

THEORETICAL FOUNDATIONS OF MATHEMATICS INSTRUCTION
MATH 510 FALL 2004

INSTRUCTOR: Dr. Diana F. Steele
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COURSE OBJECTIVES: The objectives of Math 510 are: (1) to familiarize you with current research and development in human learning that relate to mathematics learning, instruction and curriculum; (2) to introduce you to broad curriculum, learning and teaching issues that affect mathematics education; and (3) to introduce you to historical perspectives in mathematics education.

Course Requirements

Required texts:

Davis, R. B., Maher, C. A., & Noddings, N. (1990). *Constructivist views on the teaching and learning of mathematics*. Reston, VA: National Council of Teachers of Mathematics.

Schoen, H. L., & Charles, R. I. (2003). *Teaching mathematics through problem solving: Grades 6-12*. Reston, VA. National Council of Teachers of Mathematics.

Supplemental Readings furnished by instructor.

Recommended Texts:

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

Course Evaluation

Your final grade will be determined as follows:

Class Discussion Facilitator	10 points
Manipulative or Program Presentation	10 points
Current Issue Paper and Presentation	15 points
Reflective Writing	15 points
Document Presentation	10 points
Discussion Synthesis	5 points
Attendance and Participation	15 points
Final Exam	<u>20 points</u>
TOTAL	100 points

Note: I expect assignments to be completed on time even if you are absent. Assignments are due at the beginning of the class period. No assignments will be accepted after December 2.

The grading scale will be approximately as follows:

90 - 100 points	A
80 - 89 points	B
70 - 79 points	C
60 - 69 points	D

Course Assignments

You will have six assignments across the semester. They are as follows:

1. *Class Discussion Facilitator*. You will lead the class discussion of the assigned readings for one class session during the semester. You will prepare questions in advance of the session that will illuminate and generate discussion on the themes and issues raised in the assigned readings. Prepare a typed set of the questions, which you will give to me at the beginning of the class period.

2. *Manipulative/Instructional Aid or Program Presentation*. You will select a manipulative/instructional aid or mathematics program from the list below. You will prepare and submit a typed (double spaced) discussion of your selection. This discussion should include the history and use of the manipulative/instructional aid or program. You will develop a 20-30 minute presentation for the class.

If you select a *manipulative or instructional aid*, you will briefly introduce it by telling how it can be used in the classroom. After your introduction, you will lead the class through one or more activities with the manipulative or instructional aid. You may choose the grade level(s) for the activities.

If you select a *mathematics program*, you should briefly discuss the underlying philosophy of the program. After introducing the program, you will lead the class through one or more lessons or activities from the program. You should bring various components of the program (e.g., textbooks, lessons) to share with the class.

Manipulative or Instructional Aid

Cuisenaire Rods
Geoboards
Dienes Materials (Base-Ten Materials)
Algebra Tiles/Blocks
Fraction Circles/Squares/Bars/Strips
Mathematics Portfolios
Mathematics Journals
Software (e.g., Geometer's Sketchpad)
Web-based resources
Graphing calculators

Mathematics Program

Connected Mathematics (Grade 6–8)
Mathematics in Context (Grades 5–8)
Navigating Through Algebra
Navigating Through Geometry
Investigations of Number, Data, and Space (K–Grade 5)
Everyday Mathematics (K–Grade 6)
UCSMP
Contemporary Mathematics in Context (Core-Plus)
Mathematics: Modeling Our World (COMAP)
Lawrence Hall of Science (Space/Equals)
Illuminations
SMSG

3. *Current Issue Paper and Presentation*. (due November 11). You will write (and type, double spaced) an 8 to 10-page paper about a topic related to mathematics curriculum, learning mathematics, or teaching mathematics. You should select a topic for which a reasonably well-defined body of research is available. I suggest you begin your search by examining some of the following: *A Research Companion to the Principals and Standards for School Mathematics* (NCTM, 2003); *Handbook of Research on Mathematics Teaching and Learning* (Grouws, 1992); *Handbook of Research on Teaching* (Richardson, 2001). You should include in your paper the implications of your topic for teaching practice (teaching, learning, curriculum development, or curriculum implementation). You should include specific reference citations in your paper and a list of references (APA style). You must have at list 10 citations in your reference list. You will present a 10-minute report of your paper to the class.

