EDCI 650

Trends in Mathematics Education

Fall 2004
Wednesdays, 4:15 -7:00 p.m.
Room 2121, Benjamin Building
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Office hours: W, 3-4 p.m. or by appointment

COURSE OVERVIEW

The goal of the teacher education program at the University of Maryland is to prepare reflective practitioners for classrooms of diverse learners through research-based inquiry. The masters degree program in mathematics education is designed to enhance teachers' understanding of mathematics content and pedagogy, serving teachers from both elementary and secondary schools. The program addresses research that has implications for practice as well as resources for practice, while spanning topics of learning, teaching, curriculum, policy, and the social context of education. Graduate courses in mathematics education may also be accessed by prospective teacher leaders who wish to broadly sample a range of content fields that are critical to school curriculum.

EDCI 650 identifies and characterizes how developments in educational thinking and practice have affected mathematics curriculum and instruction. As such it considers both a historical perspective and the current status of mathematics education.

COURSE OBJECTIVES

Students in this course will complete reading and written assignments, engage in lecture/discussion sessions, and offer presentations so that they may develop knowledge encompassing the following abilities and understandings.

1. Characterize how practice and thinking about school mathematics curricula has evolved historically in the United States, noting what forces influenced the definition of content and instruction.
2. Describe how theories of learning have influenced perspectives on teaching as evidenced in the content, organization, pacing, and presentation of mathematics topics in published curricula.
3. Analyze curriculum frameworks for school mathematics as well as commercial curriculum materials, noting both the mathematics content, the instructional approach, and the assumptions inherent in those frameworks and materials.
4. Characterize how calculators and computer technology have influenced and could influence the expectations, structure, and presentation of mathematics in schools.
5. Describe the current status of mathematics education in the United States with respect to student achievement, curriculum standards, and assessment policies with particular attention

to international comparisons as revealed in TIMSS and to implications for equity (gender, race, and economic status).

6. Identify the important issues, policies, and challenges that are facing mathematics educators today in the United States, describing the advantages and disadvantages of proposed options for response.

REQUIRED TEXT

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: Author. (available for a fee from: http://www.nctm.org)

Additional readings taken from web sites, book chapters and journals will be assigned throughout the semester.

COURSE EXPECTATIONS

Assignments	**Points**
Review of curriculum materials from the New Math era (10/20)	50
Review of curriculum materials from the current reform era (11/17)	50
Issue brief (9/29)	25
Position paper (12/15)	95
Oral presentation of position (12/8)	20
WebCT reflections	20
Class discussion and attendance	40
	300

Issue Brief

An issue brief is a three-page, double-spaced paper that addresses a current issue in mathematics education. This assignment is due on September 29. The brief should:

- Define a current issue or challenge in mathematics education,
- Describe the advantages and disadvantages of two (or more) approaches for addressing this issue; that is, provide a summary of major arguments,
- State and defend your personal view,
- Include at least three published references, and
- Adhere to APA format.

Grading of this paper will consist of an evaluation of the quality of the presentation and the quality of the writing, as well as the use of APA format. Specifically, this assessment will consider the degree to which the paper evidences: (a) clarity in defining the topic of the brief and in indicating why and for whom this topic is a significant issue in mathematics education; (b) a well-organized and comprehensive presentation of advantages, disadvantages, and personal viewpoint; (c) well-founded selection, interpretation and cogent use of published references; and

(d) integration of background information from course readings and discussion.

Review of Curriculum Materials

Curriculum reviews are three-to-five page, double-spaced papers that examine either a grade-level text (Grades 1– 8) or a course text (secondary school) for mathematics. This review provides:

- A description of the major components of the instructional series from which this text is taken,
- A characterization of the content, organization, pacing, and presentation of mathematics topics in the text, noting both the instructional approach and the assumptions about learning and assessment inherent in the materials,
- An analysis of how this text reflected or contradicted the beliefs about mathematics and about mathematics teaching and learning that were prevalent at the time of its publication (documented by references),
- A discussion of the strengths and weaknesses of the materials, and
- Adheres to APA format.

The review of curriculum materials from the New Math era is due on October 20. The review of curriculum materials from the current reform era is due November 17.

