George Mason University
College of Education and Human Development
Secondary Education Program

EDCI 572-002 - Teaching Mathematics in the Secondary School

3 Credits, Fall 2016
Tuesday 4:30 – 7:10 Thompson Hall 1020, Fairfax Campus

Faculty

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Prerequisites/Corequisites

This course is for students who have already taken or are concurrently taking EDUC 522.

University Catalog Course Description

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.

Course Overview

As a future secondary mathematics teacher, you have the opportunity to shape 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. Further, you can shape their dispositions toward learning mathematics. You have chosen an amazing and rewarding career path!

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 who is equipped to help *all* children thrive in secondary mathematics classrooms.

Course Delivery Method

This course will be delivered using a hands-on, in-depth inquiry classroom environment related to the pedagogy required for secondary mathematics. Students are expected to participate in mathematical investigations, reflect on student thinking, observe teachers and students, and plan lessons.

Learner Outcomes or Objectives

This course is designed to enable students to do the following:

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.

IV. Technology

In this part of the course you will apply the knowledge gained in the previous three sections of the course to implementing technology into lessons.

- Throughout this section, you will learn how technology may aid in the conceptual understanding of mathematics content.

Professional Standards (NCTM SPA Standards**)**

Upon completion of this course, students will have met the following professional standards:

- demonstrate an understanding of the ways in which students develop strong, usable understandings of secondary mathematics content (NCTM SPA Standard 1 2; 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 Indicator 3c; NCTM SPA Standards 4, 5, 6; 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 Indicators 3c, 4e, 5b; 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 3a, 3b, 3c; NCTM SPA Standards 4, 6; CEHD Core Values of Collaboration and Research- Based Practice)
- demonstrate the dispositions appropriate to work as a secondary mathematics teacher (NCTM SPA Standard 6; 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 Standards 1, 2, NCTM SPA Indicators 3a, 3b; CEHD Core Value of Innovation)
- analyze different perspectives on mathematics teaching and learning - graduate students only (NCTM SPA Indicator 3.6; CEHD Core Value of Research-Based Practice)
- develop knowledge, skills, and professional behaviors across secondary settings, examine the nature of mathematics, how mathematics should be taught, and how students learn mathematics; and observe and analyze a range of approaches to mathematics teaching and learning (NCTM SPA Indicator 7c; CEHD Core Value of Research-Based Practice)

Required Texts

Access to the following materials is required:

Brahier, D.J. (2012). *Teaching secondary and middle school mathematics* (4th 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. We will look at excerpts from this text, which can be retrieved from the following website: http://www.nap.edu/catalog.php?record_id=11101

Kilpatrick, J., Swafford, J., & Findell, B. (2001). *Adding it up: Helping children learn mathematics*. Washington, D.C.: The National Academies Press. Excerpts can be found on-line at http://www.nap.edu/catalog.php?record_id=9822

Leinwand, S., Brahier, D. J., & Huinker, D. (2014). *Principles to actions: Ensuring mathematical success for all*. Reston, VA: National Council of Teachers of Mathematics. eBook available to members for $3.99 ($4.99 for non-members) at http://www.nctm.org/store/Products/(eBook)-Principles-to-Actions-(PDF-Downloads)/

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/

National Governors Association Center for Best Practices, Council of Chief State School Officers. (2010). *Common Core State Standards Mathematics.* National Governors Association Center for Best Practices, Council of Chief State School Officers, Washington D.C. The standards can be retrieved from: http://www.corestandards.org/Math

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

Recommended:
NCTM Student Membership. Provides access to:
(1) Online subscription to *Teaching Mathematics in the Middle School* (for the middle grades), *Mathematics Teacher* (for the high school grades), or other school journals,
(2) Online NCTM 2000 *Principles and Standards for School Mathematics*; and
(3) access to online articles and resources
Available from the National Council of Teachers of Mathematics, 1906 Association Drive, Reston, VA 22091; 703-620-9840; www.nctm.org website.

Course Performance Evaluation
Students are expected to submit all assignments on time in the manner outlined by the instructor (e.g., Blackboard, Tk20, hard copy).

- **Assignments and Examinations**
  The following assignments will help you (and me) to gauge your development throughout the course:

  Mathematics Autobiography
  John Graham's famous quote states, "We teach who we are." Contemporary research in mathematics education finds this to be especially true for secondary mathematics teachers. It is important to examine our own assumptions about teaching and learning mathematics as result of our leaning experiences. In this activity, you will spend some time reflecting on your personal experiences as a mathematics learner. You will use your responses as part of an in-class activity as well as a culminating activity at the end of the course.

  Procedural/Conceptual Assignment
  Individuals can understand mathematics in different ways. In order to demonstrate proficiency 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 to explain what it means to have procedural knowledge and conceptual understanding of that concept.

  Problem Lead (Pair work)
  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.

Position Papers
Mathematics education is always in flux. Issues like Common Core and standardized assessments bring new complexities to the field of mathematics. Additionally, there are some issues in the field that will always be up for debate, discussion, and reflection. Throughout the semester, you will be required to respond to prompts that raise issues regarding contemporary and long-standing issues in mathematics education. We will use your two position papers and springboards for discussion and whole-group reflection.

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.

Clinical Interview (Graduate Students only)
Effective teaching requires a keen awareness of how and what your students are thinking and understanding. The experience of conducting a clinical interview is intended to increase your awareness of the forms of questioning and engagement that offer insight into the thinking of your students.
Conduct a clinical interview with a student, or if necessary, an adult about a carefully chosen problem or activity in mathematics.

