EDCI 751: Foundations of Mathematics Education I
Theory and Research on Mathematical Thinking and Learning

Mondays 4:15 – 7:00
Benjamin Building Room 2121

Instructor
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Office Hours
By appointment

COURSE DESCRIPTION

Doctoral programs collaborating in the Mid-Atlantic Center for Mathematics Teaching and Learning are committed to the proposition that mathematics education should focus on helping students develop deep, broad, and connected understanding of mathematics. Understanding is the foundation for flexible and efficient mathematical skills, for ability to solve important problems, and for a disposition to learn new mathematical ideas and techniques whenever the need or opportunity occurs. For this reason, Foundations of Mathematics Education I focuses on theories and research that describe mathematical thinking and understanding and that help in explaining how such thinking and understanding develop.

COURSE GOALS

This course aims to develop understanding and dispositions of mathematics education doctoral students in five key areas:

- Knowledge of key questions addressed by theories of mathematics learning and the theoretical constructs that are useful in formulating such theories.
- Knowledge of prominent theories of learning that are relevant to study of mathematics learning.
- Knowledge of applications and limitations of theories and research about understanding and learning in core areas of the mathematics education.
- Understanding how theories emerge and are tested by research and application.
- Valuing the search for understanding of student thinking and learning, valuing and questioning evidence about validity of major theories, and becoming reflective about one’s own learning.

The course will engage students and faculty in analysis of personal and community beliefs about mathematical thinking and learning, reading of relevant literature, local discussions, study of mathematical thinking of students at various levels of schooling, formulation of evidence-based theories about mathematical thinking and learning, and formulation and implementation of research questions and strategies. Supporting students’ professional development as educational researchers is another focus of the course, including attention to sources of literature and literature searching (particularly in the field of mathematics education), reading and managing research literature, scholarly writing, and conducting empirical research.
TOPICS
The central topics of the course will be developed in 16 class meetings—including one all-day meeting at which students and faculty from all three universities meet face-to-face and 15 local sessions. Regular weekly meetings are on Mondays from 4:15 – 7:00 pm. The topics of the course are presented in three parts:

**Part I: Theoretical perspectives on mathematical thinking and learning**
- Sept 12 Course Overview; Thinking about mathematical thinking and learning
- Sept 19 Theories of mathematical thinking and learning: Behaviorism & Constructivism I
- Sept 26 Theories of mathematical thinking and learning: Constructivism II
- Oct 3 Theories of mathematical thinking and learning: Situative and Socio-cultural perspectives

**Part II: Research on the thinking and learning of central mathematical topics**
- Oct 10 Early number/Arithmetic
- Oct 17 Rational numbers/Proportionality
- *Saturday, Oct 22: Joint Campus Session on Interview Studies of Mathematical Thinking*
- Oct 24 Algebraic Thinking
- Oct 31 Argumentation/Proof
- Nov 7 Advanced mathematical thinking

**Part III: Enduring questions in mathematics education research on mathematical thinking and learning**
- Nov 14 How does prior/intuitive knowledge affect mathematical learning?
- Nov 21 What are the roles of symbolizing and representation in doing and learning mathematics?
- Nov 28 What is the role of student identity in doing and learning mathematics?
- Dec 5 What role does discourse play in doing and learning mathematics?
- Dec 12 What roles do culture and community play in doing and learning mathematics?
- Dec 19 Presentations of final projects and Wrap-up

The specific goals of each session and tentative reading assignments appear as an appendix to this syllabus.

**COURSE REQUIREMENTS AND EVALUATION**
The following are brief descriptions of the responsibilities and assignments that will help you meet the goals of this course. Requirements with (*) are described in detail on assignment handouts available on Blackboard. Further details about all assignments will be provided during class. Depending on how the course unfolds, some details may change. I will inform you of any changes in advance of the assignment due dates.

**Course Participation**
I expect all students to be active participants in every class meeting. There will be reading, thinking (“knowledge worrying”), and writing assignments in preparation for each class meeting. Some of this preparation will involve your participation in the discussion board on the course Blackboard website. 20% of your final grade will be based on the quality of your participation. To access the website, login at https://elms.umd.edu using your regular UMD username and password. Click on the link to EDCI 751. Course information, documents and the discussion board are available through this website.

