

Problem Solving for Elementary Teachers

Effective date: Spring, 2013

- I. Course Name and Number:** *MaEd 540*
- II. Credits:** *3 SCH*
- III. Course Title:** *Problem Solving for Elementary Teachers*
- IV. Course Description:** *This course is for elementary mathematics teachers seeking certification as Master Mathematics Teachers. Careful study of the teaching of mathematics using problem solving strategies for the elementary classroom from advanced theoretical, historical, and pedagogical viewpoints. Technology will be used where appropriate.*
- V. Text:** *A Problem Solving Approach to Mathematics for Elementary School Teachers (11th edition), Billstein, Libeskind, and Lott. ISBN 0-60-3217566-65.*
- VI. Objectives:** *This class is designed to extend the participants' knowledge of and skills in teaching elementary mathematical concepts utilizing exploring, conjecturing, communicating, and reasoning strategies. In this class, the emphasis will be on using logic and mathematical evidence rather than the teacher as authority, mathematical reasoning rather than memorizing procedures, conjecturing, inventing, and problem solving, and the connection of mathematical ideas and applications. Students will be challenged to expand their current view and notions about elementary mathematical teaching and to modify their thinking about how to teach these concepts effectively.*

Technology and manipulatives will be used where appropriate in the course for instruction, assignments, and explorations.
- VII. Prerequisites:** *Acceptance to the Master Mathematics Teacher Certificate Program*
- VIII. Justification:** *This course will enhance the elementary teachers' understanding of mathematical problem solving and problem-based learning and help prepare them to take the Master Mathematics Teacher examination.*
- IX. Course Outline:**

Competency 001

The Master Math Teacher EC-4 understands the structure of number systems, the development of a sense of quantity, and the relationship between quantity and symbolic representations.

 - 1.1 Compares and contrasts numeration systems.*
 - 1.2 Analyzes the structure of numeration systems and the roles of place value and zero in the base ten systems.*

- 1.3 *Demonstrates a sense of quantity and estimation for the real numbers (i.e., whole numbers, integers, rational and irrational numbers).*
- 1.4 *Demonstrates an understanding of a variety of models for representing real numbers (e.g., fraction strips, diagrams, base ten blocks, number lines, sets).*
- 1.5 *Demonstrates an understanding of different representations of equivalent rational numbers.*
- 1.6 *Selects appropriate representations of real numbers (e.g., expanded notation, fractions, decimals, percents, roots, exponents, scientific notation) for particular situations.*
- 1.7 *Demonstrates, explains, and uses models to show how some situations that have no solution in the whole, integer, or rational number systems have solutions in the real number system.*

Competency 002

The Master Math Teacher EC-4 understands number operations and computational algorithms.

- 2.1 *Recognizes, models, and describes different ways to interpret the four basic operations involving real numbers (e.g., whole numbers, integers, fractions, decimals).*
- 2.2 *Analyzes, describes, and connects relationships among number properties, operations, and algorithms involving the four basic operations, with real numbers (e.g., whole numbers, integers, fractions, decimals).*
- 2.3 *Recognizes error patterns that often occur when students use algorithms to perform operations.*
- 2.4 *Recognizes and analyzes appropriate alternative algorithms for the four basic operations with whole numbers, fractions, and decimals.*
- 2.5 *Translates among concrete, pictorial, and symbolic representations of the four basic operations with real numbers, and recognizes these concepts and relationships in real-life situations.*

Competency 003

The Master Mathematics Teacher EC-4 understands the basic ideas of number theory and uses numbers to model and solve problems within and outside of mathematics.

- 3.1 *Describes, sorts, and classifies numbers as prime or composite, and applies the concepts of prime and composite numbers in problem situations.*
- 3.2 *Recognizes greatest common denominators and least common multiples and uses these concepts to solve problems.*
- 3.3 *Applies the concept of prime factorization to solve problems.*

- 3.4 *Applies knowledge of place value and other number properties to develop techniques of mental mathematics and computational estimation.*
- 3.5 *Recognizes problem situations in which use of particular mathematical operations (e.g., multiplication, division) would be useful or necessary.*
- 3.6 *Uses integers, fractions, decimals, and percents to solve problems in a variety of real-world situations.*

Competency 004

The Master Mathematics Teacher EC-4 plans and designs effective instruction and assessment based on knowledge of how all students, including students who are at-risk, learn and develop number concepts, skills, and procedures.