Instruction and Assessment (Lesson) Plan and Related Assignments
**(This is a Performance Based Assessment*
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 have 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.

- **Other Requirements**
  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 quality of the class suffers. You **must** commit to 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.

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.

- **Course Performance Evaluation Weighting**

Assessment	Percentage of *Undergrad* Grade:	Percentage of *Graduate* Grade:
Participation and Preparation (including weekly assignments and readings)	15%	15%
Mathematics Autobiography	10%	10%
Procedural/Conceptual Assignment **This is a Performance Based Assessment.*	15%	10%
Problem Lead*	15%	10%
Position Papers (2)	10%	10%
Field Work Assignments	15%	10%
Clinical Interview *(Grad students only)*		15%
Instruction and Assessment (Lesson) Plan and Related Assignments **This is a Performance Based Assessment.*	20%	20%

* Problem Leads will happen at various times during the semester. A sign up sheet will be provided early in the semester.

- **Grading Policies**
  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%

- **Tk20/Performance-Based Assessment(s) Submission Requirement**
  Every student registered for any Secondary Education course with a required TK20 performance-based assessment (designated as such in the syllabus) must submit these

assessments (the Instruction and Assessment Lesson Plan and the Procedural/Conceptual Assignment) to Tk20 through 'Assessments' in Blackboard (regardless of whether a course is an elective, a one-time course or part of an undergraduate minor). Failure to submit the assessment(s) to Tk20 (through Blackboard) will result in the course instructor reporting the course grade as Incomplete (IN). Unless this grade is changed upon completion of the required Tk20 submission, the IN will convert to an F nine weeks into the following semester.

Professional Dispositions
Students are expected to exhibit professional behaviors and dispositions at all times.

Core Values Commitment
The College of Education and Human Development is committed to collaboration, ethical leadership, innovation, research-based practice, and social justice. Students are expected to adhere to these principles: http://cehd.gmu.edu/values/.

GMU Policies and Resources for Students

Policies

- Students must adhere to the guidelines of the Mason Honor Code (see http://oai.gmu.edu/the-mason-honor-code/).
- Students must follow the university policy for Responsible Use of Computing (see http://universitypolicy.gmu.edu/policies/responsible-use-of-computing/).
- Students are responsible for the content of university communications sent to their Mason 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 with disabilities who seek accommodations in a course must be registered with George Mason University Disability Services. Approved accommodations will begin at the time the written letter from Disability Services is received by the instructor (see http://ods.gmu.edu/).
- Students must follow the university policy stating that all sound emitting devices shall be silenced during class unless otherwise authorized by the instructor.

Campus Resources

- Support for submission of assignments to Tk20 should be directed to tk20help@gmu.edu or https://cehd.gmu.edu/api/tk20. Questions or concerns regarding use of Blackboard should be directed to http://coursessupport.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/).

- 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 Office of Student Support staff helps students negotiate life situations by connecting them with appropriate campus and off-campus resources. Students in need of these services may contact the office by phone (703-993-5376). Concerned students, faculty and staff may also make a referral to express concern for the safety or well-being of a Mason student or the community by going to http://studentsupport.gmu.edu/, and the OSS staff will follow up with the student.

For additional information on the College of Education and Human Development, please visit our website https://cehd.gmu.edu/.

Class Schedule

Week	Date	Topic	Readings *Readings should be completed before class	Assignments Due
1	8/30	**Introduction to the Course** **Mathematics Standards** • Virginia SOLs • Common Core Standards • NCTM Standards		**Fieldwork Survey**
2	9/6	**Nature of Mathematics** • The state of mathematics education • Trends in mathematics education • Creating a vision for your practice • Why teach mathematics? **Identity** • Examining our mathematics experiences • What does it mean to be mathematically proficient?	Donovan & Bransford: pp. 217-224; 231-236; 236-240 Aguire, Mayfield-Ingram, & Martin (2014) – (572 ONLY) Watch Mindsets video	**Mathematics Autobiography** due (Upload to Blackboard)

		• Student status and identity		
3	9/13	**Learning Theories and Implications for Instruction** • Constructivist & sociocultural perspectives on learning mathematics • Conceptual vs. procedural • understanding • What does it mean to create rich, • student-centered tasks?	Brahier Ch. 3: pp. 48-50; 56-66 Kilpatrick et al: pp.115-124; 131-133 Brahier: pp.212-217	
4	9/20	**Complexity of Mathematical Knowledge** **Student Cognition** • How students make sense of mathematics • The role of symbols	Ma (1999) Chapter 3 Kilpatrick et al: Chapter 9	**Position Paper #1** due. (Upload to Blackboard)
5	9/27	**Equitable Learning Environments** • Access to ALL students • Meeting students' needs • Privilege	Brahier Chapter 12 *Principles to Actions* pp. 59 – 69 Jacobs *Feminist Pedagogy and Mathematics*	
6	10/4	**Technology**	Doerr & Zangor (2000)- **TBD**	**Procedural/ Conceptual** due (Upload to Blackboard)
	10/11 Fall Break	**Fall Break**		
7	10/18	**Manipulatives, Representations, and Modeling** • The Lesh Framework • Algebra manipulatives • Square tiles • Cuisenaire Rods • Geometry models • What is Modeling?	Brahier: pp. 176-183 *Principles to Actions* pp. 24 – 35 Modeling in CCSS http://www.corestandards.org/Math/Content/HSM/ Modeling: A Learning Progression http://commoncoretools.me/wp-	**Lesson Plan topic** (Topic selection and connection to VA SOL as well as Common Core standards due. Upload to Blackboard)