**Session Leadership***
As you are preparing for careers in which you are likely to be an instructor, this assignment involves the preparation and leading of discussion/activities for two class sessions. You will be working with partner(s) to prepare and lead sessions. 15% of your grade will be based on this activity.

**Review of research on the learning of a mathematical topic (Due November 7)**
Because the course focuses on research about thinking and learning in mathematics, there will be a paper (which you may connect to mathematical topic of your empirical project), requiring you to find, read and synthesize the literature on the learning of a specific mathematical topic of your selection. This literature review is 20% of your grade.

**Annotated Bibliography (Due December 12)**
After you complete your weekly readings, take a moment to annotate the course reading list with important insights you gleaned from each article or collection of articles. Your annotations should be 2-3 sentences or phrases of summary and 1-2 sentences or phrases of evaluation. The complete set of annotations will be due near the end of the course; however it may be useful for you to bring your annotations and any other notes you may have taken about the readings to class each week. This assignment is 20% of your grade. For more information on annotated bibliographies, please see: [http://www.wisc.edu/writing/Handbook/AnnotatedBibliography.html](http://www.wisc.edu/writing/Handbook/AnnotatedBibliography.html).

**Empirical Project: Analysis of mathematical thinking (Final Project Due December 19)**
Because the course focuses on student mathematical thinking and learning, there will be a major course project in which you will design and implement an interview study in order to examine the student thinking about a mathematical topic. The project, which is comprised of several stages throughout the semester, is 25% of your grade.

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**COURSE POLICIES**

**Expectations for written work**
All written work should be typed in Microsoft Word or Pages. Specific page length and formatting requirements for each assignment will be provided in the assignment description handouts. Punctuation, grammar, expression, and proper citation of sources are the responsibility of the author and are evaluated as part of the grade on an assignment. Citation formats should follow the APA 6th edition guidelines (see reference below). These mechanics are expected to reflect graduate level work, i.e., meet academic standards for professional papers.


It is not expected that you purchase this source (though it will also be useful for you throughout your program). There are several websites that have compiled the APA 6th ed. citation formats, including:

- [http://owl.english.purdue.edu/owl/resource/560/01/](http://owl.english.purdue.edu/owl/resource/560/01/)

**Late assignments**
All assignments must be turned in by the dates and times given. If circumstances make completing the assignment on time impossible, you must notify me at least 24 hours in advance and we will decide an appropriate deadline. No credit will be given for late assignments if prior notice has not been provided.

Extra credit work will NOT be accepted. Only in very exceptional cases is it possible to change a grade by repeating or correcting an assignment.

**Academic Accommodations**
If you have a documented disability and wish to discuss academic accommodations, please contact me as soon as possible.
ADDITIONAL RESOURCES

Below is a list of resources that will be helpful in your exploration of student mathematical thinking and learning. These are important resources for researchers in mathematics education with which you should become familiar through your graduate studies.

Journals
- Journal for Research in Mathematics Education
- Educational Studies in Mathematics
- For the Learning of Mathematics
- ZDM: The International Journal on Mathematics Education
- Journal of Mathematical Behavior
- Mathematical Thinking and Learning
- The Journal of the Learning Sciences
- Cognition and Instruction
- Review of Educational Research
- Educational Researcher

Books and Handbooks
- *Handbook of Educational Psychology* (multiple editions)

Professional Organizations
- National Council of Teachers of Mathematics: [http://www.nctm.org](http://www.nctm.org) (NCTM)
- Psychology of Mathematics Education (PME) and PME-North America (PME-NA)
- American Educational Research Association (AERA)
- International Society of the Learning Sciences (ISLS)
- American Mathematical Society (AMS) and the Mathematical Association of America (MAA)
The University has a nationally recognized Honor Code, administered by the Student Honor Council. The Student Honor Council proposed and the University Senate approved an Honor Pledge. The University of Maryland Honor Pledge reads:

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

This Pledge statement should be included in each email or online submission of all papers, projects, or other academic assignments submitted for evaluation in this course. Details about how to do so will be provided in class.

