editors*, Committee on Understanding the Influence of Standards in K-12 Science, Mathematics, and Technology Education Center for Education, National Research Council. National Academy Press: Washington, D.C.

Knowing What Students Know: The Science and Design of Educational Assessment (2001) by James W. Pellegrino, Naomi Chudowsky, and Robert Glaser, *Editors*, Committee on the Foundations of Assessment, Board on Testing and Assessment, Center for Education, National Research Council. National Academy press: Washington, D.C.

Classroom Assessment and the National Science Education Standards. (2001) by J. Myron Atkin, Paul Black, Janet Coffey, *Editors*, Committee on Classroom Assessment and the National Science Education Standards, Center for Education, National Research Council. National Academy Press: Washington, D.C.

Science, Evidence, and Inference in Education: Report of a Workshop by Lisa Towne, Richard J. Shavelson, and Michael Feuer, *Editors*, Committee on Scientific Principles in Education Research, National Research Council, National Academy Press: Washington, D.C.

Knowing and Learning Mathematics for Teaching: Proceedings of a Workshop. (2001) Mathematics Teacher Preparation Content Workshop Program Steering Committee, Center for Education, National Research Council, National Academy Press: Washington, D.C.

Education Teaches of Science, Mathematics, and Technology: New Practices for the New Millennium (2000) Committee on Science and Mathematics Teacher preparation, National Research Council, National Academy press; Washington D.C.

How People Learn: Brain, Mind, Experience, and School: Expanded Edition (2000) Committee on Developments in the Science of Learning Research with Educational Practice, National Research Council. National Academy Press.

Inquiry and the National Science Education Standards: A Guide for Teaching and Learning (2000) by Steve Olson and Susan Lourks-Horsley, *Editors*, Committee on the Development of an Addendum to the National Research Council, 224 pages. National Academy Press,

Global Perspectives for Local Action: Using TIMSS to Improve US Mathematics and Science Education. (1999). Committee on Science Education K-12 and Mathematical Sciences Education Board, National Research Council, National Academy Press: Washington, D.C.

How to use this reading list.

1. The four books on standards: science (NSES and Benchmarks), math (NCTM), technology (ITEA) will be read thoroughly and will be used as a backdrop of the various discussions on trends and issues.
2. Selected chapters in the books listed will be assigned for seminar discussion as indicated in the schedule. Assignments of chapters and seminar leaders will be decided on during the second meeting after perusing the materials.
3. Additional research articles will be assigned to enrich the discussion.