			content/uploads/2013/07/ccss_progression_modeling_2013_07_04.pdf	
8	10/25	**Instructional Design and Learning Objectives** • NCTM Curricular Standards • State- and Local-level Objectives • Common Core Standards • Implementing a Course of Study o Goals and Objectives o Role of Textbooks o Alternative Sources **Structure of a Lesson**	Brahier: pp.74-82; 121-131 Brahier: pp. 237-248 Smith, Bill, & Hughes (2008)	**Problem Lead Presentations:** Group A Group B
9	11/1	**Structure of a Lesson *cont.*** **Differentiation and Access**	Smith, Hughes, Engle, & Stein (2009) Small & Lin (2010)	**Fieldwork:** At least 7 hours of fieldwork should be completed **Clinical Interview:** Submit short paragraph about student and topic to Blackboard. **Problem Lead Presentations:** Group C Group D
10	11/8	**Establishing a Learning Environment Conducive to Student Engagement** • Classroom set-up • Role of Discourse • Effective Questioning • Cooperative Learning • Productive Struggle	Herbel-Eisenman & Breyfogle (2005) Reinhart (2000) *Principles to Actions* pp. 48 – 52	**Lesson Plan:** Draft #1 due **Problem Lead Presentations:** Group E Group F
11	11/15	**Assessment** • The role of evidence • Formative vs. summative • Rubrics • Alternative assessments • Tests • Homework	Brahier Chapter 10 Choice of section on Brahier, Chapter11 Morrow-Leong (2016) *Principles to Actions*	**Position Paper #2** due. (Upload to Blackboard)

			pp. 53 – 57	
12	11/22	**Focus On Algebra** • Big Ideas • Algebraic Habits of Mind (Driscoll)	Rubenstein & Thompson (2001) Choike (2000) Brahier pp. 222 - 235	
13	11/29	**Algebra and Equity**	Schoenfeld (2002) Checkley (2001)	**Clinical Intervew** due.
14	12/6	**Productive and Unproductive Beliefs** **Instruction and Assessment (Lesson) Plan Presentations**		**All Field Work Completed** (accompanying assignments and log sheet due. Upload to Blackboard)
15	12/13	**Instruction and Assessment (Lesson) Plan Presentations *cont.***		**Lesson Plan** Due by December 15

Note: Faculty reserves the right to alter the schedule as necessary, with notification to students.

Assessment Rubric(s)

Teacher Candidate Instruction and Assessment Plan Rubric

Criteria	Does Not Meet Standard 1	Approaches Standard 2	Meets Standard 3	Exceeds Standard 4
Section 1 Description of Individual Student				
The candidate regularly assesses individual and group performance in order to design and modify	The candidate does not provide a description or the description of student **does not** include assessment data	The candidate provides description of student that includes appropriate assessment data	The candidate provides description of student that includes appropriate assessment data	The candidate provides description of student that includes both appropriate and multiple forms of

instruction to meet learners' needs in each area of development (cognitive, linguistic, social, emotional, and physical) and scaffolds the next level of development. ***InTASC 1(a)***	**related to cognitive, linguistic, social, emotional, and/or physical** developmental skill levels and abilities, interests, **or** educational progress.	related to **some but not all** of the following: cognitive, linguistic, social, emotional, and/or physical developmental skill levels and abilities, interests, **or** educational progress.	on **all** of the following: cognitive, linguistic, social, emotional, and/or physical developmental skill levels and abilities, interests, and educational progress. The candidate describes impact of student characteristics on learning.	assessment data on **all** of the following: cognitive, linguistic, social, emotional, and/or physical developmental skill levels and abilities, interests, and educational learning need. The candidate describes **and** provides examples of impact of student characteristics on learning.
Statement of Educational Need				
The candidate effectively uses multiple and appropriate types of assessment data to identify each student's learning needs and to develop differentiated learning experiences. ***InTASC 6(g)***	The candidate **does not** address student educational needs or **inappropriately uses** assessment data to create a statement of educational need.	The candidate uses assessment data to create a statement of educational need that is **marginally** aligned with assessment results.	The candidate uses assessment data to create an **appropriate** statement of educational need that is **aligned** with assessment results.	The candidate **effectively** uses assessment data from **multiple sources** to create a **thorough and appropriate** statement of educational need that is **aligned** with assessment results.
Section 2 **Identification of Learning Objectives**				
The candidate individually and collaboratively selects and	The candidate identifies learning objectives that	The candidate identifies learning objectives	The candidate identifies learning objectives with	The candidate identifies **distinct** learning objectives with