4. *Reflective/Interpretive Writing*. Writing can be a powerful tool for thinking about and learning mathematics. We will experiment with writing in our course as a vehicle for reflecting on what we are thinking and learning about the themes and issues around which the course is organized. You will write each week about your own sense-making of the ideas. The aim is to provide a formal way for you to

critically reflect about the ideas that emerge through the course readings and activities. I will collect your writing each week. Occasionally, (at least six times) you will be asked to write at the beginning of class about some issue from your readings. I will respond to your writings with my own written feedback. I would prefer the reflective writings done out of class be typed.

5. *Document Presentation*. You will prepare (and type, double spaced) a two- or three-page summary of an assigned document related to mathematics education. In the summary, you will outline the major points of the document. Prepare a handout for each class member. Begin the handout with the complete citation (APA style) for the document. Prepare a 15-minute class presentation for class members.

You may choose from the following list:

Carpenter, T. P., Coburn, T. G., Reys, R. E., & Wilson, J. W. (1978). *Results for the first mathematics assessment of the National Assessment of Educational Progress*. Reston, VA: NCTM.

National Council of Teachers of Mathematics. (1980). *An agenda for action: Recommendations for school mathematics of the 1980's*. Reston, VA: Author.

National Research Council. (1989). *Everybody counts: A report to the nation on the future of mathematics education*. Washington, DC: National Academy Press.

Third International Mathematics and Science Study (TIMSS)
TIMSS-R

National Assessment of Educational Progress (NAEP) Most recent.

National Council of Teachers of Mathematics. (1991). *Professional standards for teaching mathematics* (pp. 1–67). Reston, VA: Author.

National Council of Teachers of Mathematics. (1991). *Professional standards for teaching mathematics* (pp. 71-119). Reston, VA: Author.

National Council of Teachers of Mathematics. (1991). *Professional standards for teaching mathematics* (pp. 123-186). Reston, VA: Author.

National Council of Teachers of Mathematics. (1995). *Assessment standards for school mathematics* (pp. 25–77). Reston, VA: Author.

National Council of Teachers of Mathematics. (1995). *Assessment standards for school mathematics*(pp. 1–22, 81–83). Reston, VA: Author.

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

6. *Discussion Synthesis*. For one class session during which you are not the discussion facilitator, you will write (and type, double spaced) a synthesis of the class discussion of the readings. This synthesis is due the next week after the discussion. The goal is to provide a formal way for you to critically reflect on the ideas that emerge through the course readings.

FINAL EXAM, THURSDAY, DECEMBER 9, 6:00-7:50 P.M.

Schedule for Assignments

Class discussion facilitator: See sign-up sheet

Manipulative or program presentation: See sign-up sheet

Current issue paper: November 11

Reflective writing: Every week (out of class) and six times (in class)

Document presentation: See sign-up sheet

Discussion synthesis: See sign-up sheet

Final exam: December 9, 6:00-7:50 pm

Note: Students with Disabilities

NIU abides by Section 504 of the Rehabilitation act of 1973 which mandates reasonable accommodations be provided for qualified students with disabilities. If you have a disability and may require some type of instructional and/or examination accommodation, please contact me early in the semester so that I can provide or facilitate in providing accommodation you may need. If you have not already done so, you will need to register with the Center for Access-Ability Resources (CAAR), the designated office on campus to provide services and administer exams with accommodations for students with disabilities. The CAAR office is located on the 4th floor of the University Health Services building (815-753-1303). I look forward to talking with you soon to learn how I may be helpful in enhancing your academic success in this course.

