

# The Teaching of Algebra

Math 513

Fall 2006

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## Course Objectives

To identify and discuss relevant issues and trends related to the teaching and learning of algebra

To develop and implement an algebra instructional activity for the middle of high school level

To read, discuss, and critically analyze research studies and position papers in mathematics education that promote algebraic thinking in general and relate to the teaching and learning of algebra

To communicate in writing and write a research proposal for a original possible study that focuses on extending our knowledge base on students' understanding of algebraic concepts

## Course Requirements

Text:

Driscoll, M. (1999). *Fostering Algebraic Thinking: A Guide for Teachers Grades 6-10*.  
Portsmouth, NH: Heinemann.

Selected Supplemental Readings

Assignments:

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

1. *Class Attendance and Participation*. A significant part of this course will be class discussions of readings assigned for each week. When not leading the activities or discussions, you will be expected to participate in class discussions and activities. Participation and co-learning are important concepts for this course. Class participation includes activities such as speaking, listening, observing, sharing ideas, and reflecting. You are expected to attend all class sessions. You are also expected to read and reflect on all of the assigned articles prior to class. Therefore, come to class prepared to contribute your critical reflections of assigned readings and related material.

This component accounts for 15% of your grade. Each week you will have an opportunity to earn one point for attendance and participation. All students will earn one point for overall participation.

Attendance: (0.5 points)

Participation: (0.5 points)

\_\_\_\_\_ Evidence of prior reflection on articles (ability to react to and integrate articles with each other and outside experiences)

\_\_\_\_\_ Engaged in class dialogue (speaking and active listening)

2. *Class Discussion Facilitator*. (date and reading to be determined). One time during the semester you will lead the class discussion, as an expert, of the assigned readings, either from the required text or from supplemental readings.

This component accounts for 15% of your grade. Criteria for evaluation of discussion leader facilitator will be:

Discussion Questions Prepared: (10 points)

- \_\_\_\_\_ Article carefully and closely read and analyzed
- \_\_\_\_\_ Thoughtfulness of questions--key points identified

You should provide a copy for each member in class on the night of your discussion (two copies for me).

Group Discussion: (5 points)

- \_\_\_\_\_ Extent to which group dialogue was stimulated
- \_\_\_\_\_ Extent to which discussion encouraged critical analysis of articles
- \_\_\_\_\_ Extent to which discussion was kept on track

3. *Reflective 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. You will relate the ideas from the readings to the development of your own teaching. I will collect your writing each week and will respond to your writings with my own written feedback. I would prefer the reflective writings be typed.

This component accounts for 15% of your grade and will be evaluated according to the following criteria:

Writing: (15 points)

- \_\_\_\_\_ Submitted on-time
- \_\_\_\_\_ Well-organized
- \_\_\_\_\_ Evidence of critical analysis of course materials and experiences
- \_\_\_\_\_ Reflections on readings, experience in community, and personal challenges uncovered

4. *Problem-Solving Lesson Presentation.* (date and reading to be determined) Once during the semester, you will teach a lesson. It should be about 45 minutes. Evaluation is based upon your planning, preparation, knowledge, presentation and overall effectiveness. You will be choose an algebra concept/topic to teach to your peers (even though the level will be prepared for the 6-12 level). Be sure to have your “students” involved during your lesson and get feedback using questions. A typed handout of your lesson plan should be give to each class member on the day of the presentation (two copies for me). Your presentation should conform to the “spirit” of this course. This implies that the presentation should focus on development of conceptual knowledge, problem solving, and active student learning.

This component accounts for 15% of your grade and will be evaluated according to the following criteria:

Lesson: (15 points)

- \_\_\_\_\_ Lesson plan well written including all the components
- \_\_\_\_\_ Demonstrates knowledge of mathematical concept(s) and procedure(s)
- \_\_\_\_\_ Tasks or activities actively involve students in problem solving, reasoning, and communication
- \_\_\_\_\_ Instruction displayed appropriate use of resources (time, space, materials)
- \_\_\_\_\_ Instruction creates a positive learning environment and respect for students' ideas
- \_\_\_\_\_ Instruction based upon assessment of students' understanding of concept(s)

5. *Written proposal for a research study.* For this assignment you will define and develop a topic for research. The choice of topic is up to you, but you should choose something significant to learning and/or teaching of algebra. Include an introduction section that gives a statement and the significance of the problem and a list of the research questions. Include a literature review section for the problem. Also include a research method section. In order to identify an area for which there is a well-defined body of research, I suggest you begin your search by examining some of the following reference guides: *Handbook of Research on Mathematics Teaching and Learning* (1992) D. Grouws (Ed.) or *Handbook of Research on Teaching* (1986 and 1991) M. Wittrock (Ed.) and V. Richardson (Ed.) or *Handbook of Research on Teacher Education* (1990) W. R. Houston (Ed.). Conclude your paper with a reference list of at least 10 references. (preferably in the last 15 years).

