

TEXAS A&M UNIVERSITY – SAN ANTONIO
COLLEGE OF EDUCATION & HUMAN DEVELOPMENT
DEPARTMENT OF CURRICULUM & INSTRUCTION

Math Methods in Middle and Secondary Levels

A. COURSE REQUIREMENTS

No late assignments will be accepted. If work cannot be completed on time, make arrangements with the instructor prior to the due date.

1. Participation & Preparation
(Standards I-VIII; *4-8 Competencies 001-019; 7-12 Competencies 001-021*)
2. Tests
 - (1) Midterm Test
(Standards I, V, VI, VII, & VIII; *4-8 Competencies 001-003 & 015-019; 7-12 Competencies 001-003 & 018-021*)
 - (2) Final Test
(Standards I-VIII; *4-8 Competencies 001-019; 7-12 Competencies 001-021*)
3. Article Critique (Standard IX; PPR Standard I)
4. Reflection Papers (Standards V-IX; PPR Standards I & III)
 - (1) Personal Reflection Paper
 - (2) Final Reflection Paper
5. Team Planned Lesson
(Standards I-VIII; *4-8 Competencies 001-019; 7-12 Competencies 001-021; PPR Standards I & III*)
6. Curriculum Development (Creating a Model-Eliciting Activity)
(Standards I-VIII; *4-8 Competencies 001-019; 7-12 Competencies 001-021; PPR Standards I & III*)
7. Analyzing Student Work & Re-engagement Strategy
(Standards I-VIII; *4-8 Competencies 001-019; 7-12 Competencies 001-021; PPR Standards I & III*)
8. Lesson Plan & Microteaching
(Standards I-VIII; *4-8 Competencies 001-019; 7-12 Competencies 001-021; PPR Standards I & III*)

B. COURSE GOALS/OBJECTIVES:

The purpose of this course is the following:

- to help you develop your own understanding of what mathematics is, how children learn math, and how to analyze your students' mathematical thinking,
- to help you develop a repertoire of teaching strategies that is congruent with your beliefs regarding mathematics,
- to help you familiarize yourself with current curricular trends, and
- to help you foster a community of learners that includes ALL students.

After completion of this course, the student should meet the following standards, competencies, and requirements:

TEXES Mathematics Standards

- Standard I.** *Number Concepts:* The mathematics teacher understands and uses numbers, number systems and their structure, operations and algorithms, quantitative reasoning, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.
- Standard II.** *Patterns and Algebra:* The mathematics teacher understands and uses patterns, relations, functions, algebraic reasoning, analysis, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.
- Standard III.** *Geometry and Measurement:* The mathematics teacher understands and uses geometry, spatial reasoning, measurement concepts and principles, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.
- Standard IV.** *Probability and Statistics:* The mathematics teacher understands and uses probability and statistics, their applications, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.
- Standard V.** *Mathematical Processes:* The mathematics teacher understands and uses mathematical processes to reason mathematically, to solve mathematical problems, to make mathematical connections within and outside of mathematics, and to communicate mathematically.
- Standard VI.** *Mathematical Perspectives:* The mathematics teacher understands the historical development of mathematical ideas, the interrelationship between society and mathematics, the structure of mathematics, and the evolving nature of mathematics and mathematical knowledge.
- Standard VII.** *Mathematical Learning and Instruction:* The mathematics teacher understands how children learn and develop mathematical skills, procedures, and concepts, knows typical errors students make, and uses this knowledge to plan, organize, and implement instruction; to meet curriculum goals; and to teach all students to understand and use mathematics.
- Standard VIII.** *Mathematical Assessment:* The mathematics teacher understands assessment and uses a variety of formal and informal assessment techniques appropriate to the learner on an ongoing basis to monitor and guide instruction and to evaluate and report student progress.
- Standard IX.** *Professional Development:* The mathematics teacher understands mathematics teaching as a profession, knows the value and rewards of being a reflective practitioner, and realizes the importance of making a lifelong commitment to professional growth and development.

TEXES PPR Standards

- Standard I.** The teacher designs instruction appropriate for all students that reflects an understanding of relevant content and is based on continuous and appropriate assessment.
- Standard III.** The teacher promotes student learning by providing responsive instruction that makes use of effective communication techniques, instructional strategies that actively engage students in the learning process, and timely, high-quality feedback.

