Program Cover Document --- MTT 380: Methods of Teaching Mathematics I

I. Basic Course Information

MTT 380: Methods of Teaching Mathematics I is primarily a junior level course. It is scheduled for two 80-minute meetings each week, with an optional fourth hour to be used at the instructor's discretion. Its prerequisites are MAT 200, MAT 205, and MAT 229. It is the first course in a two-course sequence of professional courses designed for mathematics education majors. This course will be a writing intensive course to satisfy the sophomore/junior level writing intensive liberal learning requirement.

II. Learning Goals

The content and performance goals for MTT 380 and the second professional course, MTT 390, directly address the goals of the MATT program. In these courses, students make connections between the higher level mathematics courses they have taken/are taking and the K-12 mathematics curriculum (a recommendation set forth in the Conference Board of Mathematical Sciences (CBMS) *Mathematical Education of Teachers* document published in 2001). In MTT 380, they will begin to comprehend the scope and sequence of K-12 mathematics with a focus on the middle school level.

Students in MTT 380 will begin to relate their subject matter knowledge to content pedagogy appropriate for mathematics. They will be introduced to national and state standards for mathematics and standards-based teaching and curricula. This will form the basis for discussing appropriate instructional strategies, theories of learning, materials, and technology. In addition, students will begin to learn how to continue their professional development beyond graduation.

An additional learning goal for MTT 380 is to help students develop as writers in the context of their field of study.

III. Student Assessment

The assessment in MTT 380 is a crucial part of the assessment plan for the MATT program. This will be the first time the student is assessed on the pedagogical goals for the program. It will be vital to get evidence of student progress and to give feedback at this point before the student takes part in the junior and senior field experiences where he/she will be teaching mathematics to middle or high school grade students. All of the homework and projects in MTT 380 are designed as learning activities as well as methods of assessment. For example, creating a final portfolio is a culminating experience where the student must choose certain pieces of work from the semester to meet various criteria. In this process, the student reflects on his/her learning in the course. Since this is a writing intensive course, students will receive feedback on all written assignments and revise as necessary to improve writing competency. The final portfolio should demonstrate evidence of their progress as a writer.

Student performance on these assessment instruments and the performance of students in their future professional courses, such as MTT 390 and MTT 490 (Student teaching), will be used to assess the success of MTT 380 in achieving its learning goals and its contribution to the fulfillment of the MATT program goals.

IV. Learning Activities

Students must experience standards-based teaching and learning in order to understand how to implement it. Learning activities should be situated in middle school content and a variety of strategies and methods of instruction should be used to model effective teaching of mathematics. Learning activities will consist of a combination of lectures, demonstrations,

explorations, group work, participation in class discussions, readings, writing and revising homework assignments, and preparing a portfolio.

This study of standards-based teaching will continue in MTT 390 as they focus on high school curricula. In the second course of the sequence, students will have to develop a unit plan and teach a two-week mini-unit in their field placement. The foundation they build in MTT 380 will help prepare them for this experience.

Departmental Course Syllabus – MTT 380: Methods of Teaching Mathematics I

A typical syllabus for MTT 380 follows this. Any syllabus for MTT 380 should include the points listed below.

I. Basic Information

A. Purpose statement: In addition to subject matter knowledge, an effective teacher needs to have pedagogical content knowledge. MTT 380 is the first in a two-course sequence of professional courses designed to prepare mathematics education majors to teach mathematics effectively.

B. Course description: This course is the first in a two-course sequence of professional courses for mathematics education majors. Students will be introduced to national and state standards for k-12 mathematics, and learn how to teach according to these standards. Topics include the use of manipulatives and technology in teaching mathematics, learning theories, and the investigation of standards-based curricula. These topics will be situated in the content of middle school mathematics. Students will make connections between their college mathematics courses and middle school mathematics. This is a writing intensive course and as such, students will be expected to submit written assignments for feedback and make revisions.

C. Course prerequisites: MAT 200 (Discrete Math), MAT 205 (Linear Algebra), and MAT 229 (Multivariable Calculus) are prerequisites for this course. Students need to be majoring in mathematics to take this course. They need a strong foundation in higher level mathematics so that subject matter pedagogy can be examined and related to their content knowledge.