Grading of these reviews will consist of an evaluation of the quality of the presentation and the quality of the writing, as well as the use of APA format. Specifically, this assessment will consider the degree to which the paper evidences: (a) a cogent summary of components of the series; (b) a well-organized and comprehensive presentation of the content, organization, pacing, and presentation of mathematics topics in the text; (c) clarity in its presentation of the assumptions about learning and assessment inferred from the text materials; (d) well-founded selection, interpretation and cogent use of a few published references characterizing the beliefs about mathematics and about mathematics teaching and learning that were prevalent at the time of the text's publication and supporting an argument as to how this text coincided with or dissented from those perspectives; and (e) integration of background information from course readings and discussion in the analysis of the strengths and weaknesses of the text.

Position Paper

The position paper is approximately 20 double-spaced pages in length (+/– 5 pages). This paper argues how an issue, belief, or perspective has influenced the content and instructional approach evidenced in mathematics education over time. For example, you could argue that perspectives about what is the important mathematics students should learn (or what it means to know mathematics) is critical to defining mathematics curriculum. Or you could argue that technology, standardized assessments, public policy, or some research on/theories of teaching and learning have strongly influenced mathematics curricula over time. This paper should offer:

- A clear definition of the issue, belief, or perspective and an argument as to how or why this position may influence mathematics curriculum content, instruction, and/or organization,
- Specific examples from published mathematics curriculum materials over time that evidence the influence of the identified issue, belief, or perspective on content and/or instructional approach, and

- A documented analysis of how and why (or whether) this influence has ebbed and flowed over time.

The position paper must adhere to APA format and offer a substantive citation of literature to clarify the definition of the position as well as to analyze its impact. Grading of the position paper will consist of an evaluation of the quality of the presentation and the quality of the writing, as well as the use of APA format. Specifically, this assessment will consider the degree to which the paper evidences: (a) a clear presentation of the issue, belief, or perspective; (b) a well-organized and evidenced argument as to the influence of this issue or perspective on mathematics curriculum and instruction over time, including citations from published curriculum or assessment materials; (c) well-founded selection, interpretation and use of published references that adequately support the premise of the paper; and (e) integration of background information from course readings and discussion in the analysis. The position paper is due on December 15.

Position Presentation

The in-class presentation addressing the premise of your position paper on December 8 will consist of preparation and distribution of appropriate written materials, oral presentation of information defining the position and evidence of its influence in mathematics education, and facilitation of class discussion.

Class Discussion, Attendance and Reflection

This course addresses how developments in educational thinking and practice have affected mathematics curriculum and instruction. As experienced teachers, you have been actively involved in implementing mathematics curriculum and instructional policy, as well as making instructional decisions within your teaching. As such you have much to offer to the conduct of this course through your participation and contributions. You are expected to read and reflect critically and analytically on the weekly assigned readings and to share your perspectives in weekly class meetings as well as in group discussions. Thus, your attendance at class sessions is very important. However, because it generally is not possible to share each person's reflections and to consider the implications of all of the readings during any given class period, we will also use WebCT to support discussion outside of class throughout the semester.

I will expect you to check in on WebCT frequently, to read the contributions offered by your colleagues, and to respond when you have perspectives to offer. WebCT will serve as a forum wherein we can continue discussion initiated in class, begin conversations related to interesting aspects of the readings, and benefit from the insights and experiences that individual members of the class may offer. The commentaries that you submit to WebCT may take differing forms. They may be:

- shared reflections on components of the readings that were especially pertinent to you,
- questions that the readings triggered in your mind (either questions about material that is new to you or questions that characterize how the readings have challenged your prior conceptions), or
- responses to commentaries or questions submitted by your peers.

The purpose of the WebCT is to engage you in an academic exchange. The WebCT commentaries reflect your efforts to incorporate new ideas into your existing knowledge base and to reflect on how the readings or ensuing discussion aligns or contributes to your

experiences. Do not use WebCT as a forum for summarizing the assigned readings; rather use it as a platform for recording your thinking as catalyzed by the readings and resulting discussion chain.

Grading for this expectation within the course is not simply a matter of quantity or frequency of input. There is no pre-determined "correct content" for composing a reflection or phrasing a question. Rather the expectation is for you to offer a legitimate record of your thinking. In terms of format, let's agree that at least one paragraph is necessary to raise an issue, to share a perspective, or to respond honestly. There is no extra credit for long-windedness. You are not required to write a contribution for the WebCT weekly, but you are expected to contribute to class discussion weekly and to check into the WebCT platform weekly.

