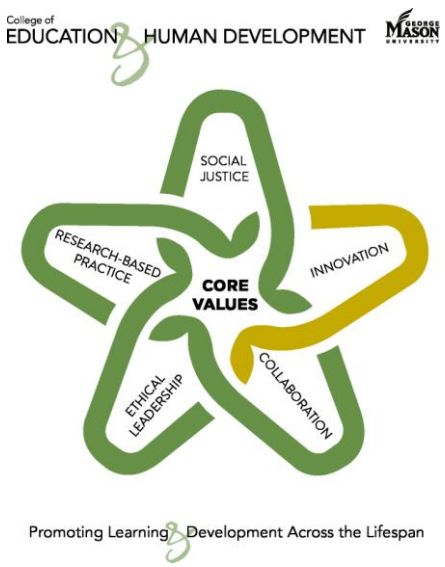
George Mason University
College of Education and Human Development
Secondary Education Program
EDCI 572: Teaching Mathematics in the Secondary School



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Students learn mathematics through the experiences that teachers provide. Thus, students' understanding of mathematics, their ability to use it to solve problems, and their confidence in, and disposition toward, mathematics are all shaped by the teaching they encounter in school.

Teaching mathematics well is a complex endeavor, and there are no easy recipes for helping all students learn or for helping all teachers become effective. Nevertheless, much is known about effective mathematics teaching, and this knowledge should guide professional judgment and activity.

(NCTM, 2000, pp. 16-17)

Purpose of the Course
As a future secondary mathematics teacher, you have the opportunity to touch the future. You can play an important role in the development of adolescents and have an influence on the way in which they come to understand the world in which they live. You can help students to develop strong understandings of mathematics and its uses, understandings that are foundational for work beyond high school. What a wonderful career you have chosen! ☺

In this course, you will come to develop knowledge, skills and understandings that will be useful to you in your work as a secondary mathematics teacher. Though there are no "easy recipes" for helping students learn mathematics, research has identified *characteristics* of effective mathematics teaching. Throughout the semester, we will explore these characteristics and ways in which you can incorporate them into your teaching. You will learn how to be reflective about your work and that of other teachers so that you can continue to draw on and build upon the knowledge and understandings you gain in this course throughout your career as a secondary mathematics teacher.

Course Description as provided in the Course Catalog
This course emphasizes developing different styles of teaching and covers curricula, current issues, and research literature in secondary school mathematics. School-based field experience required. This course is for students who have already taken or are concurrently taking EDUC 522.

Objectives
Success in this course is measured by the degree to which you are able to:

- demonstrate an understanding of the ways in which students develop strong, usable understandings of secondary mathematics content (NCTM SPA Standards 7, 8; CEHD Core Value of Research-Based Practice)
- analyze instruction and instructional materials for their potential to promote student learning of secondary mathematics content in diverse settings (NCTM SPA Standards 1, 2, 3, 4, 5; CEHD Core Value of Research-Based Practice and Social Justice)
- design tasks, including those that rely on technology, that foster the development of deep understanding of secondary mathematics concepts (NCTM SPA Standard 6; NCTM SPA Indicators 7.4 and 8.8; CEHD Core Values of Research-Based Practice and Innovation)
- justify instructional decisions by reference to research findings, national standards, and learning theory (NCTM SPA Indicators 7.4; 8.1, 8.4, 8.6, and 8.7; CEHD Core Values of Collaboration and Research-Based Practice)
- demonstrate the dispositions appropriate to work as a secondary mathematics teacher (NCTM SPA Standard 7; CEHD Professional Dispositions)
- continue to develop your own knowledge of mathematics and problem solving ability as you explore mathematics from the perspective of a teacher and student (NCTM SPA Standard 1; NCTM SPA Indicators 10.4, 10.5, 11.4, 13.2, 14.6; CEHD Core Value of Innovation)
- compare and contrast different perspectives on mathematics teaching and learning - graduate students only (NCTM SPA Indicator 8.6; CEHD Core Value of Research-Based Practice)

Plan for the Course
We will address the guiding questions and objectives as we progress through the course, which is organized into four sections:

I. The Nature of Mathematics and Current Thinking in Mathematics Teaching and Learning
In this part of the course we will explore the nature of doing and understanding mathematics. You will become familiar with the reform movement in mathematics education and the factors that catalyzed that movement. You will also become familiar with the resulting recommendations for teaching and learning offered by the National Council for Teachers of Mathematics (NCTM).