Readings Schedule for Math 510 Fall 2004

August/September

Session	Date	Topic
1	Aug. 30	Overview of the course Brief overview of history of mathematics education. Introduction: National Council of Teachers of Mathematics. <i>Curriculum and evaluation standards for school mathematics</i> . (1989). Reston, VA: Author. Addenda series
2	Sept. 2	Fey, J. (1978). Change in mathematics education since the late 1950's—Ideas and realisation USA. <i>Educational Studies in Mathematics</i> , 9, 339-353. Hayden, R. W. (1983). <i>A historical view of the "new mathematics."</i> Eric Document ED228046. Miller, J. W. (1990). Whatever happened to new math? <i>American Heritage</i> , 8, 76-83. Riedesel, C. A. (1995). Roots of Today's Elementary School Mathematics Curriculum. <i>Teaching elementary school mathematics</i> (pp. 14-23). Engelwood Cliffs, NJ: Prentice Hall.
3	Sept. 9	Brownell, W. A. (1947). Meaning of skill—Maintaining the balance. <i>Arithmetic Teacher</i> , 3,311-316. Hiebert, J., & Wearne, D. (2003). Developing understanding through problem solving. In H. L. Schoen & R. I. Charles (Eds.), <i>Teaching mathematics through problem solving: Grades 6-12</i> (pp. 3-13). Reston, VA. National Council of Teachers of Mathematics. NCTM. (2000). <i>Principles and standards for school mathematics</i> . Reston, VA: Author. Read Chapters 1, 2, and 8. Romberg, T. A. (1992). Problematic features of the school mathematics curriculum. In P. W. Jackson (Ed.), <i>Handbook of research on curriculum</i> (pp. 749-756). NY: American Educational Research Association.
4	Sept. 16	Erlwanger, S. (1973). Benny's conception of rules and answers in IPI mathematics. <i>The Journal of Children's Mathematical Behavior</i> , 1, 7-27. Gagne, R. (1971). Gagne on the learning of mathematics: A "product" orientation. In D.B. Aichele & R.E. Reys (Eds.), <i>Readings in secondary school mathematics</i> (pp. 157-165). Boston, MA: Prindle, Weber & Schmidt. NCTM. (2000). <i>Principles and standards for school mathematics</i> . Reston, VA: Author. Read Standards for grades 6-8. Steen, L. A. (1990). Pattern. In L. A. Steen (Ed.), <i>On the shoulders of giants: New approaches to numeracy</i> (pp. 1-10). Washington, DC: National Academy Press.
5	Sept. 23	Bruner, J. (1971). Bruner on the learning of mathematics: A "process" orientation. In D.B. Aichele & R.E. Reys (Eds.), <i>Readings in secondary school mathematics</i> (pp. 166-177). Boston, MA: Prindle, Weber & Schmidt.

Dienes, Z.P. (1971). Dienes on the learning of mathematics. In D.B. Aichele & R.E. Reys (Eds.), *Readings in secondary school mathematics* (pp. 222-237). Boston, MA: Prindle, Weber & Schmidt.

Kahan, J. A., & Wyberg, T. R. (2003). Mathematics as sense making. In H. L. Schoen & R. I. Charles (Eds.), *Teaching mathematics through problem solving: Grades 6-12* (pp. 15-25). Reston, VA. National Council of Teachers of Mathematics.

NCTM. (2000). *Principles and standards for school mathematics*. Reston, VA: Author. Read Standards for grades 9-12.

6 Sept. 30

Adler, I. (1971). Piaget on the learning of mathematics. In D. Aichele & R. Reys (Eds.), *Readings in Secondary School Mathematics* (pp. 210-221). Boston, MA: Prindle, Weber, & Schmidt, Inc.

D'Ambrosio, B.S. (2003). Teaching mathematics through problem solving: A Historical perspective. In H. L. Schoen & R. I. Charles (Eds.), *Teaching mathematics through problem solving: Grades 6-12* (pp. 39-52). Reston, VA. National Council of Teachers of Mathematics.

Davis, R.B., Maher, C.A., & Noddings, N. (1990). Introduction: Constructivist views on the teaching and learning of mathematics. In R.B. Davis, C.A. Maher, & N. Noddings (Eds.) *Constructivism Views on the Teaching and Learning of Mathematics* (pp. 1-3). Reston, VA: NCTM.