creates learning experiences that are appropriate for curriculum goals and content standards, and are relevant to learners. ***InTASC 7(a)***	are **either** (a) **incomplete** because related outcomes are not identified **or** (b) the objectives are **not directly related** to student educational need.	**without relevance** to student educational need.	related outcomes that are **relevant** to individual student needs. .	related outcomes that are **relevant** to individual student needs.
Identification of Rationale for Learning Objectives				
The candidate plans for instruction based on formative and summative assessment data, prior learner knowledge, and learner interest. ***InTASC 7(d)***	The candidate **does not provide** rationales which are aligned to the specific learning objectives and/or the relationship of the learning objectives to student educational needs is **missing or unclear.**	The rationales provided **are not** be aligned to the specific learning objective and the relationship of the learning objectives to student educational needs is **unclear**.	The rationales provided **are aligned** with the learning objective and the relationship of learning objectives to student educational needs is **clearly** identified.	The rationales provided **are aligned** with the learning objective and the relationship of the learning objectives to student educational needs is **clearly and effectively** identified.
Section 3 **Description of Instructional Strategies**				
The candidate plans how to achieve each student's learning goals, choosing appropriate strategies and accommodations, resources, and materials to differentiate instruction for individuals and	The candidate **does not** identify instructional strategies or identifies instructional strategies that are **not related** to the learning objectives **or** student learning needs.	The candidate identifies instructional strategies that are **marginally** related to the learning objectives **or** student learning needs.	The candidate identifies **evidence-based** instructional strategies that are aligned to the learning objectives and student learning needs.	The candidate identifies **evidence-based** instructional strategies that are aligned to **specific** learning objectives and student learning needs. The candidate provides **specific sources of**

groups of learners. ***InTASC 7(b)***				evidence for the instructional strategy.
Rationale for Instructional Strategies				
The candidate understands that each learner's cognitive, linguistic, social, emotional, and physical development influences learning and knows how to make instructional decisions that build on learners' strengths and needs. ***InTASC 1(e)***	The candidate **does not provide** rationales which are aligned to the specific instructional strategies **and/or** the relationship of instructional strategies to the learning objectives and student educational needs is **missing or unclear**.	The rationales provided **do not** aligned to the specific instructional strategies and, the relationship of the instructional strategies to the learning objectives that meet student educational needs is **unclear**.	The rationales provided **are aligned** with instructional strategies and, the relationship of the instructional strategies to the learning objectives that meet student educational needs is **clearly** identified.	The rationales provided **are aligned** with the strategies and, the relationship of the instructional strategies to **specific** learning objectives that meet student educational needs is **clearly and effectively** identified.
Section 4 **Description of Instructional Adaptation**				
The candidate accesses resources, supports, and specialized assistance and services to meet particular learning differences or needs. ***InTASC 2(f)***	The candidate **does not identify** either adaptations or accommodations to support student achievement of learning objectives.	The candidate identifies **either** adaptations or accommodations that **minimally support** student achievement of learning objectives.	The candidate identifies and describes appropriate adaptations or accommodations that **clearly support** student achievement of learning objectives.	The candidate identifies and thoroughly describes appropriate adaptations or accommodations that **clearly support** student achievement of learning objectives.

Rationale for Instructional Adaptation				
The candidate knows a range of evidence-based instructional strategies, resources, and technological tools and how to use them effectively to plan instruction that meets diverse learning needs. ***InTASC 7(k)***	The candidate **does not provide** rationales that are aligned to the adaptations and accommodations **and/or** the relationship of the adaptations and accommodations to student educational needs is **missing or unclear**.	The rationales **marginally provides** evidence to support the adaptations and accommodations and the relationship of the adaptations and accommodations to student educational needs is **unclear**.	The rationales provide **adequate** evidence to support the adaptations and accommodations and the relationship of the adaptations and accommodations to student educational needs is **clearly identified.**	The rationales provide **evidence-based support** for the specific adaptations and accommodations and the relationship of the adaptations and accommodations to student educational needs is **clearly and thoroughly** identified.
Section 5 Assessment and Documentation of Student Progress				
The candidate designs assessments that match learning objectives with assessment methods and minimizes sources of bias that can distort assessment results. ***InTASC 6(b)***	The candidate **does not** describe an assessment plan that that evaluates all student learning objectives **or** describes a plan that **does not** directly measure all of the student learning objectives (e.g., is **not observable, measurable**).	The candidate describes an assessment plan that evaluates all student learning objectives but **does not** include documentation of **both** formative and summative measures that **does not** address possible assessment bias.	The candidate describes an assessment plan that evaluates all student learning objectives **and includes both** formative and summative assessments that minimize sources of bias. The candidate describes the assessment results that would prompt modification of instructional plans **and** those specific modifications.	The candidate describes an assessment plan that evaluates **all** student learning objectives, **includes** formative and summative assessments that minimize sources of bias and includes **multiple** data sources for each objective. The candidate describes **multiple** assessment results that would prompt modification of instructional

				plans **and** those specific modifications.

EDCI 372/572
NCTM Secondary Mathematics Rubric
Fall 2016

***NCTM* Standard 2: Mathematical Practices**
Candidates solve problems, represent mathematical ideas, reason, prove, use mathematical models, attend to precision, identify elements of structure, generalize, engage in mathematical communication, and make connections as essential mathematical practices.

