EMAT 3400 - CHILDREN'S MATHEMATICAL LEARNING
Fall 2005

Course Instructor:

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Class Meetings:

102 Aderhold Mondays and Wednesdays, 10:10 am – 12:00 pm

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Course Goals and Themes

This is the first of two mathematics education courses you will take at UGA as part of your teacher preparation program. We will concentrate on three main arenas of teachers' work that will enable you to practice skillfully as a beginning teacher:

1. Establishing a *classroom culture* that supports the development of students' mathematical proficiency — and, in particular, what this takes at the beginning of the year;
2. Interpreting and developing *students' mathematical thinking*;
3. Designing, teaching, and improving *mathematics lessons* and segments of instructional work in classrooms.

Acquiring professional knowledge and skills in these three related arenas will support your learning to teach mathematics effectively. You will be able to make sense of what students are thinking, assess their progress, and use that to develop their mathematical proficiency. You will become more skilled at designing lessons, carrying them out, appraising what students were learning, and revising and improving your efforts. You will become more skillful at creating a classroom environment that can support the kind of mathematical work that you are trying to promote. And, across our work together, you will develop a greater sense of yourself as a professional, as someone joining a community of practice that shares norms, specialized knowledge, and ethical commitments.

Being able to teach mathematics well is shaped by your skills in two other areas, and we will work on both of these:

- using mathematics in teaching
- promoting equity in mathematics learning

The interaction of these themes can be represented with this graphic:

	Using mathematics in teaching	Promoting equity
Establishing classroom culture		
Interpreting and developing students' thinking		

Designing, teaching, and improving lessons		

There are two aspects involved in **using mathematics in teaching**, and we will work on both across the semester: (a) having a robust sense of what it means to be proficient in mathematics, and (b) understanding and being able to use mathematics in ways needed for the work of teaching.

First, teachers need to appreciate what kinds of understanding and skill they are aiming at with their students. So we ask: *What is involved in knowing and doing mathematics proficiently?* In reading and language arts, most teachers have a highly developed sense of what it means to be literate with language. But understanding what the analogue is in mathematics is more elusive for many. This course is designed to help you consider what it means to be capable with mathematics. We begin with a provisional definition: that mathematical proficiency involves conceptual understanding, procedural fluency and skill, and the use of a variety of *mathematical practices* –– skills, tools, and habits of mind and action –– important to learning, doing, and using mathematics. Examples include using mathematical language, justifying claims and solutions, and developing and comparing representations. Being mathematically proficient also includes confidence in one's own capacity and a sense of how to work productively. We will use our work together over the semester and your work in the field to flesh out this definition.

Second, *teaching mathematics requires a great deal of specialized mathematical knowledge and reasoning*. Your own understanding, fluency, and comfort with mathematics will be important to your effectiveness as a teacher. Teaching depends on kinds of mathematical understanding and skill different from what it takes to do well in a math course as a student yourself, or to be good at other jobs that require mathematics. In preparing to teach, teachers need to determine the mathematical goals of activities, anticipate the varied ways students might respond, and prepare mathematically for what might happen as the lesson unfolds. Teachers must prepare good questions to ask and generate easier as well as harder versions of the problem, either as a back-up plan or as a way to focus or extend students' work. In order to hold high expectations of students, teachers need a keen sense of the complexity of particular mathematical ideas, and ways they can be scaffolded for students' learning. These are but some of the examples of important mathematical work that teachers do.

We will work this semester on developing mathematics knowledge that is useful for teaching, and on learning to use mathematics as teachers. Our focus is the *mathematical content* of place value with whole numbers and decimals; the meanings of the operations of addition, subtraction, multiplication, and division; and procedures, place value meanings, and representations for whole and decimal number computation. Within these topics, we will also work on *mathematical practices*, focusing particularly on the use of mathematical language, representations, and mathematical reasoning. We selected this array of mathematical content and practices because they are central to so much of the K-8 curriculum, because they are difficult for many students, and because teaching them well is not easy. Your fluency as a teacher in these areas of mathematics will give you significant leverage as a beginning professional.

