George Mason University
College of Education and Human Development
Graduate School of Education
Mathematics Education Leadership

MATH 613.6M6 – Algebra and Functions for K-8 Teachers
3 Credits, Fall 2019
Thursdays (7:20 – 10:00) Synchronous Online

Faculty

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Prerequisites/Corequisites

Admission to the Mathematics Education Leadership Master's Degree Program or instructor permission.

University Catalog Course Description

The course will examine representing and analyzing mathematical situations and structures using generalization and algebraic symbols and reasoning. Attention will be given to the transition from arithmetic to algebra, working with quantitative change, and the description of and prediction of change. Offered by Mathematics. May not be repeated for credit.

Course Overview

This course, for future K-8 mathematics teacher specialists, examines concepts contained in the rational number strands of the Virginia Standards of Learning (SOL), Common Core State Standards (CCSS), and/or referenced in the National Council of Teachers of Mathematics (NCTM) Principles and Standards. Through a coordinated program of activities, participants will learn to explore the structure of algebra, especially those in grades 5-8 and develop number sense, computation and estimation concepts and skills.

Course Delivery Method

This course will be delivered using a lecture format.

Learner Outcomes or Objectives

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

1. Candidates will develop a comprehensive understanding of algebraic reasoning, representation and creation of algebraic formulas.
2. Candidates will examine in depth algebra content appropriate for K-8 mathematics teachers, including the use of technology to study algebra and historical connections to algebra.
3. Candidates will explore fundamentals of algebra, functions, tables, graphs, and relationships.
4. Candidates will examine algebraic Habits of Mind, in order to assess their own progress throughout the course and to discover these models' pedagogical implications on classroom instruction.

Professional Standards (National Council of Teachers of Mathematics)

Upon completion of this course, students will have met the following professional standards:
To be prepared to support the development of student mathematical proficiency, all elementary mathematics specialists should know the following topics related to algebra with their content understanding and mathematical practices supported by appropriate technology and varied representational tools, including concrete models:

C.2.1 Algebraic notation, symbols, expressions, equations, inequalities, and proportional relationships, and their use in describing, interpreting, and modeling relationships and operations
C.2.2 Function classes including constant, linear, quadratic, polynomial, exponential, and absolute value, and how choices of parameters determine particular cases and model real-world situations
C.2.3 Functional representations (tables, graphs, equations, descriptions, and recursive definitions), characteristics (e.g., zeros, average rates of change, domain and range), and notations as a means to describe, interpret, and analyze relationships and to build new functions
C.2.4 Patterns of change in linear, quadratic, polynomial, and exponential functions and in proportional and inversely proportional relationships and types of real-world relationships these functions can model
C.2.5 Historical development and perspectives of algebra including contributions of significant figures and diverse cultures

Standard 2: Mathematical Practices (NCTM NCATE Mathematics Content for Elementary Mathematics Specialist *Addendum to the NCTM NCATE Standards 2012)*

In their role as teacher, lead teacher, and/or coach/mentor, elementary mathematics specialist candidates:

3a) Apply knowledge of curriculum standards for elementary mathematics and their relationship to student learning within and across mathematical domains in teaching elementary students and coaching/mentoring elementary classroom teachers.
3c) Plan and assist others in planning lessons and units that incorporate a variety of strategies, differentiated instruction for diverse populations, and mathematics-specific instructional technologies in building all students' conceptual understanding and procedural proficiency.

3e) Implement and promote techniques related to student engagement and communication including selecting high quality tasks, guiding mathematical discussions, identifying key mathematical ideas, identifying and addressing student misconceptions, and employing a range of questioning strategies.
5b) Engage students and coach/mentor teachers in using developmentally appropriate mathematical activities and investigations that require active engagement and include mathematics-specific technology in building new knowledge.

Required Texts

Schifter, D., Bastable, V., & Jo Russell, S. (2015). *Patterns, functions and change. (Developing mathematical ideas)*. Reston, VA: NCTM.

National Council of Teachers of Mathematics. (2014). *Principles to actions: Ensuring mathematical success for all.* Reston, VA: NCTM.

Suggested Texts

Van de Walle, J., Karp, K, & Bay-Williams, J. (2018). *Elementary and middle school mathematics: Teaching developmentally* (10th edition). Boston, MA: Pearson Education.

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/or Examinations**

  A. Reflections (50%) – Performance Based Assessment
  NCATE/NCTM Indicator 1a (C.2.1 - C. 2.5), 2a, 2b, 2c, 2f
  Student will reflect on four rich mathematical tasks problem and submit a reflection for each. Additionally, students will explore a historical figure and write a reflection on the historical contribution.