- 4.1 *Evaluates and applies established research evidence on how all students, including students who are at-risk, learn and use number concepts.*
- 4.5 *Structures problem-solving activities so students can recognize patterns and relationships within number concepts.*
- 4.6 *Designs challenging and engaging problem-solving tasks that develop number-concepts content knowledge as well as students' critical and analytical reasoning capacities.*
- 4.7 *Integrates number concepts within and outside of mathematics.*
- 4.9 *Uses strategies to help students understand that results obtained using technology may be misleading and/or misinterpreted.*
- 4.10 *Recognizes common errors and misconceptions and determines appropriate correction procedures.*

Competency 005

The Master Mathematics Teacher EC-4 implements a variety of instruction and assessment techniques to guide, evaluate, and improve students' learning of number concepts, skills, and procedures.

- 5.1 *Creates a positive learning environment that provides all students with opportunities to develop and improve number concepts, skills, and procedures.*
- 5.2 *Know how to teach number concepts, skills, procedures, and problem-solving strategies using instructional approaches supported by established research.*
- 5.4 *Uses multiple representations, tools, and a variety of tasks to promote students' understanding of number concepts.*
- 5.6 *Uses a variety of questioning strategies to identify, support, monitor, and challenge students' mathematical thinking.*

Competency 006

The Master Mathematics Teacher EC-4 understands and uses mathematical reasoning to identify, extend, and analyze patterns, and understands the relationships among variables, expressions, equations, relations, and functions.

- 6.2 *Uses a variety of number patterns (e.g., fact families, number charts, multiplication by powers of 10) to explore number properties.*
- 6.3 *Formulates rules to describe and construct sequences using concrete models, geometric figures, tables, graphs, and algebraic expressions.*
- 6.5 *Applies relations and functions to represent mathematical and real-world situations.*
- 6.6 *Translates problem-solving situations into expressions and equations.*

Competency 007

The Master Mathematics Teacher EC-4 understands and uses linear functions to model and solve problems using a variety of methods, including algebra.

- 7.1 *Demonstrates an understanding of the concept of linear functions using concrete models, tables, graphs, and symbolic and verbal representations.*
- 7.2 *Analyzes the relationship between a linear function or relation and its graph.*
- 7.3 *Uses linear function and relations to model problems.*
- 7.4 *Uses tables, graphs, and algebraic techniques to solve linear equations.*
- 7.5 *Gives appropriate justification for the manipulation of algebraic expressions and equations in one variable.*

Competency 008

The Master Mathematics Teacher EC-4 plans and designs effective instruction and assessment based on knowledge of how all students, including students who are at-risk, learn and develop patterns and algebraic concepts, skills, and procedures.

- 8.1 *Evaluates and applies established research evidence on how all students, including students who are at-risk, learn and use patterns and algebra.*
- 8.5 *Structures problem-solving activities so students can recognize patterns and relationships within patterns and algebra.*
- 8.6 *Designs challenging and engaging problem-solving tasks that develop patterns and algebra content knowledge as well as students' critical and analytical reasoning capacities.*
- 8.7 *Integrates patterns and algebra within and outside of mathematics.*
- 8.9 *Uses strategies to help students understand the results obtained using technology may be misleading or misinterpreted.*

Competency 009

The Master Mathematics Teacher EC-4 implements a variety of instruction and assessment techniques to guide, evaluate, and improve students' learning of patterns and algebra concepts, skills, and procedures.

- 9.1 *Creates a positive learning environment that provides all students with opportunities to develop and improve patterns and algebra concepts, skills, and procedures.*
- 9.2 *Knows how to teach patterns and algebra concepts, skills, procedures, and problem-solving strategies using instructional approaches supported by established research.*
- 9.4 *Uses multiple representations, tools, and a variety of tasks to promote students' understanding of patterns and algebra concepts.*
- 9.6 *Uses a variety of questioning strategies to identify, support, monitor, and challenge students' mathematical thinking.*
- 9.7 *Demonstrates classroom management skills, including applying strategies that use instructional time effectively.*

Competency 010

The Master Mathematics Teacher EC-4 understands measurement as a process.

- 10.4 *Applies measurement concepts and dimensional analysis to derive units and formulas for a variety of situations, including average rates of change of one variable with respect to another.*
- 10.5 *Uses methods of approximation and estimates the effects of error on measurement.*

Competency 012

The Master Mathematics Teacher EC-4 understands transformational and coordinate geometry and connects geometry with other topics in the mathematical curriculum.

- 12.8 *Makes connections among geometric ideas and number concepts, measurement, probability and statistics, algebra, and analysis.*

X. Methods of Instruction: *Class time will be spent discussing homework problems, technology-related assignments, and answering questions. New material will be introduced through lecture, demonstrations, and various teacher- or student-created problem . Some class time may be devoted to technology projects.*

XI. Course Requirements and Means of Evaluation: *One in-class Midterm examination (200 points) and a final examination (200 points) will be given.*

Additionally, two special assignments and/or technology explorations will be required, each worth approximately 100 points.