II. Learning Goals

A. Content goals: Students will become familiar with the national and state standards relating to mathematics instruction, know how to teach according to these standards, and become familiar with standards-based curricula. They will understand learning theories and how they apply to the teaching and learning of mathematics. They will know what it means to teach through problem solving. They will understand the mathematical content of the middle school mathematics curricula, how it relates to college level mathematics, and become familiar with the manipulatives and technology that are available for teaching it.

Many students will enter the course with the misconception that doing mathematics is merely doing computation. They will learn that the mathematical processes of problem solving, reasoning, communicating mathematically, making connections between mathematical ideas, and representing these ideas should be a focus of the entire K-12 curriculum, according to national and state standards. They will come to a new understanding of what it means to "do mathematics" at any level.

B. Performance goals: The successful student completing this course should be able to do all of the following:

- Demonstrate understanding of national and state standards.

- Select and use appropriate concrete manipulative materials, activities, performance tasks, textbooks, and other representations to develop mathematical concepts and skills.
- Demonstrate use of appropriate calculators and computer software in teaching mathematics.
- Utilize effective strategies, based in theory of learning, for teaching various mathematical topics in the middle school curriculum.
- Demonstrate knowledge of various methods of assessment and evaluative criteria.
- Reflect on his/her own growth as a doer and teacher of mathematics.
- Demonstrate knowledge of print and electronic resources available to them.
- Demonstrate progress as a writer.

III. Student Assessment

A. Assessment plan: Students will be assessed and receive regular feedback on their work through some combination of homework, written and oral communication, portfolios, presentations, and in-class examinations. Written assignments will be submitted for feedback and revisions made.

B. Rationale: A variety of methods of assessment are needed to assess the performance goals. In-class examinations, which normally preclude the use of books and the practice of group discussion, enable the professor to assess the knowledge an individual student has readily available. This is a writing intensive course and as such, students should also be assessed on their progress as writers.

C. Methods and criteria: A syllabus should coincide with the assessment plan in Part A and clearly describe the schedule for these assessment tools, the criteria that will be used to evaluate student performance, and how grades will be calculated.

IV. **Learning activities**

A. Summary of learning activities: Learning activities will consist of a combination of lectures, demonstrations, explorations, group work, participation in class discussions, readings, writing and revising homework assignments, and preparing a portfolio. Outside of class, students are expected to do a significant amount of individual or group homework to achieve the learning goals.

B. Calendar or outline: A guide to the organization of the course, a schedule of assessment tools, and a plan for the coverage of topics should be provided to the students.

C. Rationale: Students must experience standards-based teaching and learning in order to understand how to implement it. Learning activities should be situated in middle school content and a variety of strategies and methods of instruction should be used to model effective teaching of

mathematics. Writing is a way of learning and students are more apt to develop as writers in the context of their own field of study. As they prepare assignments such as a report of a field (clinical) interview, they will learn how to express their ideas and findings in a way that is accessible to interested readers, such as other educators and parents.

MTT 380-Methods of Teaching Mathematics I
Fall, 2004

Instructor: Cathy Liebars
Office: Science Complex 212
Phone: 771-3043
E-mail: liebars@tcnj.edu
Office Hours: TF 12:30 – 1:50
Other hours by appointment

Textbook: *Teaching and Learning Middle Grades Mathematics,* Rubenstein, Beckmann, and Thompson, Key College Publishing, 2004.

Basic Information
In addition to subject matter knowledge, an effective teacher needs to have pedagogical content knowledge. MTT 380 is the first in a two-course sequence of professional courses designed to prepare mathematics education majors to teach mathematics effectively. You will be introduced to national and state standards for k-12 mathematics, and learn how to teach according to these standards. Topics include the use of manipulatives and technology in teaching mathematics, learning theories, and the investigation of standards-based curricula. These topics will be situated in the content of middle school mathematics. You will make connections between your college mathematics courses and middle school mathematics. This is a writing intensive course and as such, you will be expected to submit written assignments for feedback and make revisions. MAT 200 (Discrete Math), MAT 205 (Linear Algebra), and MAT 229 (Multivariable Calculus) are prerequisites for this course.