A second major set of skills on which we will work this semester centers on developing the commitment and capacity to be able to **promote equity** in mathematics learning. "Promoting equity" means teaching in ways that actively support the learning of every student and that do not inadvertently reproduce inequality across social groups. The harsh reality of mathematics education is that our system produces starkly uneven results. While a small fraction of students do become mathematically proficient in school, most do not. And those who do not are disproportionately students of color and students living in poverty. Although the gap in achievement between males and females has narrowed in the last decade, attention to gender is also crucial. Clearly, issues related to poverty, class, race, culture, language, and gender are broader and deeper than any single

classroom. But pedagogy matters, too. Teaching can shape students' experiences, their sense of themselves as mathematics learners, and the development of their mathematical capacities. We ask: *What can teachers do to promote equity in their mathematics teaching?* What you do with your particular students is vital. Your work with them can serve to enable them to develop mathematical knowledge and practices to be successful with mathematics, or it can unintentionally reinforce existing patterns of success and failure. Our focus this term will be on learning more about the students you will teach and on how to develop practices of teaching that are sensitive to and respectful of differences, and that enable you to help each of your students become successful mathematics learners.

How We Will Work Together

One semester is a short time to achieve the goals sketched above—and we will continue to work on them next semester. If you work hard and attentively this term, you will learn to *do* mathematics teaching, as well as to *analyze* it. You will develop skills of watching and listening that enable you to make sense of how others think mathematically and express themselves in multiple ways. You will develop practices that enable you to attend and respond to students' mathematical ideas and ways of thinking, and to plan, teach, and analyze mathematics lessons. You will elaborate your knowledge of some areas of mathematics in ways that ready that knowledge for the specific work of teaching it. And, attentive to potential sources of inequity, you will be able to work in support of each of your students' learning in mathematics.

Working on these elements of mathematics teaching will enable you not only to get started, but also to go on learning from practice. We have designed your work this term to help you also learn how to *learn teaching*. This involves learning how to study and examine practice, and to develop criteria for judging alternative instructional decisions and moves. In short, it means asking, exploring, and experimenting with the teaching of mathematics in school, *in ways that make children's ideas central to the work, and that preserve the mathematics with intellectual rigor and integrity*.

Four kinds of experience support our learning in this course:

1. *Our class itself:* Our activities, discussions, and interactions will be a central "text" for our work together. What I do with you is teaching, and you and your classmates are directly engaged in learning. There will be things to learn from reflections on our interactions together. We will work actively and collectively on all the strands of the course, developing new insights and knowledge from what we do together. You will be making a notebook as a site for recording and using this joint work.
2. *Records from a real third grade classroom:* We will study records of practice to learn the work of teaching. These records — videotapes of lessons, students' work, and the teacher's plans and reflections — make it possible for us to study together mathematics in use in a classroom, the work of teaching, and students.
3. *Your field placement*: In this course, you will have classes at UGA and a field experience at Barrow Elementary School—you will meet with students for out-of-classroom activities. We will engage in some common tasks in the field so that we can discuss and learn from one another's experiences in the field.
4. *Course readings and assignments:* Your engagement with readings and other assignments will help you extend the resources and perspectives you can bring to thinking about mathematics teaching and learning.

Course Requirements and Grading

Attendance and class participation: Your participation in our class activities and discussions is important not only for your own learning but also the learning of others. I expect you to

attend every class, to arrive on time for a prompt start, and to participate in and contribute to class. You cannot readily "make up" the class if you are absent because so much rests on what we do together as we work. If circumstances prevent you from attending class, please send me an email or call me in advance.

Notebook: You will keep mathematical and other drawings, writings, weekly assignments (described below), and reflections in a special mathematics notebook. The work you do in your notebook is a central part of the course. From time to time, I will look at and respond to your work in your notebook. When I read it, I will provide suggestions for amplifying your use of this medium for your own learning so that you get as much as possible out of the experience. Please see handout for specific guidelines for working in your notebook, and criteria for the quality of your work.

Assignments: You will have assignments for each week and specific classes. These will include reading and reflection on what you read, mathematical problems that help you learn to use mathematics for teaching, and tasks related to the core practices of teaching that you are developing this term. These assignments will be completed in your notebook. I will give you feedback on your assignments and on the quality of your professional work. My goal is to help you use effectively this term's opportunities to learn to teach mathematics.