The written product will be a paper of 12-18 double-spaced pages. You must use APA (American Psychological Association) style of writing in all aspects of the research report. The final paper is tentatively due on NOVEMBER 30.

This component accounts for 25% of your grade and will be evaluated according to the following criteria:

Paper: (25 points)

- \_\_\_\_\_ Submitted on-time
- \_\_\_\_\_ Proper length
- \_\_\_\_\_ APA formatting
- \_\_\_\_\_ Literature review
- \_\_\_\_\_ Well-defined problem
- \_\_\_\_\_ Appropriate Methodology
- \_\_\_\_\_ Well written

During class on November 30, you will give a 10-minute talk about your paper .

**Course Evaluation**

The grading scale will be approximately as follows:

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

Your final grade will be determined as follows:

Attendance and participation	10 points
Class discussion facilitator	15 points
Reflective writing	15 points
Problem-Solving Lesson	15 points
Written Proposal for a Research Study	25 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. All assignments will be expected to be turned in by December 7.

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 accommodations 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 service and administer exams with accommodations for student with disabilities. The CAAR office is located on the 4th floor of the University Health Services building (815/753-1303).

Reminders: General Classroom Etiquette

- \* Turn off pagers, phones, etc.
- \* Plan to arrive on time, stay to the end of class, and be in the classroom for the entire session
- \* Only students who are registered for this course should attend this class

**Note:** Changes and adjustments may be made to this syllabus when judged appropriate by the instructor. Such changes, should they occur, will be announced in class.

**Readings Schedule for Math 513      Fall 2006**  
August/September

Session	Date	Topic
1	Aug. 31	<p>Introductions            Discussion of assignments            What is algebra?            What is algebraic thinking?            Developing a research proposal</p>
2	Sept. 7	<p>Driscoll, M. (1999). <i>Fostering algebraic thinking</i>. Introduction and Chapter 1.</p> <p>Silver, E. A. (1997). "Algebra for all?—Increasing students' access to algebraic ideas, not just algebra courses. <i>Mathematics Teaching in the Middle School</i>, 2, 204-207.</p> <p>Usiskin, Z. (1988). Conceptions of school algebra and uses of variables. In A. Coxford &amp; A. Shulte (Eds.), <i>The Ideas of Algebra, K-12</i>. Chapter 2.</p>
3	Sept. 14	<p>Driscoll, M. (1999). <i>Fostering algebraic thinking</i>. Chapter 2.</p> <p>Kaput, J. J. (1999), Teaching and learning a new algebra. In E. Fennema &amp; T. A. Romberg (Eds.), <i>Mathematics classrooms that promote understanding</i>. Chapter 8.</p> <p>Kieran, C., &amp; Chalouh, L. (1999). Prealgebra: The Transition from arithmetic to algebra. In B. Moses (Ed.), <i>Algebraic thinking, grades K-12</i> (pp. 59-70). Reston, VA: National Council of Teachers of Mathematics.</p>
4	Sept. 21	<p>Driscoll, M. (1999). <i>Fostering algebraic thinking</i>. Chapter 3.</p> <p>Warren, E., &amp; Pierce, R. (2004). Learning and teaching algebra. <i>Research in mathematics education in Australasia 2000-2003</i> (pp. 291-311). MERGA.</p> <p>Philipp, R. A. (1999). Algebra as generalized arithmetic: Starting with the known for a change. <i>Mathematics Teacher</i>, 92, 310-316.</p>
5	Sept. 28	<p>Driscoll, M. (1999). <i>Fostering algebraic thinking</i>. Chapter 4.</p> <p>Warren, E. (2000). Research in Teaching and learning algebra. <i>Research in mathematics education in Australasia 1996-1999</i> (pp. 161-180). MERGA.</p>
6	Oct. 5	<p>Driscoll, M. (1999). <i>Fostering algebraic thinking</i>. Chapter 5.</p> <p>Küchemann, D. (1981). Children's understanding of numerical variables. <i>Mathematics in School</i>, 7, 23-26.</p> <p>MacGregor, M., &amp; Stacey, K. (1995). The effect of different approaches to algebra on students' perceptions of functional relationships. <i>Mathematics Education Research Journal</i>, 7, 69-85.</p>
7	Oct. 12	<p>Driscoll, M. (1999). <i>Fostering algebraic thinking</i>. Chapter 6.</p> <p>Arcavi, A. (1994). Symbol sense: Informal sense-making in formal mathematics. <i>For the</i></p>