TEXES Mathematics 4-8 Test Competencies

- Competency 001.** The teacher understands the structure of number systems, the development of a sense of quantity and the relationship between quantity and symbolic representations.
- Competency 002.** The teacher understands number operations and computational algorithms.
- Competency 003.** The teacher understands ideas of number theory and uses numbers to model and solve problems within and outside of mathematics.

- Competency 004.** The teacher understands and uses mathematical reasoning to identify, extend and analyze patterns and understands the relationships among variables, expressions, equations, inequalities, relations and functions.
- Competency 005.** The teacher understands and uses linear functions to model and solve problems.
- Competency 006.** The teacher understands and uses nonlinear functions and relations to model and solve problems.
- Competency 007.** The teacher uses and understands the conceptual foundations of calculus related to topics in middle school mathematics.
- Competency 008.** The teacher understands measurement as a process.
- Competency 009.** The teacher understands the geometric relationships and axiomatic structure of Euclidian geometry.
- Competency 010.** The teacher analyzes the properties of two- and three-dimensional figures.
- Competency 011.** The teacher understands algebra and geometry through the Cartesian coordinate system and demonstrates knowledge of transformational geometry.
- Competency 012.** The teacher understands how to use graphical and numerical techniques to explore data, characterize patterns and describe departures from patterns.
- Competency 013.** The teacher understands the theory of probability.
- Competency 014.** The teacher understands the relationship among probability theory, sampling and statistical inference and how statistical inference is used in making and evaluating predictions.
- Competency 015.** The teacher understands mathematical reasoning and problem solving.
- Competency 016.** The teacher understands mathematical connections within and outside of mathematics and how to communicate mathematical ideas and concepts.
- Competency 017.** The teacher understands how children learn and develop mathematical skills, procedures and concepts.
- Competency 018.** The teacher understands how to plan, organize and implement instruction using knowledge of students, subject matter and statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) to teach all students to use mathematics.
- Competency 019.** The teacher understands assessment and uses a variety of formal and informal assessment techniques to monitor and guide mathematics instruction and to evaluate student progress.

TEXES Mathematics 7-12 Test Competencies

- Competency 001.** The teacher understands the real number system and its structure, operations, algorithms and representations.
- Competency 002.** The teacher understands the complex number system and its structure, operations, algorithms and representations.
- Competency 003.** The teacher understands number theory concepts and principles and uses numbers to model and solve problems in a variety of situations.
- Competency 004.** The teacher uses patterns to model and solve problems and formulate conjectures.
- Competency 005.** The teacher understands attributes of functions, relations and their graphs.
- Competency 006.** The teacher understands linear and quadratic functions, analyzes their algebraic and graphical properties and uses them to model and solve problems.
- Competency 007.** The teacher understands polynomial, rational, radical, absolute value and piecewise functions, analyzes their algebraic and graphical properties and uses them to model and solve problems.
- Competency 008.** The teacher understands exponential and logarithmic functions, analyses their algebraic and graphical properties and uses them to model and solve problems.
- Competency 009.** The teacher understands trigonometric and circular functions, analyzes their algebraic and graphical properties and uses them to model and solve problems.
- Competency 010.** The teacher understands and solves problems using differential and integral calculus.
- Competency 011.** The teacher understands measurement as a process.
- Competency 012.** The teacher understands geometries, in particular Euclidian geometry, as axiomatic systems.
- Competency 013.** The teacher understands the results, uses and applications of Euclidian geometry.

Competency 014. The teacher understands coordinate, transformational and vector geometry and their connections.

Competency 015. The teacher understands how to use appropriate graphical and numerical techniques to explore data, characterize patterns and describe departures from patterns.

Competency 016. The teacher understands concepts and applications of probability.

Competency 017. The teacher understands the relationships among probability theory, sampling and statistical inference and how statistical inference is used in making and evaluating predictions.

Competency 018. The teacher understands mathematical reasoning and problem solving.

Competency 019. The teacher understands mathematical connections both within and outside of mathematics and how to communicate mathematical ideas and concepts.