You will be reading a variety of articles and other materials for this class. Some of the readings will be discussed explicitly in class, some you will comment on in your notebook, and others will simply be used in the context of our work. I will expect you to be able to bring these readings to bear in assignments and discussions.

Some assignments will ask you to use your field placement as a site to try out things you are working on in our course.

Student Thinking Project: This project will be focused on close study of students' mathematical thinking. Taking some of the mathematics content that we ourselves will have been exploring, you will learn to elicit, make sense of, and work with students' ideas.

Teaching Segments: To equip you with skills and tools that will enable you to effectively develop, improve, and teach mathematics lessons, you will learn to design and carry out different slices of mathematics teaching that are a routine part of teaching. We will refer to these "slices of teaching practice" as <u>teaching segments</u>. These teaching segments have been chosen to provide you with skills to carry out important tasks of teaching which will help you in your work as a beginning teacher. As you prepare, practice, and perform these teaching segments throughout the semester in your field placement, you will use what you have learned about attending to mathematics, students, and equity. The point is to learn to <u>do</u> teaching, not only analyze it.

Specific criteria for grading the project, teaching segments, and lesson will be given with the assignments.

Final Examination: The course will conclude with a final examination designed to focus on your knowledge and skills for teaching mathematics. Consistent with the course goals of developing your proficiency as a beginning teacher of mathematics, this exam will ask you to demonstrate your performance in the main areas of the course. The tasks you will be asked to do will be consistent with those you will be practicing all term. You will be able to prepare in advance for the performances (written and oral) that the exam will ask of you. Two weeks before the final examination, I will distribute a list of possible exam problems and tasks. You will be able to prepare for each, working with others if you choose. You may make notes, gather ideas, and practice skills. The actual examination will consist of a subset of those

tasks and problems. The final exam date and time is **Friday, December 16, from 8:00 to 11:00 am**.

Grading: This is a professional course. The standards of performance are tied to those you will be expected to meet as a teacher:

- meticulous preparation,
- appropriate use of professional knowledge,
- careful consideration of alternatives,
- genuine curiosity about ideas and about learners,
- exercise of professional judgment,
- collegial work on teaching,
- analysis and reflectiveness,
- skills of ongoing professional learning,
- clear expression,
- organization,
- timeliness.

Completing assignments and projects with attention to all the elements of professional work will be judged as satisfactory professional performance (equivalent to a letter grade of B). Exceptional performance (equivalent to a letter grade of A) is reflected in work that goes beyond basic requirements of an assignment, demonstrating skills and thinking that are more nuanced or developed. Work that displays lack of care with particular elements, or is underdeveloped, is evaluated as performance in need of improvement (equivalent to a letter grade of C). You may revise and further develop any assignments or projects that I evaluate as in need of improvement, and resubmit them within a specified time period for me to re-evaluate as satisfactory or not. Work that is not turned in on time (without prior arrangement and our agreement) or demonstrates significant lack of care and attention may be determined to be unsatisfactory. Unsatisfactory work cannot be resubmitted

Your final grade will be composed as follows based on your performance of each of the course requirements:

Attendance and class participation	10%
Notebooks and weekly assignments	15%
Barrow Reports	10%
Student thinking project	20%
Teaching segments	25%
Final exam	20%

Course materials:

Required

1. Lampert, M. (2001). Teaching problems and the problems of teaching. New Haven: Yale University Press. *Available at UGA bookstore or on the web (e.g., www.amazon.com or www.bn.com).*
2. Additional readings are available online through a WebCT page. To access this page go to webct.uga.edu and once you log in you will see the class web page. I will also post assignments, notes, and other important classroom materials on our webct page.

Recommended

Van de Walle, J. (2004). Elementary and middle school mathematics: Teaching developmentally (5th ed.). White Plains, NY: Longman.

National Council of Teachers of Mathematics (2000). Principles and Standards for School Mathematics. Reston, VA: Author. (Also available on the web at: http://www.nctm.org/standards/)

TENTATIVE COURSE OUTLINE

I. Establishing a Classroom Culture to Support the Development of Students' Mathematical Proficiency

Weeks 1 - 3

Questions: In what ways does the culture of the classroom shape students' opportunities to become mathematically proficient — to develop conceptual understanding, procedural fluency, and to use mathematical practices? What is the work of the teacher to create a classroom culture conducive to successful learning and doing of mathematics? In particular, what does it take to start deliberately developing such a culture at the beginning of the school year? What is important to attend to with respect to issues of equity? What images about what it means to be good at mathematics are crucial to convey to students, and how can a teacher do so? How can participation be encouraged from the beginning of the year?