*Learning of mathematics, 14, 24-35.*

MacGregor, M., & Stacey, K. (1996). Origins of students' interpretations of algebraic notation. In L. Puig & A. Gutierrez (Eds.), *Proceedings of the 20<sup>th</sup> Conference of the International Group for the Psychology of Mathematics Education* (pp. 297-304). Valencia, Spain: University of Valencia.

- 8 Oct. 19 Driscoll, M. (1999). *Fostering algebraic thinking*. Chapter 7.
- Moschkovich, J., Schoenfeld, A., & Arcavi, A. (1993). Aspects of understanding: On multiple perspectives and representations of linear relations and connections among them. In T. Romberg, E. Fennema, & T. Carpenter (Eds.) *Integrating research on the graphical representation of functions* (pp. 69-100). Hillsdale, NJ: Lawrence Erlbaum Associates.
- 9 Oct. 26 Brenner, M. E., Mayer, R. E., Moseley, B., Brar, T., Duran, R, Reed, B. S., & Webb, D. (1997). Learning by understanding: The role of multiple representations in learning algebra. *American Educational Research Journal, 34, 663-690.*
- Herscovics, N. (1989). Cognitive obstacles encountered in the learning of algebra. In S. Wagner & C. Kieran (Eds.), *Research issues in the learning and teaching of algebra* (pp. 60-86). Reston, VA: National Council of Teachers of Mathematics.
- 10 Nov. 2 MacGregor, M., & Stacey, K. (1993). Cognitive models underlying students' formulation of simple linear equations. *Journal for Research in Mathematics Education, 24, 217-232.*
- MacGregor, M., & Price, E. (1999). An exploration of aspects of language proficiency and algebra learning. *Journal for Research in Mathematics Education, 30, 449-467.*
- Yerushalmy, M. (2006). Slower algebra students meet faster tools: Solving algebra word problems with graphing software. *Journal for Research in Mathematics Education, 37, 356-387.*
- 11 Nov. 9 Breidenbach, D., Dubinsky, J. H., & Nichols, D. (1992). Development of the process conception of function. *Educational Studies in Mathematics, 23, 247-285.*
- O'Callaghan, B. R. (1998). Computer-intensive algebra and students' conceptual knowledge of functions. *Journal for Research in Mathematics Education, 28, 21-40.*
- 12 Nov. 16 Izsak, A. (2003). "We want a statement that is always true": Criteria for good algebraic representations and development of modeling knowledge. *Journal for Research in Mathematics Education, 34, 191-227.*
- Graham, A. T., & Thomas, M. O. J. (2000). Building a versatile understanding of algebraic variables with a graphic calculator. *Educational Studies in Mathematics, 41, 265-282.*
- Hollar, J. C., & Norwood, K. (1999). The effects of a graphing-approach intermediate algebra curriculum on students' understanding of function. *Journal for Research in Mathematics Education, 34, 220-226.*
- 13 Nov. 30 Leinhardt, G., Zaslavsky, O., & Stein, M. K. (1990). Functions, graphs, and graphing: Tasks, learning, and teaching. *Review of Educational Research, 60, 1-64.*
- 14 Dec. 7 Confrey, J., & Smith, E. (1995). Splitting, covariation, and their role in the development

of exponential functions. *Journal for Research in Mathematics Education*, 26, 66-86.

Ayers, P. L. (2001). Systematic mathematical errors and cognitive load. *Contemporary Educational Psychology*, 26, 227-248.

Pierce, R., & Stacey, K. (2002). Algebraic insight: The algebra needed to use computer algebra systems. *Mathematics Teacher*, 95, 622-627.