

The Teaching of Algebra

MATH 513
Spring 2005

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Office Hours: M,T,W 10:00-11:00 am
and T 5:00-6:00 pm
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Course Objective

To identify and discuss relevant issues and various models concerning the teaching and learning of algebra

To read, discuss, and critically analyze research and position papers related to the teaching and learning of mathematics

To synthesize significant issues and prior research results, and formulate a research proposal related to the teaching and/or learning of algebra.

Required Texts:

Moses, B. (Ed.) (1999) *Algebraic thinking, Grades K-12*. National Council of Teachers of Mathematics: Reston, VA. ISBN 0-87353-474-3. Required. \$40.50

Cuoco, A.A. (Ed.) (2001) *The roles of representation in school mathematics (2001 Yearbook)*. National Council of Teachers of Mathematics: Reston, VA. ISBN 0-87353-495-6. Optional.

Lott, J. (Ed.) (2000). Algebra? A gate! A barrier! A mystery! *Mathematics Education Dialogues*, April 2000. Required. <http://www.nctm.org/dialogues/2000-04.pdf>

Course Evaluation

Midterm exam 100 points

Final exam 100 points

Research Proposal 100 points

Other written and oral presentation assignments 70 points

Class Participation and Mathematical Disposition 30 points

90 – 100 % □ A

80 – 89.9 % □ B

70 – 79.9 % □ C

60 – 69.9 % □ D

Course Assignments

- Read all assigned papers and participate in class discussions.
- Complete reflective writing as assigned
- Bring in an interesting problem, article, newspaper column, etc., to share with the class.
- One time during the semester you will lead the class discussion and facilitate reflection on one of the readings from the required texts or assigned supplemental readings.
- Present an instructional unit in class for about 15 minutes on an algebraic topic. This may include the use and/or comparison of graphing calculators, computer software, or manipulative materials, instructional techniques, sets of algebraic problem(s) to solve.
- Formulate a research proposal outline of 2-3 typed pages including what you intend to investigate and how you plan to conduct your investigation. The topic of your study should be related to the teaching and/or learning of algebra in general, or to specific algebraic concepts.
- Prepare a research proposal following the APA style of writing. Include an introduction chapter that gives a statement and the significance of the problem and a list of the research questions. Include a literature review chapter for the problem. Also include a research method chapter. 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.), Encyclopedia of Educational Research (1992) M. Alkin (Ed.), Handbook of Research on Teaching (1986 and later). Conclude your paper with a reference chapter prepared according to APA style.

Semester Schedule and Readings for Math 513

1. Jan 18

What is Algebra?

Understanding the roles of variables

Developing a research proposal

2. Jan 25

Lott, J. (Ed.) (2000). Algebra? A gate! A barrier! A mystery! Mathematics Education Dialogues, April 2000. <http://www.nctm.org/dialogues/2000-04.pdf>

3. Feb 1

Doing Algebra in Grades K-4. Zalman Usiskin, Teaching Children Mathematics, February 1997.

Conceptions of School Algebra and Uses of Variables. Zalman Usiskin, Ideas of Algebra, K-12, 1988 Yearbook of the National Council of Teachers of Mathematics.

Communicating the Importance of Algebra to Students. Paul T. Christmas and James T. Fey, Algebra for Everyone, 1990.

Discussion Leader 1 _____

Algebra: What should we teach and how should we teach it? John A. Thorpe, In S. Wagner and C. Kieran (eds.) Research Issues in the Learning and Teaching of Algebra.

Why Elementary Algebra Can, Should, and Must be an Eighth-Grade Course for Average Students. Zalman Usiskin. Mathematics Teacher, September 1987.

Does Everybody Need to Study algebra? Lynn Arthur Steen. Mathematics Teacher, April 1992.

The Transition from Arithmetic to Algebra. Richard D. Lodholz, Algebra for Everyone, 1990.

Discussion Leader 2 _____

4. Feb 8

Prealgebra: The Transition from Arithmetic to Algebra. Carolyn Kieran and Louis Chaloub, Research Ideas for the Classroom: Middle Grades Mathematics, 1993.

What Should Not Be in the Algebra Curriculum of Average College-Bound Students. Zalman Usiskin, Mathematics Teacher, September 1980.

A Technology-Intensive Approach to Algebra. M. Kathleen Heid and Rose Mary Zbiek, Mathematics Teacher, November 1995.

Discussion Leader 3 _____

Experiences with Patterning. Joan Ferrini-Mundi, Glenda Lappan, and Elizabeth Phillips, Teaching Children Mathematics, February 1997.

Perimeter patterns. Richard A. Austin and Patricia Biafore, Teaching Children Mathematics, December 1995.

Discussion Leader 4 _____

5. Feb 15

Patterns as Tools for Algebraic Reasoning. Kristen Herbert and Rebecca H. Brown, Teaching Children Mathematics, February 1997.

Liz's Pattern. Jill E. Land and Paul G. Becher. Teaching Children Mathematics, February 1997.

Discussion Leader 5 _____

Teaching Patterns, Relationships, and Multiplication as Worthwhile Mathematics Tasks. Barbara E. Armstrong, Teaching Children Mathematics, March 1995.

Marcy's Dot Pattern. Patricia Ann Kenney, Judith S. Zawojewski, and Edward A. Silver, Mathematics Teaching in the Middle School, May 1988.

Introducing the Variable through Pattern Exploration. Lyn D. English and Elizabeth A. Warren, Mathematics Teacher, February, 1998.

(Naturally) Numbers Are Fun. Don Crossfield, Mathematics Teacher, February 1997.