Readings:

Kilpatrick, J., Swafford, J., and Findell, B. (2001). Number: What is there to know? (pp. 71 – 114). Adding it up: Helping children learn mathematics. Washington, DC: National Academy Press. (Also available at www.nap.edu/books/0309069955/html/.)

Labinowicz, E. (1987). Children's right to be wrong. Arithmetic Teacher, 35 (4), 2 & 20.

Ladson-Billings, G. (1994). Seeing color, seeing culture. In Dreamkeepers: Successful teachers of African American children (ch. 3, pp. 30 – 53). San Francisco: Jossey-Bass. (Also available for e-check out at www.netlibrary.com.)

Lampert, M. (2001). Teaching problems and the problems of teaching, (chaps. 1 – 4, 10) (pp. 1 –100, 265-328). New Haven: Yale University Press.

National Council of Teachers of Mathematics (1991). Environment, and Standard 5: Learning environment (pp. 56-61). Professional standards for teaching mathematics Reston, VA: Author.

II. Interpreting and Developing Students' Mathematical Thinking

Weeks 3 - 8

Questions: How can we gain insight into what children think? What does it mean to "know" something in mathematics? How can we learn to make sense of children's mathematical language? What is entailed in learning to connect with and hear diverse students? How can teachers probe students' ideas? How do the particular problems we use, including their contexts and tools, affect what students "know"? What counts as evidence of students' knowledge or understanding?

Readings:

Erlwanger, S. (1975). Benny's conceptions of rules and procedures in IPI mathematics. Journal of Mathematical Behavior, 1, 157-283.

Kilpatrick, J., Swafford, J., and Findell, B. (2001). The strands of mathematical proficiency (pp. 115 – 155). Adding it up: Helping children learn mathematics. Washington, DC: National Academy Press. (Also available at www.nap.edu/books/0309069955/html/.)

Ladson-Billings, G. (1994). The tree of knowledge. In Dreamkeepers: Successful teachers of African American children (ch. 5, pp. 78-101). San Francisco: Jossey-Bass.

Lampert, M. (2001). Teaching problems and the problems of teaching, (chaps. 5 - 6) (pp. 101-142). New Haven: Yale University Press.

Ma, L. (1999). Subtraction with regrouping: Approaches to teaching a topic. In Knowing and teaching elementary mathematics, (ch. 1, pp. 1- 27). Mahwah, NJ: Lawrence Erlbaum. (Also available for e-check out at www.netlibrary.com.)

Paley, V. (1986). On listening to what children say. Harvard Educational Review, 56, 122-131.

Van de Walle, J. (2004). Whole number place value development. In Elementary and middle school mathematics: Teaching developmentally (5th ed.) (ch. 12, pp. 178-200). White Plains, NY: Longman.

III. Designing, Teaching, and Improving Mathematics Lessons

Weeks 9 - 15

Questions: What is there to consider in choosing instructional tasks? How can you distinguish a more promising from a less promising task? How does the choice of mathematical tasks shape students' opportunities to be successful? How can one appraise, select, modify and use mathematical tasks and curriculum materials? What are considerations of the teacher's role in class? What's entailed in designing lessons that focus on mathematical content and also provide opportunities for the development of mathematical practices? What is involved in respecting students' differences and in expecting all students to be capable of learning? How can you promote equity in the way you teach mathematics lessons?

Readings:

Ladson-Billings, G. (1994). We are family. In Dreamkeepers: Successful teachers of African American children (ch. 4, pp. 54 - 77). San Francisco: Jossey-Bass.

Lester, Jill Bodner. (1996). Establishing a community of mathematics learners. In D. Schifter (Ed.), What's happening in math class? Envisioning new practices through teacher narratives (pp. 88 - 102). New York: Teachers College Press.

Lampert, M. (2001). Teaching problems and the problems of teaching, (chaps. 7 – 9, 12), (pp. 143-264, 361-388). New Haven: Yale University Press.