Evaluation

Final course grades will be assigned based on the percentage of possible points earned.

A	90% or better	(270–300 points)
B+	88–89.7%	(264–269 points)
B	80–87.7%	(240–263 points)
C+	78–79.7%	(234–239 points)

Honor Code

All students are expected to abide by the code of academic integrity throughout this course. Academic dishonesty, including cheating, fabrication, and plagiarism will not be tolerated and will be reported to the Student Honor Council. The full text of the code is available on the web at www.inform.umd.edu/Campus Info/Departments/jpo/code acinteg.html. In accordance with the Honor Pledge, you are asked to write the following pledge by hand and sign on submitted papers, unless specifically exempted by the instructor. The Pledge reads:

I pledge on my honor that I have not given or received any unauthorized assistance on this assignment/examination.

Accommodations

Students with documented disabilities who would like accommodations should contact the instructor as soon as possible to make appropriate arrangements.

Students will not be penalized because of observances of their religious beliefs. Whenever possible, students will be given reasonable time to make up any academic assignment that is missed due to participation in a religious observance. Please let the instructor know as soon as possible (during the first week of classes if possible) about any intended absences for religious observances.

SEMESTER SCHEDULE

September 1: What is a curriculum and why does it matter?

Suppose you were asked to produce a curriculum for an elementary, middle, or high school mathematics program, what would you expect to produce? Could a curriculum differ from a

commercial mathematics textbook (textbook series)? Should it? What would be the benefits and dangers of a common, coherent curriculum in a school, a district, a state, or a nation?

Kaufmann, D., Johnson, S. M., Kardos, S. M., Liu, E., & Peske, H. G. (2002, Summer). Without curriculum, navigating instruction can be tough. *American Educator*, *26*(2), 6-8, 46.

Wattenberg, R. (2002, Summer). The cascading benefits of a common,coherent curriculum. *American Educator*, *26*(2), 9.

September 8: International perspectives on mathematics achievement

So what is the status of school mathematics achievement in the United States? How does that compare to other nations? How does curriculum and instruction in the United States compare to that in other nations? What influences student achievement?

National Research Council. (1999). *Global perspectives for local action: Using TIMSS to improve U. S. mathematics and science education.* Washington, D.C.: National Academy Press. (Pages 9-29).

Payne, K. J., & Biddle, B. J. (1999, August-September). Poor school funding, child poverty, and mathematics achievement. *Educational Researcher*, *28*(6), 4-13.

Schmidt, W., Houang, R., & Cogan, L. (2002, Summer). A coherent curriculum. *American Educator*, *26*(2), 10-26, 47-48.

September 15: Mathematics achievement in the United States: Current status

Mathematics achievement is multi-dimensional as the study of mathematics encompasses conceptual understanding, skill proficiency, and problem solving across a range of content domains (algebra, geometry, data analysis and probability, measurement, and numerical meaning and operations). Further, achievement trend analysis that merely examines cognitive attainment without consideration of demographic, curricular, and instructional influences will be misleading. The National Assessment of Educational Progress (NAEP) provides a repeating snapshot of the status of mathematics education in the U.S that addresses both achievement and the context of education.

Braswell, J., Daane, M., & Grigg, W. (2003). *The nation's report card: Mathematics highlight's 2003* (NCES 2004451). Washington, D. C.: National Center for Education Statistics. (available from: http://www.nces.ed.gov/pubsearch/pubsinfo.asp?pubid =200451)

September 22: Historical perspective

Curriculum and instruction influence student achievement, but mathematics curriculum and instruction is not static. While it may seem that the traditions we experienced as students are enduring, mathematics curriculum and instruction has changed over time. To address these changes, consider the status of mathematics curriculum and instruction in the United States in the first 50 years of the 20th century, prior to the New Math movement.

Garrett, A. W., & Davis, Jr., O. L. (2003). A time of uncertainty and change: School mathematics from World War II until the New Math. In G. M. A. Stanic & J. Kilpatrick (Eds.). *A history of school mathematics* (Vol. 1, pp. 493-519). Reston, VA: National Council of Teachers of Mathematics.

Kliebard, H. M., & Franklin, B. M. (2003). The ascendance of practical and vocational mathematics, 1893-1945: Academic mathematics under siege. In G. M. A. Stanic & J. Kilpatrick (Eds.). *A history of school mathematics* (Vol. 1, pp. 399-440). Reston, VA: National Council of Teachers of Mathematics.