Competency 020. The teacher understands how children learn mathematics and plans, organizes and implements instruction using knowledge of students, subject matter and statewide curriculum (Texas Essential Knowledge and Skills [TEKS]).

Competency 021. The teacher understands assessment and uses a variety of formal and informal assessment techniques to monitor and guide mathematics instruction and to evaluate student progress.

TAC Requirements for Educator Preparation Programs

Educator Preparation Curriculum

(c) (4) the skills that educators are required to possess, the responsibilities that educators are required to accept, and the high expectations for students in this state;

(d) (1) the relevant TEKS, including the English Language Proficiency Standards;

TAC Teacher Standards

(3) Standard 3--Content Knowledge and Expertise. Teachers exhibit a comprehensive understanding of their content, discipline, and related pedagogy as demonstrated through the quality of the design and execution of lessons and their ability to match objectives and activities to relevant state standards.

(A) Teachers understand the major concepts, key themes, multiple perspectives, assumptions, processes of inquiry, structure, and real-world applications of their grade-level and subject-area content.

(i) Teachers have expertise in how their content vertically and horizontally aligns with the grade-level/subject-area continuum, leading to an integrated curriculum across grade levels and content areas.

(ii) Teachers identify gaps in students' knowledge of subject matter and communicate with their leaders and colleagues to ensure that these gaps are adequately addressed across grade levels and subject areas.

(iii) Teachers keep current with developments, new content, new approaches, and changing methods of instructional delivery within their discipline.

(B) Teachers design and execute quality lessons that are consistent with the concepts of their specific discipline, are aligned to state standards, and demonstrate their content expertise.

(i) Teachers organize curriculum to facilitate student understanding of the subject matter.

(ii) Teachers understand, actively anticipate, and adapt instruction to address common misunderstandings and preconceptions.

(iii) Teachers promote literacy and the academic language within the discipline and make discipline-specific language accessible to all learners.

(C) Teachers demonstrate content-specific pedagogy that meets the needs of diverse learners, utilizing engaging instructional materials to connect prior content knowledge to new learning.

(i) Teachers teach both the key content knowledge and the key skills of the discipline.

(ii) Teachers make appropriate and authentic connections across disciplines, subjects, and students' real-world experiences.

C. LECTURE/DISCUSSION TOPICS:

1. Standards (NCTM & TEKS Standards)

2. Learning versus Teaching Mathematics: Learning Theory
(*Numbers & Operations*)
3. Planning for Mathematics Instruction & Mathematical knowing for teaching
(*Algebra*)
4. Role of Problem Solving
5. Model-Eliciting Activities (MEAs)
6. Teaching Effective Math Lessons
(*Integers, Fraction & Decimals*)
7. *Data Analysis, Probability & Statistics*
8. Technology to Enhance Mathematics Instruction
(*Geogebra*)
9. Enriching Mathematics Instruction
(*Geometry & Measurement*)
10. Algebraic Thinking
(*Patterns & Functions; Ongoing Assessment*)
11. Professional Literature & Assessment Analysis
(*Tessellation*)

D. REQUIRED READINGS/MATERIALS:

Textbook: Brahier, D. J. (2013). *Teaching secondary and middle school mathematics*, (4th Ed.). Pearson.

References:

- English, L. D. (2008). Introducing complex systems into the mathematics curriculum. *Teaching Children Mathematics*, 15(1), 38-47.
- Kim, Y. R., Park, M. S., Moore, T. J., & Varma, S. (2013). Multiple levels of metacognition and their elicitation through complex problem-solving tasks. *Journal of Mathematical Behavior*, 32(3), 377-396.
- Mokros, J., & Russell, S. J. (1995). Children's concepts of average and representativeness. *Journal for Research in Mathematics Education*, 26(1), 20- 39.
- Shulman, L. S., (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15(4), 4-14.
- Skemp, R. R. (2006). Relational understanding and instrumental understanding. *Mathematics Teaching in the Middle School*, 12(2), 88- 95.
- Wyberg, T., Whitney, S. R., Cramer, K. A., Monson, D. S., & Leavitt, S. (2011). Unfolding fraction multiplication. *Mathematics Teaching in the Middle School*, 17(5), 288-294.