Learning Goals
Content goals: You will become familiar with the national and state standards relating to mathematics instruction, know how to teach according to these standards, and become familiar with standards-based curricula. You will understand learning theories and how they apply to the teaching and learning of mathematics. You will know what it means to teach through problem solving. You will understand the mathematical content of the middle school mathematics curricula, how it relates to college mathematics, and become familiar with the manipulatives and technology that are available for teaching it.
Many of you will enter the course with the misconception that doing mathematics is merely doing computation. You will learn that the mathematical processes of problem solving, reasoning, communicating mathematically, making connections between mathematical ideas, and representing these ideas should be a focus of the entire K-12 curriculum, according to national and state standards. You will come to a new understanding of what it means to "do mathematics" at any level.

Performance goals: The successful student completing this course should be able to do all of the following:

- Demonstrate understanding of national and state standards.
- Select and use appropriate concrete manipulative materials, activities, performance tasks, textbooks, and other representations to develop mathematical concepts and skills.
- Demonstrate use of appropriate calculators and computer software in teaching mathematics.
- Utilize effective strategies, based in theory of learning, for teaching various mathematical topics in the middle school curriculum.
- Demonstrate knowledge of various methods of assessment and evaluative criteria.
- Reflect on his/her own growth as a doer and teacher of mathematics.
- Demonstrate knowledge of print and electronic resources available to them.
- Demonstrate progress as a writer.

Learning activities and assessment

You must experience standards-based teaching and learning in order to understand how to implement it. Learning activities will be situated in middle school content and a variety of strategies and methods of

instruction will be used to model effective teaching of mathematics. Learning activities will consist of a combination of lectures, demonstrations, explorations, group work, participation in class discussions, readings, writing and revising homework assignments, interviews with students, and preparing a portfolio. Outside of class, you are expected to do a significant amount of individual or group homework to achieve the learning goals.

Your final grade will be based on the following:

20% midterm exam
30% final exam
Criteria for all of the assignments below will include quality of writing, and drafts will be submitted for feedback and revision.
25% final portfolio
15% written assignments (Math autobiography, Case Study Analysis, etc.)
5% lesson plan
5% field interview

Class policies:

1. For each class period an assignment is late, it will drop a level on the rubric.
2. Additional assignments for extra credit will not be given.
3. The instructor must be contacted prior to any due date to negotiate alternative arrangements if necessary.
4. Students are responsible for any work that is missed.
5. Make-up exams will be given for excused absences in which case I must be notified within 24 hours of the missed exam. Make-up exams will generally be harder.

National Council of Teachers of Mathematics (NCTM) Electronic Standards and Course CD

All of the readings for the course are either on the CD that accompanies the textbook or are from the *Principles and Standards for School Mathematics (PSSM)* on the NCTM website (www.nctm.org). You will need to sign up for 90-day free access to the Electronic Standards on the NCTM website. Go to the NCTM Standards in the left column on the main page and then click on "Standards-Electronic". You will then find the link to register for the 90-day free access.

Field Interview

A natural way to learn about how children think and understand mathematics is through clinical interviews. You will give your students the task(s) to complete and ask probing questions to gain insight into the students' reasoning. At the end of the unit, come to class prepared to discuss your "findings" with others in our class. You may also be asked to read an article and compare your findings with those of the researchers who authored the article from which the tasks were derived (found on course CD)*. You will then submit a written summary of your interview that includes the following components:

1. Student demographics (fictitious name, age, gender, grade level, and general description).
2. Interview results: comments about the interview indicating how each student attempted the problem and at least two assertions about each student's mathematical thinking and why you make them. One way to think about this is to imagine that you are writing a report for a parent to read. How would you explain what the child seems to understand and think? How could you illustrate your claims with examples?
3. Reflection: a reflection about the interview experience, including its benefits and concerns. Were there questions that worked especially well? Were there some that did not work well? How did you feel about how you did in trying to probe your student's thinking? What from this experience do you think you can take to your teaching?

*Not all tasks have related articles.

Rubric

Interview results – 4
Rich description and in-depth analysis of interviews. Assertions about students' thinking connected to evidence.

Reflection – 3
Thoughtful reflection about interview experience, with all assertions supported by evidence.

Technical quality – 3
Student demographics included. Paper is typed, well-written, with very few, if any, typos and/or grammatical and spelling errors.

Lesson Plan Assignment

Select a geometry topic that appears in both the New Jersey Core Curriculum Content Standards (NJCCCS) and the NCTM *Principles and Standards for School Mathematics* for middle grades. Prepare a lesson plan using the lesson planning guide presented in Lesson 3.2. You should also use the sample lesson plan in Appendix C as a guide for the format of the lesson plan. You should find at least two different resources for your lesson plan (textbook, website, journal article, etc.) and cite them.