Plans include opportunities for students to engage in the following:

NCTM CAEP Sub-Element Alignment	Does Not Meet Expectations (1)	Approaches Expectations (2)	Meets Expectations (3)	Exceeds Expectations (4)
2a.1	Lessons provide no evidence of use of problem solving to develop conceptual understanding.	Lessons include limited or unclear uses of problem solving to develop conceptual understanding	Lessons include activities that use problem solving to develop conceptual understanding.	Lessons include activities that provide students with opportunities to use problem solving and to develop conceptual understanding.
2a.2	Lessons do not show evidence of connections to the field of mathematics or real-world contexts	Lessons do not engage students in problem solving activities or the activities only connect to the field of mathematics	Lessons engage students in problem solving activities within the field of mathematics. The candidate makes connections in real-world contexts.	Lessons engage students in problem solving activities within the field of mathematics and to connections in real-world contexts.
2a.3	Lessons offer few opportunities for students to adapt and present a variety of problem solving strategies and to make sense of problems and persevere in solving them.	Lessons offer opportunities for students to solve problems and to make sense of them and persevere in solving them. Opportunities to present a variety of problem are lacking.	Lessons create opportunities for students to adapt and present a variety of problem solving strategies and often lead to students making sense of problems and persevere in solving them.	Lessons consistently create opportunities for students to adapt and present a variety of problem solving strategies and to make sense of problems and persevere in solving them.
2a.4	Lessons do not include opportunities for students	Lessons include experiences that allow for	Lessons include an opportunity for students to	Lessons include several mathematical activities

	to formulate and test conjectures in order to frame generalizations.	student discovery but lack the proper foundation for students to frame generalizations.	formulate and test conjectures in order to frame generalizations.	and investigations that allow for students to formulate and test conjectures in order to frame generalizations
2b.1	Lessons are not designed to allow students opportunities to reason abstractly and quantitatively with attention to precision.	Lessons are designed to allow students opportunities to reason abstractly and quantitatively with attention to precision, yet inappropriate strategies or flawed arguments are within the materials.	Lessons support opportunities to communicate mathematical reasoning with clarity, precision, and logical order.	Lessons support opportunities to reason abstractly, reflectively, and quantitatively with attention to units, constructing viable arguments and proofs.
2b.2	Lessons have no evidence of students having opportunity to understand the mathematical reasoning and strategies of others.	Lessons have evidence of attempts for students having opportunities to reason mathematically or understand the strategies of others. Candidate inconsistently interprets the reasoning of his/her student in the analysis or draws limited conclusions.	Lessons have evidence of consistent opportunities for students to reason mathematically and understand the strategies of others. Candidates can meaningfully interpret the reasoning of his/her students.	Lessons have evidence of consistent opportunities for students to reason mathematically and understand the strategies of others. Candidates can meaningfully interpret the reasoning of his/her students.
2b.3	Lessons do not include opportunities for students to represent or model generalizations using mathematical reasoning.	Lessons include very few opportunities for students to represent or model generalizations using mathematical reasoning.	Lessons include opportunities for students to represent and model generalizations using mathematical reasoning.	Lessons are designed around opportunities for students to represent and model generalizations and to recognize patterns of mathematical reasoning.
2b.4	Lessons only allow student to communicate mathematical ideas using a single representation (e.g., only symbolic representation).	Lessons allow for communication using more than one representation, but no connections are made between/among the representations.	Lessons mostly require student communication and connections across a variety of representations.	Lessons consistently require student communication and connections across a variety of representations.
2b.5	Lessons do not provide opportunities for students to use appropriate vocabulary and symbols to communicate mathematical ideas to other.	Lessons provide very few opportunities for students to use appropriate vocabulary and symbols, OR vocabulary is only used in a definitional way so students do not use it to communicate mathematical ideas.	Lessons mostly require students to use appropriate vocabulary and symbols to communicate mathematical ideas to others.	Lessons consistently require students to use appropriate vocabulary and symbols to communicate mathematical ideas to others.
2c.1	Lessons are not designed to recognize mathematical models derived from real-world contexts.	Lessons incorporate real-world contexts, but do not require students to formulate and represent them.	Lessons provide opportunities for students to formulate and represent mathematical models derived from real-world contexts.	Lessons provide opportunities for students to formulate and represent mathematical models derived from real-world contexts and to build mathematical understanding from the models.
2c.2	Lessons are not designed to recognize mathematical models derived from real-world contexts.	Lessons incorporate real-world contexts, but do not require students to analyze and interpret them.	Lessons provide opportunities for students to analyze and interpret mathematical models derived from real-world contexts.	Lessons provide opportunities for students to analyze and interpret mathematical models derived from real-world contexts and to build mathematical understanding from the models.

2d	Lessons do not create opportunities for students to organize thinking and use precise mathematical language.	Lessons minimally allow for students to organize thinking. Students rarely use the language of mathematics to precisely communicate to multiple audiences.	Lessons allow for students to organize thinking and use the language of mathematics to precisely communicate ideas.	Lessons allow for students to organize thinking and use the language of mathematics to precisely communicate ideas to multiple audiences.
2e.1	Lessons do not demonstrate the interconnectedness of mathematical ideas and how they build on each other.	Lessons minimally allow students to demonstrate the interconnectedness of mathematical ideas and do not allow student to show how they build on each other.	Lessons allow students to demonstrate the interconnectedness of mathematical ideas and often allow students to show how they build on each other.	Lessons consistently allow students to demonstrate the interconnectedness of mathematical ideas how they build on each other.
2e.2	Lessons do not allow student to apply mathematical connections among mathematical ideas and across various content areas and real-world contexts	Lessons allow student to apply mathematical connections among mathematical ideas but not across various content areas and real-world contexts	Lessons often allow student to apply mathematical connections among mathematical ideas and across various content areas and real-world contexts.	Lessons consistently allow student to apply mathematical connections among mathematical ideas and across various content areas and real-world contexts.