Silver, E. A. (1986). Using conceptual and procedural knowledge: A focus on relationships. In J. Hiebert (Ed.), *Conceptual and procedural knowledge: The case of mathematics* (pp. 1-27). Hillsdale, NJ.: Lawrence Erlbaum Associates.

October Readings Schedule for Math 510

7 Oct. 7

Noddings, N. (1990). Constructivism in mathematics education. In R. B. Davis, C. A. Maher, & N. Noddings (Eds.) *Constructivist Views on the Teaching and Learning of Mathematics* (pp. 7-18). Reston, VA: National Council of Teachers of Mathematics.

Davis, R. B., & Maher, C. A. (1990). The nature of mathematics: What do we do when we "do mathematics"? In R. B. Davis, C. A. Maher, & N. Noddings (Eds.) *Constructivist Views on the Teaching and Learning of Mathematics* (pp. 65-78). Reston, VA: National Council of Teachers of Mathematics.

Stiff, L. V., Johnson, J. L., & Johnson, M. R. (1993). Cognitive issues in mathematics education. In P. Wilson (Ed.) *Research Ideas for the Classroom: High School Mathematics* (pp. 3-20). New York, NY: Macmillan.

Marcus, R., & Fey, J. T. (2003). Selecting quality tasks for problem-based teaching. In H. L. Schoen & R. I. Charles (Eds.), *Teaching mathematics through problem solving: Grades 6-12* (pp. 55-67). Reston, VA. National Council of Teachers of Mathematics.

8 Oct. 14

von Glasersfeld, E. (1990). An exposition of constructivism: Why some like it radical. In R.B. Davis, C.A. Maher, & N. Noddings (Eds.) *Constructivism Views on the Teaching and Learning of Mathematics* (pp. 19-30). Reston, VA: NCTM.

Maher, C. A., & Davis, R. B. (1990). Teachers learning: Building representations of children's meanings. In R. B. Davis, C. A. Maher, & N. Noddings (Eds.) *Constructivist Views on the Teaching and Learning of Mathematics* (pp. 79-90). Reston, VA: National Council of Teachers of Mathematics.

Goldenburg, E. P., & Walter, M. I. (2003). Problem posing as a tool for teaching mathematics. In H. L. Schoen & R. I. Charles (Eds.), *Teaching mathematics through problem solving: Grades 6-12* (pp. 69-91). Reston, VA. National Council of Teachers of Mathematics.

Steele, D. F., & Johanning, D. L. (forthcoming). A schematic-theoretic view of problem solving and development of algebraic thinking. *Educational Studies in Mathematics*, 57,1.

9 Oct. 21

Cobb, Wood, & Yackel. (1990). Classroom as Learning environments for teachers and researchers. In R.B. Davis, C.A. Maher, & N. Noddings (Eds.) *Constructivism Views on the Teaching and Learning of Mathematics* (pp. 125-146). Reston, VA: NCTM.

Lewis, C. C., & Tsuchida, I. (1998). A lesson is like a swiftly flowing river: How research lessons improve Japanese education. *American Educator*.

Steele, D.F. (2001). Using sociocultural theory to teach mathematics: A Vygotskian perspective. *School Science & Mathematics*, 101(8), 404-416.

Bakker, A., & Gravemeijer, K. (2003). Planning for teaching statistics through problem solving. In H. L. Schoen & R. I. Charles (Eds.), *Teaching mathematics through problem solving: Grades 6-12* (pp. 105-117). Reston, VA. National Council of Teachers of Mathematics.

10 Oct. 28

Davis, R.B. (1990). Discovery learning and constructivism. In R. B. Davis, C. A. Maher, & N. Noddings (Eds.), *Constructivist views on the teaching and learning of mathematics* (pp. 93-106). Reston, VA: NCTM.

Sierpiska, A. (1998). Three epistemologies, three views of classroom communication: Constructivism, sociocultural approaches, interactionism. In H. Steinbring, M. G. Bartolini-Bussi, & A. Sierpiska (Eds.), *Language and communication in the mathematics classroom* (pp. 30-62). Reston, VA: NCTM.

Lampert, M. (2001). Teaching to cover the curriculum. In *Teaching problems and the problems of teaching* (pp. 213-263). New Haven, CT: Yale University Press.

