EDU 436
Theory and Practice in Teaching and Learning Mathematics

Fall 2007
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Office hours by arrangement

Course Description
This course is designed to introduce pre-service and in-service teachers, as well as doctoral students, to key issues in the teaching and learning of mathematics. Building on research and theory in the fields of learning, teaching, curriculum, and mathematics education, the course addresses issues of content and pedagogy in secondary school mathematics. Attention is continuously given to the goal of teaching mathematics to all students, and its implications in terms of classroom practices, curriculum adaptations, and assessment. The course includes activities designed to build students mathematical knowledge and to initiate discussions about the nature of mathematics and the learning of mathematics. The course takes place concurrently with the pre-service teachers’ 100-hour field experience: this provides opportunities to link practical experiences with course readings and activities and to structure assignments that include a field-experience component.

More specifically, the course aims to help students:
1. Critically examine the effectiveness of reform-based practices in the areas of curriculum development, instructional planning, and instructional strategies specific to secondary mathematics instruction;
2. Develop skills in planning and implementing mathematics lessons that lead to the learning of significant mathematics, build on knowledge of how individual students learn, stimulate and sustain students’ interest and achievement, and take advantage of research-based instructional strategies and assessment approaches for teaching students with all ranges of abilities;
3. Develop strategies to differentiate instruction so as to best respond to students with different abilities and backgrounds;
4. Become aware of appropriate uses of technology in the teaching of mathematics;
5. Further understanding of some fundamental mathematical ideas and concepts in the areas of geometry, numbers, algebra and probability/statistics; and
6. Develop understanding and skills to integrate both the NYS and national standards for secondary mathematics into curriculum development and instructional practices.

Philosophy Informing the Course
One of the major thrusts of the course is a critical examination of the nature of mathematics and what it means to learn and teach mathematics. We think it is critical to examine the theoretical and empirical bases of the learning theories expressed or implied in various instructional strategies. A theme that cuts across the course is a concern for equity. As such, the course will raise awareness and develop understanding of the different needs mathematics students may experience because of their gender, class, cultural background, (dis)abilities, and previous mathematical experiences. Strategies to address these diverse needs will also be discussed throughout the course.

Course Requirements

Class Participation
The format of the course will be that of a seminar, and therefore depends on students’ full participation. Thus, attendance in class is essential. In case you are unable to attend a specific class, please let the instructors know in advance and as soon as possible; in addition, make arrangements with a classmate in advance in order to make sure that you receive information about what went on in the class that you missed as well as to get copies of all the material distributed in that class. Any class missed, for whatever reason, will result in a decrease in your participation grade. Class participation will also include the use of Blackboard.

Class Journal

An important component of the course is the class journal. Eight times throughout the semester you will be expected to write and share with the class a journal entry, which will be posted on Blackboard. Five of the journal entries will respond to prompts and need to be posted by 5pm the day before the class they are listed as due. All members of the class will read the journal entries and be prepared to discuss them in class. The other three entries will be on subjects of your choice. These journal entries should be a page or so of your thoughts, ideas, or comments regarding the learning and/or teaching of mathematics. The journal will create an additional medium for communication among the class participants and allow us to touch on issues and concerns for which we may not have an opportunity to deal with explicitly in our class sessions. Every student will be expected to contribute at least 8 journal entries over the course of the semester.

Readings

Readings will be assigned weekly, and consist of articles/documents that will be posted on Blackboard as well as sections of the following books:

Required texts:

Weekly assignments

A variety of assignments will be given each week that are expected to be completed on time as they may be used in the following class. Therefore no late assignments will be accepted, except if previously arranged with the instructors. The weekly assignments, when involving a written component, are not intended to be finished, polished reports, but rather are meant to be ways to think on paper, so that your reflections can be recorded and shared with other members of the group. Therefore, they will not receive a letter grade, although they will be assigned points for satisfactory completion and will, thus, affect the final grade in the course (see “Evaluation” section of this description, and the weekly assignment sheets that will be distributed in class, for more detail).