Plagiarism is, unfortunately a common form of dishonesty. It is one I take very seriously. If you have any questions about the definition or seriousness of this, please read [http://www.jpo.umd.edu/SHC/students.html](http://www.jpo.umd.edu/SHC/students.html).
### EDCI 751 Fall 2011: Reading List and Assignment Deadlines

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<tr>
<th>Date</th>
<th>Topic, Readings and Assignments Due</th>
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| 9/8/11   | **Course Preassignments: Due at midnight**  
- Memo on your mathematics learning (email to whole class)  
- Session Leadership Date Selection (email to me) |
| **Session 1** 9/12/11 | **Course Overview; Thinking about mathematical thinking and learning**  
**Assignments Due:**  
- Read syllabus carefully (by class)  
- Read everyone’s Mathematics Learning Memos (by class)  
- Familiarize yourself with the course website |
|          | **Readings:**  
| **Session 2** 9/19/11 | **Theories of mathematical thinking and learning: Behaviorism and Constructivism I**  
**Assignments Due:**  
- Discussion Board Questions  
- Be prepared to share ideas about Literature Review Paper and Empirical Project Topic |
|          | **Readings:**  
| **Session 3** 9/26/11 | **Theories of mathematical thinking and learning: Constructivism II**  
**Assignments Due:**  
- Discussion Board Questions  
- Literature Review Paper and Empirical Project: Topic and preliminary list of sources (email to me and be prepared to share in class) |
|          | **Readings:**  
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<tr>
<th>Session 4</th>
<th>10/3/11</th>
<th>Theories of mathematical thinking and learning: Situative and socio-cultural perspectives</th>
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<td>Assignments Due:</td>
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<td>- Discussion Board Questions</td>
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<td>- Empirical Project: Research questions (email to me prior to class)</td>
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<th>Session 5</th>
<th>10/10/11</th>
<th>Early Number/Arithmetic</th>
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<td>Assignments Due:</td>
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<td>- Discussion Board Questions</td>
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**Session 6**  
**10/17/11**  
**Rational Numbers/Proportionality**  
**Assignments Due:**  
- Discussion Board Questions  
- Empirical Project: Draft of research project proposal (hardcopy to class for feedback)

**Readings:**  


**10/22/11**  
**Saturday Session: Interviewing Student Mathematical thinking**  
**Preparation TBA**

**Session 7**  
**10/24/11**  
**Algebraic Thinking**  
**Assignments Due:**  
- Discussion Board Questions  
- Empirical Project: Research Project Proposal (email to me and bring a hardcopy to class for feedback)

**Readings:**  


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<tr>
<th>Session 8</th>
<th><strong>Proof and Argumentation</strong></th>
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<td>10/31/11</td>
<td><strong>Assignments Due:</strong></td>
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<td>- Discussion Board Questions</td>
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<td>- Literature Review Draft (optional)</td>
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<td><strong>Readings:</strong></td>
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<th>Session 9</th>
<th><strong>Advanced Mathematical Thinking</strong></th>
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<tr>
<td>11/7/11</td>
<td><strong>Assignments Due:</strong></td>
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<td>- Discussion Board Questions</td>
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<td>- Empirical Project: Pilot interview (bring protocol and be prepared to share pilot interview experience)</td>
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<tr>
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<td>- Literature Review Paper Due (uploaded to website by midnight)</td>
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<td><strong>Readings:</strong></td>
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<td>Session 10 11/14/11</td>
<td><strong>How does prior/intuitive knowledge affect learning?</strong></td>
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<td>- Discussion Board Questions</td>
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<th>Session 11 11/21/11</th>
<th><strong>What are the roles of symbolizing and representation in understanding?</strong></th>
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<td><strong>Assignments Due:</strong></td>
<td>- Discussion Board Questions</td>
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<th>Session 12 11/28/11</th>
<th><strong>What is the role of student identity in doing and learning mathematics?</strong></th>
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<td><strong>Assignments Due:</strong></td>
<td>- Discussion Board Questions</td>
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<td>- Empirical Project: Analytical Memo (email to me prior to class and bring a hardcopy to class)</td>
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**Session 13**  
**12/5/11**  
**What role does discourse play in doing and learning mathematics?**

**Assignments Due:**
- Discussion Board Questions

**Readings:**

**Session 14**  
**12/12/11**  
**What roles do culture and community play in doing and learning mathematics?**

**Assignments Due:**
- Discussion Board Questions
- Annotated Bibliography (upload to website by midnight)

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**Empirical Project:** Meet with me this week (11/28 – 12/5)

**Readings:**
**Readings:**


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**12/19/11**
**Final Project Presentations**

**Assignments Due:**
- Final Empirical Project: Report uploaded to website, video transferred to me in class, short oral presentation in class

**Readings:**