September 29: New Math

A so-called revolution in mathematics curriculum occurred in the U.S. during the 1950s and 60s. Termed "New Math," federal funds supported a number of different curriculum projects that offered a new organization and focus for school mathematics in the United States. How did these projects differ? What influenced their design? What, if any, changes generated by "New Math" persisted?

Fey, J. T., & Graeber, A. O. (2003). From the New Math to the *Agenda for Action*. In G. M. A. Stanic & J. Kilpatrick (Eds.). *A history of school mathematics* (Vol. 1, pp. 521-558). Reston, VA: National Council of Teachers of Mathematics.

Payne, J. N (2003). The New Math and its aftermath, Grades K-8. In G. M. A. Stanic & J. Kilpatrick (Eds.). *A history of school mathematics* (Vol. 1, pp.559-598). Reston, VA: National Council of Teachers of Mathematics.

Roberts, D. L., & Walmsey, A. L. E. (2003). The original New Math: Storytelling versus history. *Mathematics Teacher, 96*, 468-473.

October 6: Current calls for change

At the state and national level, there are a number of organizations and policy groups that have recommended change in both curriculum and instruction. What is their vision? What arguments and recommendations do they make to support their vision? What are opposing perspectives?

Maryland Mathematics Commission. (2001). *Keys to math success: A report from the Maryland Mathematics Commission*. Baltimore, MD: Maryland State Department of Education.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: Author. (Skim pages 3-27; read pages 28-31, 52-71.)

Schoenfeld, A. H. (2004). The math wars. *Educational policy, 18*, 253-286.

In addition, each student should read a different synopsis of a content standard from pages 32-51 out of the following resource and be prepared to share this overview when contributing to a discussion addressing standards for mathematics reform.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: Author.

October 13-November 3: Reforming school mathematics: Rationale, recommendations, and challenges

Over the next four weeks we will consider four strands of school mathematics content, strands that are foci of high stakes standards and associated accountability measures. We will be examining curriculum standards at the state and national level, an illustrative research article addressing the teaching and learning of that content, and sample commercial textbook materials that profess to support instruction of that content. Throughout, class discussion will address rationale, recommendations, and challenges for change.

October 13: Standards for school mathematics: Number and operations

Hiebert, J., Carpenter, T. P., Fennema, E., Fuson, K. C., Wearne, D., Murray, H., Olivier, A., & Human, P. (1997). *Making sense: Teaching and learning mathematics with understanding*. Portsmouth, NH: Heinemann. (Pages 75-100 only)

Maryland State Department of Education. (2003). *Voluntary State curriculum – Mathematics Grades 3-8.* Baltimore: Author. (http://www.mdk12.org/instruction/curriculum/index.html)

Students should also be prepared to contribute to discussion addressing content standards taken from the following reference for one of the following grade bands: PreK-2, 3-5, 6-8 or 9-12.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: Author. (Select from pages 73-88; 143-156; 211-221; 287-294)

October 20: Standards for school mathematics: Algebra

Maryland State Department of Education. (2003). *Algebra and data analysis: Core learning goals.* Baltimore: Author. (http://www.mdk12.org/practices/support_success/hsa/algebra/goals.html)

Silver, E. A. (1997). "Algebra for all"–Increasing students' access to algebraic ideas, not just algebra courses. *Mathematics Teaching in the Middle School*, *2*, 204-207.

Wu. H. (2001). How to prepare students for algebra. *American Educator*, *25*(2), 10-17.

Students should also be prepared to contribute to discussion addressing content standards taken from the following reference for one of the following grade bands: PreK-2, 3-5, 6-8 or 9-12.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: Author. (Select from pages 90-95; 158-163; 222-231; 296-306)

October 27: Standards for school mathematics: Geometry and measurement

Chazan, D., & Yerushalmy, M. (1998). Charting a course for secondary geometry. In R. Lehrer & D. Chazan (Eds.), *Designing learning environments for developing understanding of geometry and space* (pp. 67-90). Mahwah, NJ: Erlbaum.

Maryland State Department of Education. (2003). *Geometry: Core learning goals.* Baltimore: Author. (http://www.mdk12.org/practices/support_success/hsa/geometry/goals.html)

Schoenfeld, A. (1988). When good teaching leads to bad results: The disasters of "well taught"

mathematics courses. *Educational Psychologist, 23*(2), 145-166.