A thoroughly researched lesson plan aligned to state and national standards that uses best practices to present an appropriate mathematical concept will be required and worth 100 points. A class presentation using hands-on activities that will engage students and a student Reflection Journal will also be required.

Participants will be evaluated on:

Midterm and Final exams 400 total points

<i>Two assignments</i>	<i>200</i>	<i>total points</i>
<i>Research requirement</i>	<i>100</i>	<i>points</i>
<i>Reflection Journal</i>	<u><i>100</i></u>	<i>points</i>
	<i>800</i>	<i>grand total</i>

Exams will be individually scaled and a periodic assessment of each student's standing will be provided. The final course grade will be based on the total points accumulated.

XII. Resources needed: *No additional resources needed*

XIII. Faculty Requirement: *Minimum of Masters Degree in Mathematics, PhD preferred*

XIV. Justification for Graduate Credit: *Participants will build upon their background to study topics in more depth than when studied in an undergraduate course. They will do research in order to prepare lesson plans that are part of an integrated curriculum aligned to state and national standards. Participants will use manipulatives and technology to develop their own understanding and ability to present mathematical concepts to a class.*

XV. Bibliography:

Billstein, Libeskind, and Lott, A Problem Solving Approach to Mathematics for Elementary School Teachers, 6th edition. Addison-Wesley.

NCTM. Navigating Through Data Analysis. National Council of Teachers of Mathematics.

NCTM. Professional Standards for Teaching Mathematics. National Council of Teachers of Mathematics.

NCTM. Curriculum and Evaluation Standards for School Mathematics. National Council of Teachers of Mathematics.

NCTM. Curriculum and Evaluation Standards for School Mathematics. Grade K-6 Agenda Series. National Council of Teachers of Mathematics.

NCTM. Curriculum and Evaluation Standards for School Mathematics Grades 5-8 Addenda Series. National Council of Teachers of Mathematics.

Polya, G. (1945). How to Solve It. Princeton and Oxford; Princeton University Press.

Silver, Harvey F. (2010). Compare and Contrast: Teaching Comparative Thinking to Strengthen Student Learning. Alexandria, VA: ASCD.

SBEC. Master Mathematics Teacher Standards. Texas State Board for Educator Certification.

Swartz, Robert J, et al. (2008). Thinking-based Learning. New York and London: Teachers College Press.

Torp, Linda, and Sage, Sara. (2002). Problems as Possibilities. Alexandria, VA: ASCD.

Van de Walle, John A. and Lovin, Louann H. (2006). Teaching Student-Centered Mathematics. Boston: Pearson Education, Inc.

- XVI. Drop Policy:** *University Drop Policy: To drop this course after the 12th class day, a student must complete the Drop/ Withdrawal Request Form, located on the University website <http://tamut.edu/Registrar/droppingwithdrawing-from-classes.html>) or obtained in the Registrar's Office. The student must submit the signed and completed form to the instructor of each course indicated on the form to be dropped for his/her signature. The signature is not an "approval" to drop, but rather confirmation that the student has discussed the drop/withdrawal with the faculty member. The form must be submitted to the Registrar's office for processing in person, email Registrar@tamut.edu, mail (7101 University Ave, Texarkana, TX 75503) or fax (903-223-3140). Drop/withdraw forms missing any of the required information will not be accepted by the Registrar's Office for processing. It is the student's responsibility to ensure that the form is completed properly before submission. If a student stops participating in class (attending and submitting assignments) but does not complete and submit the drop/withdrawal form, a final grade based on work completed as outlined in the syllabus will be assigned.*
- XVII. Academic Integrity:** *Academic honesty is expected of students enrolled in this course. Cheating on examinations, unauthorized collaboration, falsification of research data, plagiarism, and undocumented use of materials from any source, constitute academic dishonesty, and may be grounds for a grade of "F" in the course and/or disciplinary actions. For additional information see the university catalog.*
- XVIII. Email:** *Upon application to Texas A & M University–Texarkana an individual will be assigned an A & M-Texarkana email account. This email account will be used to deliver official university correspondence. Each individual is responsible for information sent and received via the university email account and is expected to check the official A & M-Texarkana email account on a frequent and consistent basis. Faculty and students are required to utilize the university email account when communicating about coursework.*
- XIX. Disability Accommodation:** *Students with disabilities may request reasonable accommodations through the A & M-Texarkana Disability Services Office by calling 903-223-3062.*
- XX. Disclaimer:** *Items above are subject to change as course progresses.*