II. The Learning/Classroom Environment
In this part of the course, you will become familiar with various characteristics of effective mathematics teaching. You will explore ways of using questioning, group activity, and well-designed mathematics tasks to promote the development of strong understandings of secondary mathematics concepts. And, you will examine curricular resources and standards documents in consideration of they made be used to design instruction.

III. Planning Instruction
In this part of the course you will apply the knowledge gained in the previous two sections of the course to instructional design. Throughout this section, you will learn how mathematics content can be organized into a series of lessons.

Textbooks and Materials
Daily access to the following materials is required:

Brahier, D.J. (2009). *Teaching secondary and middle school mathematics* (3rd edition). Boston: Pearson Education Inc.

Donovan, M. S., & Bransford, J. D. (2005). *How students learn: Mathematics in the classroom*. Washington, D.C.: The National Academies Press. Graduate Students Only: We will look at excerpts from this text, which can be found at: http://www.nap.edu/catalog.php?record_id=11101

National Council of Teachers of Mathematics (2000). *Principles and standards for school mathematics*. Reston, VA: Author. Excerpts can be found on-line at http://standards.nctm.org/

Virginia Standards of Learning available at http://www.pen.k12.va.us/VDOE/Superintendent/Sols/home.shtml

Course Expectations/Assignments
The following assignments will help you (and me) to gauge your development throughout the course:

Assessment	Percentage of Grade: *Graduate* Level
Participation and Preparation	15%
Procedural/Conceptual Assignment	10%
Problem Lead	15%
Textbook Analysis	20%
Field Work Assignments	10%
Collection of Activities: Analysis and Critique	10%
Lesson Plan and Related Assignments	20%

Participation and Preparation
The participation of each class member is vitally important. If you do not come prepared to discuss the readings, to share you work on a given assignment, and to participate in the activities of the day the entire class will suffer. You **must** commit to be coming to every class on time, being prepared for the evening's activities, and being ready to participate. You can expect that, in addition to work on the larger projects outlined below, there will be weekly readings and assignments that will fall into this category. If, however, there is an emergency and you cannot make it to class, you **must email me ahead of time** and submit all assignments electronically before the end of class.

Procedural/Conceptual Assignment
Individuals can understand mathematics in different ways. In order to be proficient in mathematics, one needs, among other things, both procedural knowledge and conceptual understanding of mathematics. Teachers need to design lessons that develop both. A first step is outlining what those terms mean with respect to the concept a teacher is about to teach. In this assignment, you will have the opportunity to analyze a mathematical concept and outline what it means to have procedural knowledge and conceptual understanding of that concept.

Problem Lead
This assignment will give you a chance to test your skills in leading work and discussion on a mathematics problem. Given a mathematics problem and a learning goal, you will prepare a "lesson" based around that problem. After the "lesson" you will reflect upon the effectiveness of the approach you used to engage your peers in work with mathematical content.

Textbook Analysis
After you've spent some time thinking about characteristics of instruction that are effective for promoting the development of strong understandings of mathematics, you will have the opportunity to use what you have

learned to critique textbook resources for use in designing that instruction. This assignment will introduce you to various textbook resources and allow you to determine how those resources may be useful to you as you prepare to plan your own instruction for the unit plan and in your future work as a teacher.

Field Work Assignments
One of the most valuable pieces of pre-service teacher training is the opportunity to do field work. You will complete 15 hours of field work and keep a log of these hours for submission at the end of the semester. Throughout the semester, you will be required to complete observation assignments during your field work. These assignments provide you with opportunities to reflect upon the practice of teaching after having watched instances of teaching in real world settings.

Collection of Activities: Analysis and Critique (Graduate Students, Only)
This assignment will give you the opportunity to build your repertoire of teaching "tools". You will choose a mathematics topic covered in middle or high school mathematics curricula and search practitioner journals for ideas to teach that topic. You will then summarize and critique those ideas and consider ways that you might use them (possibly in modified form) in your future work as a teacher. You will then share these ideas with your classmates so that everyone will have a collection of teaching ideas to take with them.