Major assignments

Major Assignment One
1. Integrating art and mathematics: In this project, you will design an activity that connects mathematics to art in a way that informs the study of both subjects. By designing this activity, you will help students understand the aesthetic component of
mathematics and the mathematical structure that underlies much of art. You may choose from a variety of areas of mathematics as well as a variety of artistic media to design your project.

OR

1. **Doctoral student assignment:** Select three articles to read that describe theories of learning mathematics. A list of articles will be provided by the instructor. You will discuss each theory described in the articles and then compare them in terms of their implications for classroom practice.

**Major Assignment Two**

2. **Midterm take-home exam:** This will consist of an in-depth analysis of one secondary classroom experience (which you will select among the accounts of reform mathematics lessons read in previous assignments) in light of the NCTM Standards and the principles of a constructivist approach to teaching mathematics. This assignment is intended to demonstrate and enhance your understanding of what it means to learn and teach mathematics, and to synthesize what you have learned in the first part of the course.

**Major Assignment Three**

3. **Implementation and reflection on an innovative series of lessons (Masters students):** Students are expected to teach a series of at least 3 lessons. Each lesson plan must be written in the format of the Warner School lesson plan. The series of three lessons are intended to give students a chance to think about how tasks build from one another and help students to develop conceptual understanding.

   OR

3. **Analysis of a research article (Doctoral students):** Students will identify a research article which they will then analyze according to the theoretical framework, methodology, analysis, and results. Students are expected to take a critical lens and to consider alternative ways of conceptualizing and carrying out the study.

**Major Assignment Four**

4. **Portfolio:** For initial certification students. Students will need to write narratives for 5 proficiencies, three of which are designated. This assignment is intended to get students started on their portfolios, which are required for graduation.

   OR

4. **Investigation of mathematical topic:** For non-initial certification Masters students. In this paper, students will research one mathematical topic (e.g. linear equations, geometry proof), looking for articles which describe innovative ways to teach the topic and challenges students have faced in learning the topic. Papers, approximately 10 pages in length and written using APA-format, should have at least 5-references.

   OR

4. **Doctoral student assignment:** investigation of a topic addressed in class. Students should select a topic by October 15th and provide a list of proposed readings by October 22nd. The paper should be in written in APA format, with at least 10 references, and should be around 10 pages. The paper should include a description of the topic and its relevance, a synthesis of the readings, and a conclusion that suggests implications of the readings.

While a more detailed description of these assignments will be provided at appropriate times later in the course, the deadlines for each of these assignments are indicated in the attached syllabus. In
contrast to the weekly assignments, each of the major assignments described above should be polished and will be graded according to a rubric, which will be distributed along with the detailed description of each assignment.

**Course Evaluation**
Fifty percent of students’ final evaluation will be based on participation in the weekly class meetings, contributions to the class journals, and compliance with the weekly assignments; 50% of the evaluation will be based on performance on the four major assignments. More specifically:

- **Class participation: 20 percent** (i.e., credit given for each class attended with full participation in class activities and discussions)
- **Journals: 10 percent**
- **Weekly written assignments: 20 percent**
- **Major Assignment 1 (Art project OR doctoral assignment): 10 percent**
- **Major Assignment 2 (Midterm take-home exam): 10 percent**
- **Major Assignment 3 (Implementation/reflection on an innovative series of lessons OR doctoral assignment): 15 percent**
- **Major Assignment 4 (Portfolio OR Investigation of mathematical topic OR doctoral assignment): 15 percent**