2f	Lessons do not model how the development of mathematical understanding within and among mathematical domains intersects with the mathematics practices of problem solving, reasoning communicating, connecting, and representing.	Lessons model how the development of mathematical understanding within and among mathematical domains intersects with *some* the mathematics practices of problem solving, reasoning communicating, connecting, and representing.	Lessons model how the development of mathematical understanding within and among mathematical domains intersects with all the mathematics practices of problem solving, reasoning communicating, connecting, and representing.	Lessons model and allow student to model how the development of mathematical understanding within and among mathematical domains intersects with some the mathematics practices of problem solving, reasoning communicating, connecting, and representing.
			Mean Score for Standard 2	
***NCTM* Standard 3: Content Pedagogy** Candidates apply knowledge of curriculum standards for mathematics and their relationship to student learning within and across mathematical domains. They incorporate research-based mathematical experiences and include multiple instructional strategies and mathematics-specific technological tools in their teaching to develop all students' mathematical understanding and proficiency. They provide students with opportunities to do mathematics – talking about it and connecting it to theoretical and real-world contexts. They plan, select, implement, interpret, and use formative and summative assessments for monitoring student learning, measuring student mathematical understanding, and informing practice. *Lessons and/or narrative include the following:*				
3a.	Candidate's goals of instruction are unclear and/or inappropriate.	Candidate identifies the goals of instruction, but do not align them to appropriate curriculum standards.	Candidate's Lessons are appropriate and align with the curricular standards.	Candidate clearly identifies the goals of the instruction and how they align with the appropriate curriculum standards. The candidate identifies learning outcomes based on the standards.
3b	Candidate does consider research in planning for rich mathematical learning experiences in their	Candidate cites research in planning for rich mathematical learning experiences in narrative,	Candidate cites and considers research in planning for rich mathematical learning	Candidate cites, analyzes, and considers research in planning for rich mathematical learning

	narrative or lesson plans.	but it is not evident in the lessons.	experiences as evidenced in their narrative and lessons.	experiences as evidenced in their narrative and lessons.
3e.1	Lessons do not incorporate selection of high quality tasks.	Lessons rarely incorporate high-quality tasks	Lessons often incorporate high-quality tasks	Lessons consistently incorporate high-quality tasks
3e.2	Candidate does not engage students through guided mathematical discussions.	Candidate rarely engages students in guided mathematical discussions.	Candidate often engage students in guided mathematical discussions.	Candidate consistently engage student in guided mathematical discussions and encourage students to facilitate their own discourse.
3e.3	Lessons do not support students in identifying key mathematical ideas.	Lessons have potential to support students in identifying key mathematical ideas, but candidate does not plan for opportunities for students to conjecture.	Lessons often support students in identifying key mathematical ideas.	Lessons consistently support students in identifying key mathematical ideas.
3f.1	Candidate is not competent in planning, selecting, and implementing formative or summative assessments, as evidenced by materials and narrative.	Candidate is competent in planning, selecting, and implementing summative or formative assessments, but not both, as evidenced by materials and narrative.	Candidate is competent in planning selecting and implementing summative assessments, as evidenced by materials and narrative.	Candidate is competent in planning, selecting, implementing formative and summative assessments to inform instruction, as evidenced in materials and narrative. Candidate uses results to inform instructional planning as evidenced in materials and narrative.
3f.2	Candidate is not competent in interpreting and using formative assessments, as evidenced by materials and narrative.	Candidate is competent in interpreting and using formative assessments or summative assessments, but not both, as evidenced by materials and narrative.	Candidate is competent in interpreting and using results of formative and summative assessments to inform instruction by reflecting on mathematical proficiencies essential for all students, as evidenced by materials and narrative.	Candidate is competent in interpreting in and using results of formative and summative assessments to inform instruction by reflecting on mathematical proficiencies essential for all students, as evidenced by materials and narrative. Candidate uses assessment results for subsequent instructional planning, as evidenced in narrative.
			Mean Score for Standard 3	
***NCTM* Standard 4: Mathematical Learning Environment** Candidates exhibit knowledge of adolescent learning, development, and behavior and use this knowledge to create learning opportunities that are grounded in mathematics education research in which students are actively learning and building on prior knowledge and skills. *Plans include the following:*				
4a.1	Candidate does not demonstrate evidence of in-depth knowledge of adolescent development. Lessons contain activities that do not align with adolescent behavior and development.	Candidate demonstrates minimal evidence of general knowledge of adolescent development. Lessons contain some activities that do not align with adolescent behavior and development.	Candidate demonstrates evidence of general knowledge of adolescent development. Lessons contain activities that align with adolescent behavior and development.	Candidate demonstrates strong evidence of in-depth knowledge of adolescent development. Lessons contain activities that align with adolescent behavior and development.