Students should be prepared to contribute to discussion addressing content standards taken from the following reference for one of the following grade bands: PreK-2, 3-5, 6-8 or 9-12.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: Author. (Select from pages 96-106; 164-175; 232-247; 308-323)

November 3: Standards for school mathematics: Data analysis and probability

Garfield, J. B., & Gal, I. (1999). Teaching and assessing statistical reasoning. In L. V. Stiff & F. R. Curcio (Eds.), *Developing mathematical reasoning in Grades K-12* (pp. 207-219). Reston, VA: National Council of Teachers of Mathematics.

Jones, G. A., Thornton, C. A., Langrall, C. W., & Tarr, J. E. (1999). Understanding students' probabilistic reasoning. In L. V. Stiff & F. R. Curcio (Eds.), *Developing mathematical reasoning in Grades K-12* (pp. 146-155). Reston, VA: National Council of Teachers of Mathematics.

Maryland State Department of Education. (2003). *Algebra and data analysis: Core learning goals.* Baltimore: Author. (http://www.mdk12.org/practices/support_success/hsa/algebra/goals.html)

Students should be prepared to contribute to discussion addressing content standards taken from the following reference for one of the following grade bands: PreK-2, 3-5, 6-8 or 9-12.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: Author. (Select from pages 108-114; 176-181; 248-255; 324-333)

November 10: What does it mean to be mathematically proficient and what form of instruction might promote it?

While the vision of school mathematics has differed over time, there has consistently been an assumption that the intended goal of mathematics education is student learning. But what might "successful mathematics learning" be? And, how should instruction be framed to support it? A recent national committee of educators, researchers, and mathematicians met to address this question for PreK-8 mathematics.

Students should be prepared to address either Chapter 4 "The strands of mathematical proficiency" (pages 115-155) or Chapter 9 "Teaching for mathematical proficiency" (pages 313-368) of the following text.

Kilpatrick, J., Swafford, J., & Findell, B. (Eds.). (2001). *Adding it up: Helping children learn mathematics*. Washington, D. C.: National Academy Press.

November 17: Reform and change

Reforms in education seem to come and go with great regularity and sometimes with little appreciable impact. But, what influences reform? And, what is the role of research in reform? While calls for reform in mathematics education have asserted the need to improve mathematics

achievement, variations in students' mathematical achievement have long been associated with gender, race/ethnicity, and economic status. What influences differential achievement in mathematics? How might a variety of influences enable or derail intended policy reform?

Becker, J. P., & Jacob, B. (2000). The politics of California school mathematics: The anti-reform of 1997-99. *Phi Delta Kappan, 81*, 529-537.

Campbell, P. F. (2004, September). *Optimizing mathematics achievement through centrally coordinated instructional reform*. Paper presented at the First Annual Research Symposium of the Maryland Institute for Minority Achievement and Urban Education, College Park, MD.

November 24: Time for a break.

No class due to Thanksgiving recess. Enjoy the holiday!

December 1:No Child Left Behind: The influence of policy on mathematics education

The No Child Left Behind Act of 2003 uses standardized mathematics achievement tests as an instrument of educational policy with the belief that testing will catalyze higher academic standards and will keep educators and students accountable, thereby increasing public confidence in schooling. What is the rationale behind this agenda? What does it mean for public schooling?

Linn, R. L., Baker, E. L., & Betebenner, D. W. (2002). Accountability systems: Implications of requirements of the No Child Left Behind Act of 2001. *Educational Researcher, 31*(6), 3-16.

Maryland State Department of Education. (2002). *About MSA for mathematics.* Baltimore: Author. (http://www.mdk12.org/instruction/assessment/about_mas_math.html)

U. S. Department of Education. (2002). *The "No child left behind act" of 2001 (Executive summary).* Washington, D. C.: Author. (http://www.ed.gov/offices/OESE/esea/exec-summ.html)

U. S. Department of Education. (2002). *The "No child left behind act" of 2001 (Fact sheet).* Washington, D. C.: Author. (http://www.ed.gov/offices/OESE/esea/factsheet.html)

December 8: Oral presentations

Each student will have 12-15 minutes to share and discuss the premise of his/her position paper. Leave time for questions so the class can share in a brief discussion. A one-page handout could be useful.

December 15:

No class meeting. Position paper is due by 4:30 p.m. today.