  B. Individual Content Assessments (20%)
  Students will complete various content assessments that will assess their individual understanding of K-8 algebraic content.

  C. Technology Project (20%)
  Explore math specific technology (i.e.: virtual graphing software, Geogebra, etc. NOT Smartboards, iPads, etc.). Prepare a short presentation for teachers that explains how the technology can be used for algebra in multiple grade levels. The presentation should be interactive and engage teachers in using the technology to explore a task.

D. Participation (10%)

A commitment to participation in class discussions and course activities depends heavily and primarily on the regular attendance and participation of all involved. Participation will include taking part in discussions informed by critical reading and thinking, leading discussions about selected mathematics problems, and sharing with the class the products of various writing, reflection, lesson planning, and field experience assignments. The expectations, demands and workload of this course are professional and high. This requires students to consider number systems and number theory using different strategies and a variety of manipulatives and resources. During math work time, students should be developing strategies and non-traditional algorithms for the entire work time or discussing and sharing algorithms with each other. During math-talk and discussion times, students should be actively engaged by voicing their thoughts and connecting to topics presented during the discussion.

Participation in this course requires a commitment to reading reflectively and critically the assigned readings. The readings will be used to provide a framework and coherent theme to the course content. They have been selected to introduce themes in professional development as well as research and critical commentary on current issues in mathematics education.

Other Requirements

It is your responsibility to attend all class sessions. Please report your reasons for any absences to the instructor in writing.

Tardiness: It is your responsibility to be on time for each class session. Please report your reasons for any tardiness to the instructor in writing.

Class materials will be posted for each class session on Blackboard. Students are responsible for reviewing these materials and submitting required artifacts (where appropriate) to online class discussion boards.

All assignments are to be turned in to your instructor on time. **Late work will not be accepted for full credit.** Assignments turned in late will receive a 10% deduction from the grade per late day or any fraction thereof (including weekends and holidays).

- **Grading**

A 93%-100%	B+ 87%-89%	C 70%-79%
A- 90%-92%	B 80%-86%	F Below 70%

For Master's Degrees:

Candidates must have a minimum GPA of 3.00 in coursework presented on the degree application, which may include no more than 6 credits of C. (Grades of C+, C-, or D do not apply to graduate courses. The GPA calculation excludes all transfer courses and Mason non-degree studies credits not formally approved for the degree).

For Endorsement Requirements

Candidates must have a grade of B or higher for all licensure coursework (endorsement coursework).

Professional Dispositions

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

In addition to being punctual, students are expected to actively participate and engage in assignments and class discussions. In order to maintain a focused class, laptops and cell phones are to be used exclusively for the current class topic. Examples of this include searching for math standards, videos of mathematical algorithms, taking pictures of manipulatives, etc. Emailing, texting, and other forms of communication and social media are not permitted during class time unless it is directly related to the activity. In addition, students should refrain from grading papers and preparing lesson materials for their school placements during class time. Additional requirements set by the college: See https://cehd.gmu.edu/students/polices-procedures/

Class Schedule

PTA: Principles to Action
Cases: Patterns, Functions, and Change 23, 26
Bb: Additional readings that can be downloaded from Blackboard > Readings

Date	Topic(s)	Readings	Due
Week 1 Aug 29	Syllabus Overview *Principles to Actions* (NCTM, 2014): The Mathematics Teaching Practices Connecting to the TRU Framework Equity survey **TASK: Grow Worm**		
Week 2 Sep 5	Equlity: history and notation **TASK: Chicken Problem (PBA #1)**	Cases: 1, 4, 19, 20 Bb: Social Justice in Mathematics (TODOS & NCTM position paper) Bb: Introduction to TRU framework	
Week 3 Sep 12	Growing Patterns **TASK: Growing Squares**	Cases: 11, 13 Growing Squares article on Blackboard	PBA #1
Week 4	Slope and y-intercept **TASK: Stairway to Chichen Itza**	Cases 2, 3, 8 Slope and y-intercept article on Blackboard	