Lesson Plan Assignment and Presentation
Throughout the semester, you will explore many issues related to the teaching and learning of mathematics. In this culminating assignment, you will have the opportunity to use the knowledge, skills, and understandings you've gained in the creation of a series of lesson plans. Within these lessons, you will design lessons that pay attention to the use of technology, the development of student understanding of mathematics content, various standards documents, and problem-based instruction. After submission of the lesson plan, you will present your ideas to your peers so that the entire class can begin to create a collection of teaching ideas for various content areas within secondary mathematics. You must meet minimum standard on this, or you will be asked to resubmit.

Communication
You must have a GMU email address (and you must check it often as I will **only** communicate via this medium), you must be able to access Bb (https://courses.gmu.edu/), and you must be able to use the library's collection of e-journals. The best way to contact me is through email, rather than phone.

Evaluation
Final course grades will be assigned based upon weighted percentages as indicated by the Course Expectations.

A	93-100%
A-	90-92%
B+	88-89%
B	80-87%
C	70-79%
F	Below 70%

Student Expectations (as described by the College of Education and Human Development)
- Students must adhere to the guidelines of the George Mason University Honor Code [See http://academicintegrity.gmu.edu/honorcode/].
- Students with disabilities who seek accommodations in a course must be registered with the George Mason University Office of Disability Services (ODS) and inform their instructor, in writing, at the beginning of the semester [See http://ods.gmu.edu/].
- Students must follow the university policy, including that for Responsible Use of Computing [See http://universitypolicy.gmu.edu].

- Students are responsible for the content of university communications sent to their George Mason University email account and are required to activate their account and check it regularly. All communication from the university, college, school, and program will be sent to students solely through their Mason email account.
- Students must follow the university policy stating that all sound emitting devices shall be turned off during class unless otherwise authorized by the instructor.
- Students are expected to exhibit professional behaviors and dispositions at all times.

Campus Resources

- The George Mason University Counseling and Psychological Services (CAPS) staff consists of professional counseling and clinical psychologists, social workers, and counselors who offer a wide range of services (e.g., individual and group counseling, workshops and outreach programs) to enhance students' personal experience and academic performance [See http://caps.gmu.edu/].
- The George Mason University Writing Center staff provides a variety of resources and services (e.g., tutoring, workshops, writing guides, handbooks) intended to support students as they work to construct and share knowledge through writing [See http://writingcenter.gmu.edu/].
- For additional information on the College of Education and Human Development, Graduate School of Education, please visit our website [See http://gse.gmu.edu/].

College Expectations
The College expects students to exhibit the following Professional Dispositions:

Commitment to the profession
Promoting exemplary practice
Excellence in teaching and learning
Advancing the profession
Engagement in partnerships

Commitment to honoring professional ethical standards
Fairness
Honesty
Integrity
Trustworthiness
Confidentiality
Respect for colleagues and students

Commitment to key elements of professional practice
Belief that all individuals have the potential for growth and learning
Persistence in helping individuals succeed
High standards
Safe and supportive learning environments
Systematic planning
Intrinsic motivation
Reciprocal, active learning
Continuous, integrated assessment
Critical thinking
Thoughtful, responsive listening
Active, supportive interactions
Technology-supported learning
Research-based practice
Respect for diverse talents, abilities, and perspectives
Authentic and relevant learning

Commitment to being a member of a learning community
Professional dialogue
Self-improvement
Collective improvement
Reflective practice
Responsibility
Flexibility
Collaboration
Continuous, lifelong learning

Commitment to democratic values and social justice
Understanding systemic issues that prevent full participation
Awareness of practices that sustain unequal treatment or unequal voice
Advocate for practices that promote equity and access
Respects the opinion and dignity of others
Sensitive to community and cultural norms
Appreciates and integrates multiple perspectives

Tentative Schedule

The dates are subject to change dependent on the progress of the course. Due dates for major assignments will not be moved to an earlier date, only a later date if necessary. Additional, smaller assignments, will be made each week.