Rubric

Lesson setting – 3
The lesson plan considers how the lesson connects to previous and subsequent lessons. It has appropriate objectives for the concepts being explored and identifies appropriate standards that are addressed.

Lesson structure – 4
The three main parts of the lesson (Launch, Explore, Summarize) are apparent and appropriate. There are activities that engage students in exploring the mathematical concepts. The lesson plan includes expected student responses and teacher support throughout.

Technical quality – 3
The lesson plan is well-written, clear, and contains very few, if any, typos, grammatical, and spelling errors. The mathematics is accurate and all resources are cited.

Final Portfolio:

A portfolio is a collection of your work which represents and documents your accomplishments in a given field. In this course you will compile a portfolio of your mathematical work, together with your assessments of that work and your reflections of yourself as a doer and teacher of mathematics. The items you should place in your portfolio are described below, though you may include additional items that you feel are worthwhile. A portfolio does not include everything that you do in the given field; instead, it should showcase what you are capable of doing, and it should show your growth over time.

The final portfolio should include the final portfolio rubric (found on SOCS), a table of contents, an introduction (should include a mission statement, personal statement, and teaching statement – see Appendix E in text), explanations for each piece of evidence included in the portfolio, and items addressing the following listed criteria.

1. Demonstration of positive mathematical disposition.
2. Demonstration of communicating mathematically.

3. Demonstration of mathematical reasoning skills.
4. Demonstration of problem-solving skills.
5. Demonstration of mathematical connections **within** mathematics.
6. Demonstration of mathematical representations.
7. Demonstration of knowledge of the use of tools (technology, manipulatives,...)
8. Demonstration of the most important learning for you this semester in the area of learning and/or teaching mathematics.
9. Your favorite work.

Examples of items that could be included in your portfolio are:
1. out-of-class or in-class assignments
2. Any professional article(s) you have found helpful and interesting.
3. Sample lesson plans you've created
4. Sample assessment instruments you've developed

Final Portfolio rubric

Organization & Presentation – 5 points

The portfolio has a creative, professional appearance. It is well-organized so that it is easy to find required contents. The introduction, table of contents, and explanations are typed.

Technical Quality – 5 points

The introduction and explanations contain high quality writing with very few, if any, typos and grammatical errors.

Introduction, table of contents and rubric – 5 points

The introduction is meaningful, reflective, and contains connections to class or readings. It explains the purpose of the portfolio to the reader. The table of contents and this rubric are included in the portfolio.

Explanations – 10 points

There is an explanation for each item in the portfolio that explains why that item was chosen. The explanations are meaningful and reflective, with connections to class and readings.

Evidence – 10 points

The portfolio contains an item for each of the criteria which addresses the criteria for which it is intended. The item is meaningful, compelling, and shows growth.

Tentative Course Outline

Dates	**Content**	**Reading**
8/31	Syllabus Intro. to NCTM *Standards* Intro. to NJ Math Standards Intro. To Unit One Investigation Preparation for Unit One Interview	Course Introduction (pp. 1-2) Unit One Introduction (pp. 7-8) Chapter 1 from *PSSM*, "A Vision for School Mathematics," pp. 3-8 *PSSM*, Overview for Chapter 6, "Standards for Grades 6-8," pp. 211-213
9/3 – 9/28	Unit One: Creating a Learning Community Mathematics Strand: Reasoning with Patterns & Algebra	

Topics	Sample of Readings
Problem Solving	"Problem Solving Standard for Grades 6-8," *PSSM*, pp. 256-261
Reasoning and Proof	"Reasoning and Proof Standard for Grades 6-8," *PSSM*, pp. 262-267

Pattern generalization	"Building Explicit and Recursive Forms of Patterns with the Function Game," *Mathematics Teaching in the Middle School,* April 2002, pp. 426-431.
Concept of Variable	"Algebra Standard for Grades 6-8," *PSSM,* pp. 222-231
Cooperative Learning	"Using Cooperative Learning in Math," Johnson, *Cooperative Learning in Mathematics: A Handbook for Teachers,* pp. 103-125.
Learning with Materials	"Creating Connections: Promoting Algebraic Thinking with Concrete Models," Chappell, *Mathematics Teaching in the Middle School,* Sept. 2001, pp. 20-25
Functions	"Developing Students' Algebraic Reasoning Abilities," Greenes, *Developing Mathematical Reasoning in Grades K-12,* pp. 127-137.