September 19			
Week 5 Sep 26	Square numbers, Triangular numbers, and other patterns **TASK: The Bowling Alley Problem**	Cases 10, 12	Content Assessment 1
Week 6 Oct 3	Tables and graphs **TASK: The Apprentice Problem (PBA #2)**	Cases 14, 15, 16 Graphing article on blackboard	
Week 7 Oct 10	Literature in Algebra **TASK: Table Arrangements**	Cases: 21, 26	PBA #2
Week 8 Oct 17	System of equations **TASK: Cathedral Problem**	Cases: 9, 17, 18 Literature choice articles and books	
Week 9 Oct 24	Changing Variables **TASK: Even Steven**	Cases: 5, 6, 7, 22 Systems article on Blackboard	
Week 10 Oct 31	Predictability in Algebra **TASK: Paper Folding**	Cases 23, 25 Tables and Graphs article on Blackboard	PBA #3
Week 11 Nov 7	Rich Tasks **TASK: Toy Stories**	Cases: 24, 26 Toy Story article on blackboard	Content Assessment 2
Week 12 Nov 14	**TASK: Bridge Building**	Cases 27, 28, 29 Technology in the math classroom article on Blackboard choice	Technology Assignment
Week 13 Nov 21	**Technology Presentations**	Technology in the math classroom article on Blackboard choice	PBA #4
Week 14 Dec 5	**TASK: Barbie Bungee Jump** Research in Math Education – Algebra Historical Perspective Presentations	Cases: Chapter 8 Rich Task article on Blackboard	

Week 15 Dec 12	**Independent Work session**		Content Assessment 3

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

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/aero/tk20. Questions or concerns regarding use of Blackboard should be directed to http://coursessupport.gmu.edu/.

- The Writing Center 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 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 Student Support & Advocacy Center staff helps students develop and maintain healthy lifestyles through confidential one-on-one support as well as through interactive programs and resources. Some of the topics they address are healthy relationships, stress management, nutrition, sexual assault, drug and alcohol use, and sexual health (see http://ssac.gmu.edu/). Students in need of these services may contact the office by phone at 703-993-3686. 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://ssac.gmu.edu/make-a-referral/.

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

Algebra Content & Practices Problem Set Reflection

Course Performance Based Assessment

Reflection Logs 1-4 Rubric

Level/Criteria	4	3	2	1
	Exceeds Expectations	Meets Expectations	Developing	Does Not Meet Expectations
BUILDING CONCEPTUAL AND PROCEDURAL UNDERSTANDING NCTM Element 1.a Demonstrate and apply knowledge of major mathematics concepts, algorithms, procedures, applications in varied contexts and connections.	The candidate includes all of the following elements: • Application of conceptual and procedural knowledge in identifying solutions in the problem set • Explanation of the development of conceptual to procedural knowledge • Discussion of new knowledge gained and the connections to past knowledge and experiences	The candidate includes two of the following elements: • Application of conceptual and procedural knowledge in identifying solutions in the problem set • Explanation of the development of conceptual to procedural knowledge • Discussion of new knowledge gained and the connections to past knowledge and experiences	The candidate includes one of the following elements: • Application of conceptual and procedural knowledge in identifying solutions in the problem set • Explanation of the development of conceptual to procedural knowledge • Discussion of new knowledge gained and the connections to past knowledge and experiences	The candidate does not include any of following elements: • Application of conceptual and procedural knowledge in identifying solutions in the problem set • Explanation of the development of conceptual to procedural knowledge • Discussion of new knowledge gained and the connections to past knowledge and experiences
PROBLEM SOLVING NCTM Element 2.a Use problem solving to develop conceptual understanding, make a sense of a wide variety of problems and persevere in solving them, apply and adapt a variety of strategies in solving problems confronted within the field of mathematics and other contexts, and formulate and test	The candidate includes all of the following elements: • Describes the use of problem solving within the problem set to formulate generalizations • Explains how to make sense of the problems in the problem set • Apply a variety of strategies and representations to the problem set	The candidate includes two of the following elements: • Use of problem solving within the problem set to formulate generalizations • Make sense of the problems in the problem set • Apply a variety of strategies and representations to the problem set	The candidate includes one of the following elements: • Use of problem solving within the problem set to formulate generalizations • Make sense of the problems in the problem set • Apply a variety of strategies and representations to the problem set	The candidate does not include any of following elements: • Use of problem solving within the problem set to formulate generalizations • Make sense of the problems in the problem set • Apply a variety of strategies and representations to the problem set