Date	Topic	Chapter(s) from Brahier Covered	Major Assignment Due
Jan. 24	The Nature of Mathematics and the Reform Movement in Mathematics Education	Chapters 1 and 2	
Jan. 31	Mathematical Proficiency	Chapters 1 and 2	
Feb. 7	Learning Theory and Implications for Instruction	Chapter 3 (pp. 48-50; 57-66)	
Feb. 14	Learning Theory and Implications for Instruction	Chapter 3 (rest of chapter) Chapter 7 (pp. 176-180)	
Feb. 21	Establishing a Learning Environment Conducive to Student Engagement	Chapter 7 (rest of Chapter)	
Feb. 28	Instructional Design and Learning Objectives	Chapters 4 and 5	Procedural/Conceptual Assignment
Mar. 6	Planning for Instruction (Lesson Planning)	Chapter 6 (pp. 142-166)	
Mar. 13	*No Class! Spring Break*		
Mar. 20	Planning for Instruction (Lesson Planning)	Chapter 6 (pp. 142-166)	At least 7 hours of Field Work completed with accompanying assignments
Mar. 27	Technology	Chapter 7 (pp. 180-182)	Text Analysis Due
Apr. 3	Technology		
Apr. 10	Technology		
Apr. 17	TBD		
Apr. 24	Considerations for Teaching Algebra	Chapter 8 (pp. 205-216)	Collection of Activities Due
May 1	Considerations for Teaching Geometry	Chapter 8 (pp. 216-226)	All Field Work completed with accompanying assignments and log sheet
May 15	Lesson Plan Presentations (*Final Exam Day 7:30 – 10:15 p.m.*)		Lesson Plan Assignment

The Problem-Lead assignment will be done by various groups throughout the semester.

Rubric for Performance Based Assessment: **Lesson Plan Assignment**

This rubric consists of 15 categories. Teacher candidates receive a score of 0, 1, 2, or 3 on each. In order to pass the assignment, teacher candidates must earn a minimum of "1" on all categories and a mean of at least "2" on the entire rubric. Candidates earning lower than a mean of "2" or a "0" on any category will be required to redo the assignment.

	Distinguished (met) 3	**Proficient (met) 2**	**Developing (not met) 1**	**Unacceptable 0**
Lesson Construction	Lesson and assignment are written in alignment with specified formatting. All accompanying materials/resources are included. Each resource is clear and appealing to students.	Lesson and assignment are written in alignment with specified formatting. All accompanying materials/resources are included. Some resources are not clear and/or appealing to students.	Lesson and assignment are written in alignment with specified formatting. Some materials are missing and/or all materials are unclear to students.	Lesson and assignment are not written in alignment with specified formatting and/or all submitted accompanying materials are not clear to students.
Goals/Objectives *InTASC: 7* *NCTM SPA: 8.4*	All goals and objectives are written to describe learning ***outcomes*** and are aligned with state and NCTM standards. None are extraneous.	Some objectives/goals are not written to describe learning ***outcomes***. Most of the objectives/goals are related to standards. None are extraneous.	Objectives/goals are not written as learning ***outcomes***. Some of the objectives/goals are related to standards. Some are extraneous.	Objectives/goals are missing, unclear, or are unrelated to standards. Some or all are extraneous.
Content *InTASC: 1*	Instruction focuses on the "big ideas" of mathematics and shows connections between and among concepts. Content is represented accurately and developed logically.	Instruction focuses on the "big ideas" of mathematics but some connections between and among concepts may be missing. Content is represented accurately but, at times, may have gaps in its logical development.	Instruction does not focus on the "big ideas" of mathematics and does not show connections between and among concepts. Content is, represented accurately but, at time, may have gaps in its logical development.	Instruction does not focus on the "big ideas" of mathematics and does not show connections between and among concepts. Content is not represented accurately and/or developed logically.
Student Learning *InTASC: 2* *NCTM SPA: 7.2, 7.4*	All planned activities are developmentally appropriate and provide opportunities for students to engage in meaningful exploration of mathematics in the development of conceptual understanding and procedural knowledge.	Most planned activities are developmentally appropriate and provide opportunities for students to engage in meaningful exploration of mathematics in the development of conceptual understanding and procedural knowledge.	Some planned activities are developmentally appropriate and provide opportunities for students to engage in meaningful exploration of mathematics in the development of conceptual understanding and procedural knowledge.	None of the planned activities are developmentally appropriate nor do they provide opportunities for students to engage in meaningful exploration of mathematics in the development of conceptual understanding and procedural knowledge.
Instructional Activities *InTASC: 4* *NCTM SPA: 7.2, 8.7*	Instruction regularly incorporates variety of activities, engages students in high-level thinking, is problem-/inquiry-based, and is creatively designed.	Instruction often incorporates a variety of activities, engages students in high-level thinking, is problem-/inquiry-based, and is creatively designed.	Instruction rarely incorporates a variety of activities, engages students in high-level thinking, is problem-/inquiry-based, and is creatively designed.	Instruction does not incorporate a variety of activities, engage students in high-level thinking, is not problem-/inquiry-based, and is not creatively designed.