Discussion Leader 6 _____

6. Feb 22

On the Meaning of Variable. Alan H. Schoenfeld and Abraham Arcavi, Mathematics Teacher, September 1988.

The Many Uses of Algebraic Variables. Randolph A. Philipp, Mathematics Teacher, October 1992.

Teaching informal Algebra. James E. Schultz, Arithmetic Teacher, May 1991.

Discussion Leader 7 _____

Teaching Algebraic Expressions in a Meaningful Way. Louise Chalouh and Nicolas Herscovics, The Ideas of Algebra, K-12, 1988 Yearbook of the National Council of Teachers of Mathematics.

Building Algebraic Expressions: a Physical Model. Anne C. Patterson, Mathematics Teaching in the Middle School, February 1997.

Constructing Meaning for the Concept of Equation. Nicolas Herscovics and Carolyn Kieran, Mathematics Teacher, November 1980.

Algebra Can Be Elementary ... When It's Concrete. Barbara Berman and Fredda Friederwitzer, Arithmetic Teacher, April, 1989.

Discussion Leader 8 _____

7. March 1

Functions from Kindergarten through Sixth Grade. Stephen S. Willoughby, Teaching Children Mathematics, February 1997.

Algebra: Real-Life Investigations in a Lab Setting. Leah P. McCoy, Mathematics Teaching in the Middle School, February 1997.

Building the Concept of Function from Students' Everyday Activities. Susana Davidenko, Mathematics Teacher, February 1997.

A Function is a Mail Carrier. Mark Sand, Mathematics Teacher, September 1996.

Discussion Leader 9 _____

Equivalent Representations in the Learning of Algebra. Frances Van Dyke and Timothy V. Craine, Mathematics Teacher, November 1997.

When Does a Dog Become Older Than Its Owner? Anne Larson Quinn and Karen R. Larson, Mathematics Teacher, December 1996.

Multiple Representations and Connections Using Technology. Charles Vonder Embse and Vernon W. Yoder, Mathematics Teacher, January 1998.

Discussion Leader 10 _____

8. March 8 Midterm Exam

March 15 Spring Break

9 March 22

Spreadsheets, Patterns, and Algebraic Thinking. Don Ploger, Lee Klinger, and Michael Rooney, Teaching Children Mathematics, February 1997.

Using Spreadsheets to Promote Algebraic Thinking. Michael T. Battista and Carolyn Van Auken Borrow, Teaching Children Mathematics, April 1998.

Discussion Leader 11 _____

Flower Beds and landscape Consultants: Making Connections in Middle School Mathematics. Jim Hersberger and Bill Frederick, Mathematics Teaching in the Middle School, April-May 1995.

An EXCELlent Bridge to Algebra. Alex Friedlander, Mathematics Teacher, May 1998.

Discussion Leader 12 _____

10. March 29

Technology, Linear Equations, and Buying a Car. James T. Sandefur, Mathematics Teacher, October, 1992.

Computers Support Algebraic Thinking. Douglas H. Clements and Julie Sarama, Teaching Children Mathematics, February 1997.

Discussion Leader 13 _____

Solving Equations in a Technological Environment. Michal Yerushalmy and Shoshana Gilead, Mathematics Teacher, February 1997.

Uses of Technology in Prealgebra and Beginning Algebra. M. Kathleen Heid, Mathematics Teacher, March 1990.

Discussion Leader 14 _____

11. April 5

Journals: Pathways to Thinking Second-Year Algebra. Kathleen P. Chapman, Mathematics Teacher, October 1996.

The Write Way: A Look at Journal Writing in First-Year Algebra. Barbara J. Dougherty, Mathematics Teacher, October 1996.

Writing to learn Algebra. L. Diane Miller and David A. England, School Science and Mathematics, April 1989.

Discussion Leader 15 _____

Children's Difficulties in Beginning Algebra. Lesley R. Booth, The Ideas of Algebra, K-12, 1988 Yearbook of the National Council of Teachers of Mathematics.

Ideas about Symbolism that Students Bring to Algebra. Kaye Stacey and Mollie MacGregor, Mathematics Teacher, February 1997.

Some Misconceptions Concerning the Concept of Variable. Peter Rosnick, Mathematics Teacher, September 1981.

Discussion Leader 16 _____

12. April 12

What Are These Things Called Variables? Sigrid Wagner, Mathematics Teacher, October 1983.

From Words to Algebra: Mending Misconceptions. Jack Lochhead and Jose P. Mestre, The Ideas of Algebra, K-12, 1988 Yearbook of the National Council of Teachers of Mathematics.

Advancing Algebra. Sigrid Wagner and Sheila Parker, Research Issues from the Classroom: High School Mathematics, 1993.

Discussion Leader 17 _____

The Learning and Teaching of School Algebra. Carolyn Kieran, Handbook of Research on Mathematics Teaching and Learning, 1992.

Discussion Leader 18 _____

- 13. April 19** An Agenda for Research on the Learning and Teaching of Algebra. Sigrid Wagner and Carolyn Kieran, Research Issues from the Classroom: High School Mathematics, 1993.

Discussion Leader 19 _____

- 14. April 26.** Research Reports

- 15. May 3** Research Reports

Algebraic Thinking: A Theme for Professional Development. Faye Ruopp, Al Cuoco, Sue M. Rasala, and M. Grace Kelemanik, Mathematics Teacher, February 1997.

Algebra for Everyone: In-Service Training for teachers. Ann R. Crawford and Paul G. Shotsberger, Mathematics Teacher, October 1995.

- 16. May 10 Final Exam 6-7:50**