Grouws, D. A. (2003). The teacher's role in teaching mathematics through problem solving. In H. L. Schoen & R. I. Charles (Eds.), *Teaching mathematics through problem solving: Grades 6-12* (pp. 129-141). Reston, VA. National Council of Teachers of Mathematics.

November Readings Schedule for Math 510

Session	Date	Topic
11	Nov. 4	Goldin, G.A. (1990). Epistemology, constructivism, and discovery learning

mathematics. In R.B. Davis, C.A. Maher, & N. Noddings (Eds.), *Constructivism Views on the Teaching and Learning of Mathematics* (pp. 42-47). Reston, VA: NCTM.

Steffe, L.P. (1990). On the knowledge of mathematics teachers. In R.B. Davis, C.A. Maher, & N. Noddings (Eds.), *Constructivism Views on the Teaching and Learning of Mathematics* (pp. 167-184). Reston, VA: NCTM.

Sherin, M. G. (2002). A balancing act: Developing a discourse community in a mathematics classroom. *Journal of Mathematics Teacher Education*, 5, 205-233.

Rasmussen, C., Yackel, E., & King, K. (2003). Social and sociomathematical norms in the mathematic classroom. In H. L. Schoen & R. I. Charles (Eds.), *Teaching mathematics through problem solving: Grades 6-12* (pp. 143-159). Reston, VA. National Council of Teachers of Mathematics.

12 Nov. 11 Ball, D. L., Lubienski, S. T., & Mewborn, D. S. (2001). Research on teaching mathematics: The unsolved problem of teachers' mathematical knowledge. In V. Richardson (Ed.), *Handbook of research on teaching* (pp. 433-443). Washington, DC: American Educational Research Association.

Arbaugh, F. (200). Study groups as a form of professional development for secondary mathematics teachers. *Journal of Mathematics Teacher Education*, 5, 139-163.

Driscoll, M. (2003). The sound of problem solving. In H. L. Schoen & R. I. Charles (Eds.), *Teaching mathematics through problem solving: Grades 6-12* (pp. 161-175). Reston, VA. National Council of Teachers of Mathematics.

Reys, R. E. (2001). Curricular controversy on the math wars: A battle without winners. *Phi Delta Kappan*, 83, 255-258.

13 Nov. 18 Ball, D. L., Lubienski, S. T., & Mewborn, D. S. (2001). Research on teaching mathematics: The unsolved problem of teachers' mathematical knowledge. In V. Richardson (Ed.), *Handbook of research on teaching* (pp. 443-456). Washington, DC: American Educational Research Association.

Zeibarth, S. W. (2003). Classroom assessment issues related to teaching mathematics through problem solving. In H. L. Schoen & R. I. Charles (Eds.), *Teaching mathematics through problem solving: Grades 6-12* (pp. 177-194). Reston, VA. National Council of Teachers of Mathematics.

National Center for Education Statistics. Teaching mathematics in the seven countries: Results from the TIMMS 1999 Video, pp. 1-12.

Lindquist, M. M. (2001). NAEP, TIMMS, and PSSM: Entangled influences. *School Science and Mathematics*, 101, 286-291.

December Readings Schedule for Math 510

14 Dec. 2 Thompson, A. G., (1984). The relationship of teachers' conceptions of mathematics and mathematics teaching to instructional practice. *Educational Studies in Mathematics*, 101, 105-127.

Steele, D.F. (2001). The interfacing of preservice and inservice experiences of reform-based teaching: A longitudinal study. *Journal of Mathematics Teacher Education*, 4, 139-172.

Lubienski, S. T., & Stilwell, J. (2003). Teaching low-SES students mathematics through problem solving: Tough Issues, promising strategies, and lingering dilemmas. In H. L. Schoen & R. I. Charles (Eds.), *Teaching mathematics through problem solving: Grades 6-12* (pp. 207-225). Reston, VA. National Council of Teachers of Mathematics.

Martin et al., (2001). How reform secondary mathematics textbooks stack up against NCTM's principles and standards. *Mathematics Teacher* 94, 540-589.