Assignments
Math Autobiography
Comparison of sources for Introduction of Variables
Unit One Field Interview

10/2 – 10/19 Unit Two: The Learning of Mathematics
Mathematics Strand: Rational Numbers and Their Uses

Topics	Sample of Readings
Multiple representations	"Representation Standard for Grades 6-8," *PSSM,* pp. 280-285
Learning Theory	"The Learning of Mathematics: Perspectives of Different Researchers," Rubenstein.
Fractions, Decimals, and Percents	"Connection Standard for Grades 6-8," *PSSM,* pp. 274-279.
Developing Meanings of Operations	"Number and Operations Standard for Grades 6-8," *PSSM,* pp. 214-221 "Profound Understanding of Division of Fractions," Flores, *In Making Sense of Fractions, Ratios, and Proportions,* pp. 237-246.
Proportional Reasoning	"Three Balloons for Two Dollars: Developing Proportional Reasoning," Langrall, *Mathematics Teaching in the Middle School,* pp. 254-261.
Facilitating Educational Growth	"Understanding Mathematics and Basic Skills," Brahier, *Mathematics Teaching in the Middle School,* Sept. 2001, pp. 8-9.

Assignments
Case Study Analysis
Unit Two Field Interview

10/22 Mid-term exam

10/25 – 10/26 Mid-semester break

10/29 – 11/19 Unit Three: Planning and Instruction TBA
Mathematics Strand: Geometry, Measurement, and Transformations

Topics	Sample of Readings
Worthwhile mathematical tasks	"Selecting and Creating Mathematical Tasks: From Research to Practice," Schwan Smith, *Mathematics Teaching in the Middle School,* pp. 344-350.
Lesson Planning	"Geometry Standard for Grades 6-8," *PSSM,* pp. 232-239. "Measurement Standard for Grades 6-8," *PSSM,* pp. 240-247.

Guided Discovery	"The van Hiele Model of the Development of Geometric Thought," Crowley, *Learning and Teaching Geometry, K-12,* pp. 1-16.
Open-ended exploration	"Developing Lesson Plans," Sawada, *The Open-Ended Approach: A New Proposal for Teaching Mathematics,* pp. 23-35.
Direct Instruction	"Exploring Geometry with Technology," Manouchehri, *Mathematics Teaching in the Middle School,* March-April, 1998, pp. 436-442.
Effective Discourse	"Mathematical Tasks as a Framework for Reflection: From Research to Practice," Stein, *Mathematics Teaching in the Middle School,* Jan. 1998, pp. 268-275.
	"The Teaching Principle," *PSSM,* pp. 16-19.
Evaluating Curriculum materials	
	"Evaluating Instructional Materials," Bernhard, *Mathematics Teaching in the Middle School,* Nov. 1999, pp. 174-178.

Assignments
Lesson Plan
Unit Three Interview

11/23 – 12/10 Unit Four: Assessment
Mathematics Strand: Data Analysis & Probability

(Note: 11/26 is Thanksgiving break)

Topics	Sample Readings
Multiple uses of assessment	
	"Assessment and Equity," Belcher, *Multicultural and Gender Equity in the Mathematics Classroom: The Gift of Diversity,* 1997, pp. 195-200.
	"Assessment Principle," *PSSM,* pp. 22-24.
Discrete and Continuous Data	
	"Mean and Median: Are they really so easy?" Zawojewski, *Mathematics Teaching in the Middle School,* March 2000, pp. 436-440.
Probability	"Data Analysis and Probability Standard for Grades 6-8," *PSSM,* pp. 248-255.
Using rubrics	"Assessment: The STEM Model," Billstein, *Mathematics Teaching in the Middle School,* Jan. 1998, pp. 282-286.
Developing tests	"Does This Count for Our Grade?" *Mathematics Assessment: Cases and Discussion Questions for grades 6-12,* edited by Bush et al, pp. 70-77

Assignments
Unit Four Interview

12/10 Final Portfolio due

12/13 – 12/14 Reading Days

12/15 – 12/21 Final Exam period

Note: Certain sections of Unit Five will be integrated throughout course.