**Grading scheme:**
A: 96-100; A-: 91-95; B+: 88-90; B: 84-87; B-: 81-83; C: 71-80; F: \( \leq 70 \)

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<th>Assignments</th>
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<th>Percentage</th>
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<tr>
<td>Participation</td>
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<tr>
<td>Journals</td>
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<td>Weekly assignments</td>
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<tr>
<td>Major assignment 1</td>
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<td>Major assignment 2</td>
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<td>Major assignment 3</td>
<td>December 3</td>
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<td>Major assignment 4</td>
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**Tentative class agendas and related assignments**

*Note: The first 7 classes and the last class will be held together with the elementary mathematics methods course and will be taught jointly by the two instructors (Jeffrey Choppin and Mary Bauer). The remaining 7 classes will meet separately and will be taught by Jeffrey Choppin.*

**Lesson 1 (9/17):**

a. Welcome and participants’ introductions
b. Activity on the nature of mathematics and how children learn mathematics [Golden Apples problem from *Fostering Algebraic Thinking*]
c. Brief description of the course and its role in the mathematics teacher preparation program

**Hw. 1:**

1. Mathematics survey
2. Battista article, Brooks – Chapter 1, PSSM pgs 3 – 27.
3. Course materials to review
4. Journal prompt # 1
Lesson 2 (9/24):
   a. Clarifications on course requirements
   b. Follow-up discussion on the readings
   c. The Border Problem
   d. Description of art project

Hw. 2:
   1. Oakes, Thornton, and Ladson-Billings articles
   2. Journal prompt #2.

Lesson 3 (10/1):
   a. Reaction to readings and journal entries on equity issues in mathematics education
   b. Number theory activity – modulo arithmetic
   c. Reflections on the number theory activity and implications for teaching mathematics
   d. Work art project in groups

Hw. 3:
   1. Art project ideas
   2. Readings from Brooks, PSSM, and Gutstein
   3. Journal prompt #3
   4. Do lesson plan

Lesson 4 (10/8):
   a. Experience as learners: An inquiry on area (Part I)
   b. Work on art project in groups

Hw. 4:
   1. Area assignments: (a) group project on developing an area formula for the assigned “star”; (b) story of a classroom implementation of a similar unit (c) reflections and readings on mathematics of area;
   2. Read Brooks, Chapter 6 and Forman article
   3. Journal prompt #4

Lesson 5 (10/15):
   a. Inquiry on area (Part II)
   b. Reflections on the area experience (including explicit attention to the needs and learning styles of diverse students)
   c. Work on art projects in groups

Hw. 5:
   1. Hiebert et al. article, PSSM geometry, Brooks
   2. Journal prompt #5

Lesson 6 (10/22):
   a. Presentations on art projects are due at this time.
   b. Representations – CBR and representation of motion

Hw. 6:
   1. Hufferd-Ackles article, Sherin article
   2. Journal prompt #6

Lesson 7 (10/29):
   a. Designing generative tasks activity
   b. Review final project requirements
   c. Mathematics Worlds and NetLogo – technology and representations

Hw. 7:
   1. Brooks, Wren, Clement
   2. Identify main differences between conventional and inquiry mathematics classrooms
   3. Journal prompt #7
   4. Identify topic and timeline for final project.

MIDTERM due on 11/5!!

Lesson 8 (xx/xx):

Hw. 11:
Lesson 9 (10/xx):

a. Visit to School 15 to observe use of Japanese texts
b. Analyze excerpts from Japanese texts

Lesson 10 (11/12):

a. Mathematics activity – quadratics with GC’s
b. Discussion of Inclusion and design activity to differentiate instruction

Lesson 11 (11/19):

a. Focal Points
b. Activity on probability across 7 - 12 curricula

Lesson 12 (11/26):

a. Presentations on CORE-Plus unit
b. Activity on function transformations
c. Journal quiz game

Lesson 13 (12/3):

a. Examining NYS Mathematics Curriculum
b. Assessment activity (SuperItem Design)
c. R2 activity or CMP prob unit

Lesson 14 (12/10):

a. Final project presentations
b. Discussion with last year’s graduates
c. History of Mathematics activity

References