conjectures in order to frame generalizations.				
REPRESENTATIONS NCTM Element 2.b Reason abstractly, reflectively, and quantitatively with attention to units, constructing viable arguments and proofs, and critiquing the reasoning of others; represent and model generalizations using mathematics; recognize structure and express regularity in patterns of mathematical reasoning; use multiple representations to model and describe mathematics; and utilize appropriate mathematical vocabulary and symbols to communicate mathematical ideas to others.	The candidate includes all of the following elements: • Describes how multiple representations were used to model the problem set • Discusses how the representations support the creation of generalizations • Uses appropriate mathematical vocabulary and symbols	The candidate includes two of the following elements: • Describes how multiple representations were used to model the problem set • Discusses how the representations support the creation of generalizations • Uses appropriate mathematical vocabulary and symbols	The candidate includes one of the following elements: • Describes how multiple representations were used to model the problem set • Discusses how the representations support the creation of generalizations • Uses appropriate mathematical vocabulary and symbols	The candidate does not include any of following elements: • Describes how multiple representations were used to model the problem set • Discusses how the representations support the creation of generalizations • Uses appropriate mathematical vocabulary and symbols
CONTEXT NCTM Element 2.C Formulate, represent, analyze, and interpret mathematical models derived from real-world contexts of mathematical problems.	The candidate includes all of the following elements: • An example of a similar problem with a different context. • An analysis of a similar problem (compare and contrast)	The candidate includes two of the following elements: • An example of a similar problem with a different context. • An analysis of a similar problem (compare and contrast)	The candidate includes one of the following elements: • An example of a similar problem with a different context. • An analysis of a similar problem (compare and contrast)	The candidate does not include any of following elements: • An example of a similar problem with a different context. • An analysis of a similar problem (compare and contrast)

	• An interpretation of the solution	• An interpretation of the solution	• An interpretation of the solution	• An interpretation of the solution
NCTM PROCESS STANDARDS NCTM Element 2.F Use and assist teachers in using resources from professional mathematics education organizations such as teacher/leader discussion groups, teacher networks, and print, digital, and virtual resources/ collections	The candidate includes a reflection on the process standards that includes a description of how each of the five NCTM Process Standards impact the mathematical understanding. The reflection includes specific instances where the candidate assisted teachers using all of the following elements: • Teacher/Leader discussion groups • Teacher networks • Print, digital, and virtual resources/ collections	The candidate includes a reflection on the process standards that includes a description of how four of the five NCTM Process Standards impact the mathematical understanding. The reflection includes specific instances where the candidate assisted teachers using two of the following elements: • Teacher/Leader discussion groups • Teacher networks • Print, digital, and virtual resources/ collections	The candidate includes a reflection on the process standards that includes a description of how three of the five NCTM Process Standards impact the mathematical understanding. The reflection includes specific instances where the candidate assisted teachers using one of the following elements: • Teacher/Leader discussion groups • Teacher networks • Print, digital, and virtual resources/ collections	The candidate includes a reflection on the process standards that includes a description of how one or two NCTM Process Standards impact the mathematical understanding. The reflection does not include any specific instances where the candidate assisted teachers using all of the following elements: • Teacher/Leader discussion groups • Teacher networks • Print, digital, and virtual resources/ collections

Reflection Log 5 rubric

The final reflection log will involve researching a major mathematical historical development and the contributions of a historically significant figure. We will discuss many of these developments and figures during the math talk all throughout the semester. However, this discussion will be brief. Once you find a topic that interests you, you should research it further. The following reflection should be about 2 pages in length and will be evaluated using the following criteria.

Levels/Criteria	**4**	**3**	**2**	**1**
	Exceeds Expectations	**Meets Expectations**	**Developing**	**Does Not Meet Expectations**
NCTM Indicator C.1.5 Historical development of algebra.	Essay describes the historical development of algebra in depth and provides specific examples.	Essay describes the historical development of algebra and provides specific examples.	Essay describes the historical development of algebra and provides an example.	Essay includes incomplete description of historical development of algebra.
NCTM Indicator C.1.5 Historical perspectives of algebra.	Essay describes the historical perspectives of algebra in depth and provides specific examples.	Essay describes the historical perspectives of algebra and provides specific examples.	Essay describes the historical perspectives of algebra and provides an example.	Essay includes incomplete description of historical perspectives of algebra.
NCTM Indicator C.1.5 Contributions of historically significant figures and diverse cultures.	Essay describes contributions of historically significant figures and diverse cultures in depth and provides specific examples.	Essay describes contributions of historically significant figures and diverse cultures and provides specific examples.	Essay describes contributions of historically significant figures and diverse cultures and provides an example.	Essay includes incomplete description of historically significant figures and diverse cultures.