Technology Integration *InTASC: 6* *NCTM SPA: 6, 7.6, 8.9*	Technology is appropriately integrated and supports the development of student understanding of mathematics.	Some technology is used; it has limited appropriateness for some learners and/or does not support the development of student understanding of mathematics.	Technology is not appropriately used; technology does not match goals of the lesson and/or does not support the development of student understanding of mathematics.	Technology is not evident in the lesson.
Communication *InTASC: 5, 6*	Instruction frequently provides opportunities for students to develop understandings collaboratively, in groups, as well as individually. Activities frequently encourage communication between and among students and teacher.	Instruction often provides opportunities for students to develop understandings collaboratively, in groups, as well as individually. Activities often encourage communication between and among students and teacher.	Instruction rarely provides opportunities for students to develop understandings collaboratively, in groups, as well as individually. Activities rarely encourage communication between and among students and teacher.	Instruction does not provide opportunities for students to develop understandings collaboratively, in groups, as well as individually. Activities do not encourage communication between and among students and teacher.
Professional Resources *InTASC: 10* *NCTM SPA: 8.5*	Lesson plans include at least one activity that is a modification of one found in a professional resource. Modifications and/or use in the lesson are well-designed to support student understanding of mathematics.	Lesson plans include at least one activity that is a modification of one found in a professional resource. Modifications and/or use in the lesson are not well-designed to support student understanding of mathematics.	Lesson plans include at least one activity that is a modification of one found in a professional resource. No attempt to modify was made.	Lesson plans do not include reference to outside source.
Justification for Instructional Decisions *InTASC: 9, 10* *NCTM SPA: 7.4, 8.6*	Instructional decisions are aligned with research-based recommendations. Narrative includes *meaningful* references to Brahier, NCTM, additional readings, **and** Doerr and Zangor for justification of instructional decisions. Narrative provides evidence of reflection on instruction designed to engage students in meaningful exploration of mathematical content that supports development of the NCTM process standards.	Instructional decisions are aligned with research-based recommendations. Narrative includes a few references to Brahier, NCTM, additional readings, and/or Doerr and Zangor outside sources. Narrative provides evidence of reflection on instruction designed to engage students in meaningful exploration of mathematical content that supports development of the NCTM process standards	Instructional decisions are not aligned with research-based recommendations and/or narrative is weak with few references and/or little reflection on instruction designed to engage students in meaningful exploration of mathematical content that supports development of the NCTM process standards	Instructional decisions are not aligned with research-based recommendations. Narrative and reflection are weak and/or nonexistent.

Mathematical Problem Solving (*NCTM SPA Standard 1*)
Plans include opportunities for students to engage in the following:

- Apply and adapt a variety of appropriate strategies to solve problems
- Solve problems that arise in mathematics and those that arise in other contexts
- Build mathematical knowledge through problem solving
- Monitor and reflect on the process of problem solving

Distinguished (met) 3	**Proficient (met) 2**	**Developing (not met) 1**	**Unacceptable 0**
Lessons are designed as problem-based lessons. Throughout, students are consistently engaged in activities that address all 4 indicators.	Lessons are designed as problem-based lessons. Students are somewhat engaged in activities that address all 4 indicators.	Lessons are designed as problem-based lessons. Students are somewhat engaged in activities that address most of the indicators.	Lessons are not designed as problem-based lessons. Students are not engaged in activities that address most of the indicators.