4a.2	Candidate demonstrates evidence of fostering growth mind sets with students.	Candidate demonstrates evidence of fostering growth mind sets with students.	Candidate demonstrates evidence of fostering growth mind sets.	Candidate demonstrates strong evidence of fostering growth mind sets.
4b.1	Lesson plan activities were not developmentally appropriate and were not challenging enough or were too challenging.	Lesson plan activities were developmentally appropriate but were not challenging enough or were too challenging.	Lesson plan activities were developmentally appropriate and mostly integrated an adequate amount of challenge.	Lesson plan activities were sequenced to create challenge and learning opportunities that were developmentally appropriate.
4b.2	Instructional strategies are not grounded in mathematics education research.	Candidate references mathematics education research when selecting instructional strategies, but the enactment of strategies does not align with the research.	Instructional strategies are grounded in mathematics education research.	Instructional strategies are grounded in mathematics education research in which students are actively engaged.
4b.3	Lesson plans do not support students in building knowledge from prior knowledge and experiences	Lesson plans minimally support students in building new knowledge from prior knowledge and experiences.	Lesson plans support student in building new knowledge from prior knowledge and experiences.	Lesson plans actively engage students in building new knowledge from prior knowledge and experiences.
4d	Candidate demonstrates equitable treatment and high expectations for all students.	Candidate demonstrates minimal consideration for the equitable treatment and high expectations for all students.	Candidate demonstrates consideration for the equitable treatment and high expectations for all students.	Candidate demonstrates equitable treatment and high expectations for all students and incorporates students' experiences into the curriculum
4e.1	Instructional tools (e.g., manipulatives, models, virtual manipulatives, etc.) are not used in the lessons.	Lessons include instructional tools (e.g., manipulatives, models, virtual manipulatives, etc.)	Lessons incorporate instructional tools (e.g., manipulatives, models, virtual manipulatives, etc.)	Lessons incorporate instructional tools (e.g., manipulatives, models, virtual manipulatives, etc.)
		that do not enhance teaching and learning.	in ways that enhance teaching and learning.	in ways that enhance teaching and learning. Candidate recognizes both insights to be gained and possible limitations of such tools.
4e.2	Mathematics-specific technologies were not used by the candidate.	Lessons include mathematics-specific technologies that do not enhance teaching and learning.	Lessons incorporate mathematics-specific technologies in ways that enhance teaching and learning.	Lessons incorporate mathematics-specific technologies in ways that enhance teaching and learning. Candidate recognizes both insights to be gained and possible limitations of such tools.
			Mean Score for Standard 4	
***NCTM* Standard 6: Professional Knowledge and Skills** Candidates provide evidence of participating in professional development experiences specific to mathematics and mathematics education, draw upon mathematics education research to inform practice, continuously reflect on their practice, and utilize resources from professional mathematics organizations. Candidates demonstrate the following:				
6c.	Candidate does not utilize resources from professional mathematics education organizations.	Candidate cites and/or uses resources from professional mathematics education organizations, but often refers to resources that do not align with professional mathematics education organizations.	Candidate often utilizes resources from professional mathematics organizations such as print, digital, and virtual resources/collections.	Candidate consistently utilizes resources from professional mathematics education organizations such as print, digital, and virtual resources/collections.
			Mean Score for Section 6	

[Additional Program or Division content, instructions, and graphics may be placed here, as appropriate]

Procedural Conceptual Rubric

***NCTM* Standard 1: Content Knowledge** Effective teachers of secondary mathematics demonstrate and apply knowledge of major mathematics concepts, algorithms, procedures, connections, and applications within and among mathematical content domains. Preservice teacher candidates: 1a) Demonstrate and apply knowledge of major mathematics concepts, algorithms, procedures, applications in varied contexts, and connections within and among mathematical domains (Number, Algebra, Geometry, Trigonometry, Statistics, Probability, Calculus, and Discrete Mathematics) as outlined in the NCTM CAEP Mathematics Content for Secondary.				
NCTM CAEP Sub-Element Alignment	**Does Not Meet Expectations (1)**	**Approaches Expectations (2)**	**Meets Expectations (3)**	**Exceeds Expectations (4)**
Content Standard A.1.1.a	Paper does not address properties, relationships, operations, and representations of division of whole numbers with minor lapses of clarity.	Paper minimally addresses properties, relationships, operations, and representations of division of whole numbers OR addresses them with a lack of clarity.	Paper addresses properties, relationships, operations, and representations of division for whole numbers with minor lapses of clarity.	Paper clearly addresses properties, relationships, operations, and representations of division of whole numbers.
Content Standard A.1.1.b	Paper does not address properties, relationships, operations, and representations of division of integers with minor lapses of clarity.	Paper minimally addresses properties, relationships, operations, and representations of division of integers OR addresses them with a lack of clarity.	Paper addresses properties, relationships, operations, and representations of division of integers with minor lapses of clarity.	Paper clearly addresses properties, relationships, operations, and representations of division of integers.
Content Standard A.1.1.c	Paper does not address properties, relationships, operations, and representations of division of rational numbers with minor lapses of clarity.	Paper minimally addresses properties, relationships, operations, and representations of division of rational numbers OR addresses them with a lack of clarity.	Paper addresses properties, relationships, operations, and representations of division of rational numbers with minor lapses of clarity.	Paper clearly addresses properties, relationships, operations, and representations of division of rational numbers.
			Mean Score for Standard 1	

***NCTM* Standard 2: Mathematical Practices** Candidates solve problems, represent mathematical ideas, reason, prove, use mathematical models, attend to precision, identify elements of structure, generalize, engage in mathematical communication, and make connections as essential mathematical practices. *Candidates engage in the following:*				
NCTM CAEP Sub-Element Alignment	**Does Not Meet Expectations (1)**	**Approaches Expectations (2)**	**Meets Expectations (3)**	**Exceeds Expectations (4)**
2a.1	Examples in the paper provide no evidence of use of problem solving to develop conceptual understanding.	Examples in the paper include limited or unclear examples of problem solving to develop conceptual understanding	Examples in the paper include examples that use problem solving to develop conceptual understanding.	Examples in the paper include examples that use problem solving and to develop conceptual understanding.
2a.2	Examples in the paper do not show evidence of connections to the field of mathematics or real-world contexts	Examples in the paper do not promote problem solving, or they only connect to the field of mathematics	Examples in the paper promote problem solving within the field of mathematics. The candidate makes connections in real-world contexts.	Examples in the paper promote problem solving activities within the field of mathematics and to connections in real-world contexts.
2a.3	Examples in the paper offer few opportunities to adapt and present a variety of problem solving strategies and to make sense of problems and persevere in solving them.	Examples in the paper offer opportunities to solve problems and to make sense of them and persevere in solving them; however, a variety of problems are lacking.	Examples in the paper create opportunities to adapt and present a variety of problem solving strategies and lead to making sense of problems	Examples in the paper consistently create opportunities to adapt and present a variety of problem solving strategies and to make sense of

