Professional Education Unit

Program Review Document 3:
Program Experiences

(Version 05/07/08)

Preparation Program: *Elementary Mathematics Specialist*

Degree: *Endorsement (Graduate Level)*

Certification Level: *P-5*

Preparation Level: *Advanced*

Date Submitted: *February 1, 2011*

Link to Graduate Catalog: Graduate Catalog

State Regulation governing this program: **16 KAR 2:010**

Executive Summary

A. Rationale for the Elementary Mathematics Specialist (EMS) Endorsement

Kentucky's Education Professional Standards Board (EPSB) recently approved the creation of an Elementary Mathematics Specialist Endorsement, P-5, for teacher certification. In developing the endorsement, the EPSB relied on the Elementary Math Teacher Standards of the National Council of Teachers of Mathematics (NCTM), an organizational member of the National Council for the Accreditation of Teacher Education (NCATE. In addition, the national Elementary Mathematics Specialist standards prepared by the American Mathematics Teacher Educators (AMTE) have provided guidance for development of new courses, as the standards give more guidance for university programs and courses. A Joint Position Statement by AMTE, ASSM, NCSM, and NCTM recommends the use of Elementary Mathematics Specialists (EMS professionals) in pre-K–6 environments to enhance the teaching, learning, and assessing of mathematics to improve student achievement. Programs for EMS professionals should focus on mathematics content knowledge, pedagogical knowledge, and leadership knowledge and skills.

A persistent area of need is the preparation of professionals who are charged with helping young students (particularly in K–6) learn mathematics. Given the many demands and expertise required to teach all subjects of elementary school (the typical assignment of elementary classroom teachers), AMTE supports the use of elementary mathematics specialists to teach and to support others who teach mathematics at the elementary level. This expertise includes both a deep and practical knowledge of the content and pedagogy of elementary and middle school mathematics and the ability to work with other professionals to develop their mathematical knowledge for teaching.

B. Elementary Mathematics Specialist Endorsement, P-5: Unique Features and Modes of Delivery

WKU's proposed Elementary Mathematics Specialist endorsement is designed with the above standards, as well as the WKU Professional Education Unit mission (see below), in mind. This program consists of 9 hours of pedagogical courses and 6 hours of mathematics courses geared toward improving elementary teacher' ability to teach math. The delivery method for this endorsement program is primarily web-based instruction. Blackboard is used to post announcements and course documents as well as to provide a venue for discussion boards. This is an endorsement after teachers have first received an elementary teaching certificate.

C. Admission and Exit Requirements

Applicants for the endorsement for Elementary Mathematics Specialist must have or be eligible for a teaching certificate for Elementary Education, Grades P-5. Applicants who wish to count the endorsement hours toward a master's degree or other graduate program must meet the eligibility requirements of that program.

Exit requirements include that the student completes the 15 hours that comprise the EMS, each course grade is a B or above, and each Critical Performance score is 3 or 4 of the 4 points possible.

D. Mission, Vision and Beliefs of the Unit

WKU's *Conceptual Framework* represents beliefs and values that are shared by all programs that prepare university students to enter education professional fields. These fields include teachers in elementary, middle, and high schools; library media specialists; principals and superintendents; school counselors; school nurses; school psychologists; and, speech pathologists.

All these education professional preparation programs are considered by the National Council for Accreditation of Teacher Education (NCATE) and Kentucky's Education Professional Standards Board (EPSB) to represent WKU's *Professional Education Unit.*

The professional education unit aspires to become a nationally recognized community of scholars who apply the best that theory, research, and experience can contribute to teaching and learning and create new knowledge that makes teaching, learning, and the operation of the school more efficient and effective.

The WKU professional education unit recruits, prepares, and supports school practitioners and education leaders who can facilitate the learning of all children and empower them to achieve at high levels as they become life-long learners and productive citizens in a global society. It achieves this mission through living out the core values and beliefs of its Conceptual Framework, which are clearly aligned to the Kentucky Teacher Standards.