Reasoning and Proof (*NCTM SPA Standard 2*)
Plans include opportunities for students to engage in the following:

- Develop a recognition of reasoning and proof as fundamental aspects of mathematics
- Make and investigate mathematical conjectures
- Develop and evaluation mathematical arguments and proofs
- Select and use various types of reasoning and methods of proof

Distinguished (met) 3	**Proficient (met) 2**	**Developing (not met) 1**	**Unacceptable 0**
Lessons are designed to engage students in reasoning and proof. Throughout, students are consistently engaged in activities that address all 4 indicators.	Lessons are designed to engage students in reasoning and proof. Students are somewhat engaged in activities that address all 4 indicators.	Lessons are designed to engage students in reasoning and proof. Students are somewhat engaged in activities that address most of the indicators.	Lessons are not designed to engage students in reasoning and proof. Students are not engaged in activities that address most of the indicators.

Mathematical Communication (*NCTM SPA Standard 3*)
Plans demonstrate and provide opportunities for students to engage in the following:

- Communicate their mathematical thinking coherently and clearly to peers, faculty, and others
- Use the language of mathematics to express ideas precisely
- Organize mathematical thinking through communication
- Analyze and evaluate the mathematical thinking and strategies of others

Distinguished (met) 3	**Proficient (met) 2**	**Developing (not met) 1**	**Unacceptable 0**
Lessons are designed to demonstrate skill in and engage students in mathematical communication. Throughout, students are consistently engaged in activities that address all 4 indicators.	Lessons are designed to demonstrate skill in and engage students in mathematical communication. Students are somewhat engaged in activities that address all 4 indicators.	Lessons are designed to demonstrate skill in and engage students in mathematical communication. Students are somewhat engaged in activities that address most of the indicators.	Lessons are not designed to demonstrate skill in and engage students in mathematical communication. Students are not engaged in activities that address most of the indicators.

Knowledge of Mathematical Connections (*NCTM SPA Standard 4*)
Plans demonstrate and provide opportunities for students to engage in the following:

- Recognize and use connections among mathematical ideas
- Recognize and apply mathematics in contexts outside of mathematics
- Demonstrate how mathematical ideas interconnect and build on one another

Distinguished (met) 3	**Proficient (met) 2**	**Developing (not met) 1**	**Unacceptable 0**
Lessons are designed to demonstrate and develop understanding of mathematical connections. Throughout, students are consistently engaged in activities that address all 3 indicators.	Lessons are designed to demonstrate and develop understanding of mathematical connections. Students are somewhat engaged in activities that address all 3 indicators.	Lessons are designed to demonstrate and develop understanding of mathematical connections. Students are somewhat engaged in activities that address most of the indicators.	Lessons are not designed to demonstrate and develop understanding of mathematical connections. Students are not engaged in activities that address most of the indicators.

Mathematical Representation (*NCTM SPA Standard 5*)
Plans demonstrate and provide opportunities for students to engage in the following:

- Use representations to model and interpret physical, social, and mathematical phenomena
- Create and use representations to organize, record, and communicate mathematical ideas
- Select, apply, and translate among mathematical representations to solve problems.

Distinguished (met) 3	**Proficient (met) 2**	**Developing (not met) 1**	**Unacceptable 0**
Lessons are designed to demonstrate and allow students to demonstrate knowledge of mathematical representations. Throughout, students are consistently engaged in activities that address all 3 indicators.	Lessons are designed to demonstrate and allow students to demonstrate knowledge of mathematical representations. Students are somewhat engaged in activities that address all 3 indicators.	Lessons are designed to demonstrate and allow students to demonstrate knowledge of mathematical representations. Students are somewhat engaged in activities that address most of the indicators.	Lessons are not designed to demonstrate and allow students to demonstrate knowledge of mathematical representations.. Students are not engaged in activities that address most of the indicators.