			and persevere in solving them.	problems and persevere in solving them.
2a.4	Examples in the paper include opportunities to formulate and test conjectures in order to frame generalizations.	Examples in the paper include discovery but lack the proper foundation to frame generalizations.	Lessons and instruction include an opportunity for candidate to formulate and test conjectures in order to frame generalizations.	Examples in the paper include opportunities that allow candidate to formulate and test conjectures in order to frame generalizations
2b.1	Examples presented in the paper allow opportunities to reason abstractly and quantitatively with attention to precision.	Examples presented in the paper allow opportunities to reason abstractly and quantitatively with attention to precision, yet inappropriate strategies or flawed arguments are within the presentation.	Examples presented in the paper primarily allow support opportunities to communicate mathematical reasoning with clarity, precision, and logical order.	Examples presented in the paper consistently allow opportunities to reason abstractly, reflectively, and quantitatively with attention to units.
2b.2	Candidate does not select examples that lead them to represent or model generalizations using mathematical reasoning.	Candidate rarely selects examples that lead them to represent or model generalizations using mathematical reasoning.	Candidate often selects examples that lead them to represent and model generalizations using mathematical reasoning.	Candidate consistently selects examples that lead them to to represent and model generalizations and to recognize patterns of mathematical reasoning.
2b.3	Lessons and instruction only allow student to communicate mathematical ideas using a single representation (e.g., only symbolic representation).	Lessons and instruction allow for communication using more than one representation, but no connections are made between/among the representations.	Lessons and instruction mostly require student communication and connections across a variety of representations.	Lessons and instruction consistently require student communication and connections across a variety of representations.
2b.4	Candidate does not use appropriate vocabulary and symbols to communicate mathematical ideas to other.	Candidate rarely uses appropriate vocabulary and symbols to communicate mathematical ideas.	Candidate primarily uses appropriate vocabulary and symbols to communicate mathematical ideas to others.	Candidate primarily uses appropriate vocabulary and symbols to communicate mathematical ideas to others.
2c.1	Lessons and instruction are not designed to recognize mathematical models derived from real-world contexts.	Lessons and instruction incorporate real-world contexts, but do not require students to formulate and represent them.	Lessons and instruction provide opportunities for students to formulate and represent mathematical models derived from real-world contexts.	Lessons and instruction provide opportunities for students to formulate and represent mathematical models derived from real-world contexts and to build mathematical understanding from the models.
2c.2	Examples provided in the paper would not lead students to recognize mathematical models derived from real-world contexts.	Examples provided in the paper incorporate real-world contexts, but would not require students to analyze and interpret them.	Examples provided in the paper would lead students to analyze and interpret mathematical models derived from real-world contexts.	Examples provided in the paper would provide opportunities for students to analyze and interpret mathematical models derived from real-world contexts and to build mathematical understanding from the models.

2d	Candidate does not organize thinking and use precise mathematical language.	Candidate minimally thinking and rarely use the language of mathematics to precisely communicate to multiple audiences.	Candidate organizes thinking and often uses the language of mathematics to precisely communicate ideas.	Candidate organizes thinking and consistently uses the language of mathematics to precisely communicate ideas to multiple audiences.
2e.1	Candidate not demonstrate the interconnectedness of mathematical ideas (i.e., division across sets of numbers) and how they build on each other.	Candidate minimally demonstrates the interconnectedness of mathematical ideas (i.e., division across sets of numbers) OR does show how they build on each other.	Candidate often demonstrate the interconnectedness of mathematical ideas (i.e., division across sets of numbers) and how they build on each other.	Candidate consistently demonstrates the interconnectedness of mathematical ideas (i.e., division across sets of numbers)and how they build on each other.
2e.2	Candidate does not apply mathematical connections among mathematical ideas and across various content areas and real-world contexts	Candidate rarely applies mathematical connections among mathematical ideas but not across various content areas and real-world contexts	Candidate often applies mathematical connections among mathematical ideas and across various content areas and real-world contexts.	Candidate consistently applies mathematical connections among mathematical ideas and across various content areas and real-world contexts.
2f	Candidate does not model how development of mathematical understanding within this mathematical domain intersects with the mathematics practices of problem solving, reasoning communicating, connecting, and representing.	Candidate models how the development of mathematical understanding within and among this mathematical domain intersects with *some* the mathematics practices of problem solving, reasoning communicating, connecting, and representing.	Candidate models how the development of mathematical understanding within this mathematical domain intersects with ***most*** of the mathematics practices of problem solving, reasoning communicating, connecting, and representing.	Candidate models how the development of mathematical understanding within and among mathematical domains intersects with ***all*** of the mathematics practices of problem solving, reasoning communicating, connecting, and representing.
			Mean Score for Standard 2	
			OVERALL MEAN SCORE	