II. Relationship of Program to Professional Education Unit Mission and Conceptual Framework

The Elementary Mathematics Specialist (EMS) endorsement relates to the core values and beliefs of the Kentucky Teacher Standards and is designed with those in mind. First, the "Children and Schools" component of the Conceptual Framework is where all children can learn and have the right to a quality education. The EMS Endorsement is a driving force to seeing that all teachers are equipped with knowing how to make achievement gains with students who have typically struggled and also help all students move forward in their learning. Second, the "Education Professionals" component emphasizes that educators have essential professional values including diversity, home connection, and technology and that they have essential professional qualities and understanding of high ability, ongoing professional development, strategies, content knowledge, professional knowledge/pedagogy, and dispositions. The EMS endorsement provides opportunity directly related to all of these beliefs/core values. Last, the "Assessment and Accountability" component includes the assessment of teacher progress and accountability for K-12 student learning. The EMS endorsement is designed with assessments that the teacher completes and applies to the field with elementary students.

III. EMS Continuous Assessment Plan

*See Section II, Table 2 for information about how EMS candidates are assessed related to the Kentucky Teacher Standards.

IV. Required Program Experiences Components

A. Description of Courses and Experiences

1. Performance Assessments

See Table 1 below.

Table 1. Course Experiences for the Elementary Mathematics Specialist Endorsement, P-5

Course	Course Objectives	Course Projects/ Assignments/Assessment	Field Experience (Hours/Activities)	Critical Performance Indicator
ELED 571: Leadership, Math, and Technology Education	Graduate students will: • Maintain an online journal and participate in discussion forums reflecting thought-provoking, insightful comments on various topics during the course. • Critique and offer insightful interpretations in a group book study on technology integration and math instruction books. • Create a multimedia project and present the project at a course seminar. • Create two original technology products given appropriate software and tools. • Create a Leadership Growth Plan for Math and Technology.	• Online Journal • Discussion Forums • Mulitmedia project • Presentation of Multimedia project • Technology Integration Products • Leadership Growth Plan for Math and Technology	Implementation of the Multimedia Project and Technology Integration Products in individual classrooms or alternate setting (10 hours)	Leadership Plan for Math and Technology
ELED 572: Math and Technology Methods for Diverse Learners	Graduate students will: • Develop an understanding that diversity includes, but is not limited to, exceptionalities and inclusion, gifted and talented learners, English language learners and language acquisition, ethnic/racial cultural and linguistic differences, social-economic status, and gender and sexual orientation. • Maintain an online journal and participate in discussion forums reflecting thought-provoking, insightful comments on various topics during the course. • Develop their understanding of mathematics	• Online Journal • Discussion Forums • Mulitmedia project • Spreadsheet Project • Differentiated HEAT Lesson • Leadership Growth Plan for Diverse Learners in Math and Technology	Implementation of the Multimedia Project and Technology Integration Products in individual classrooms or alternate setting (10 hours)	Leadership Plan for Diverse Learners

	and technology pedagogy related to improving mathematics understanding with diverse learners. • Apply their knowledge of differentiation to designing leveled problem solving lessons requiring technology products and designing scaffolded open-ended problem solving with a focus on questioning and a technology product. • Read and analyze research literature and articles related to diverse learners in mathematics and technology in discussion boards and blog journals. (Discussion Board and Blog Journal) • Select and interview a diverse learner and analyze characteristics. (Written Paper) • Learn and apply differentiation techniques and tactics in the classroom. (Written Plan) • Analyze technology for instruction. (Presentation) • Use differentiation techniques to design learning module for diverse learners for a tiered problem solving lesson that requires a technology product. (Written Plan and Technology Product) • Use the HEAT framework to design a differentiated problem solving lesson that requires a multi-media technology product. (Lesson Plan and Technology Product) • Create a Leadership Growth Plan for Diverse Learners in Math and Technology.			

ELED 573: Math and Technology Assessment	Graduate students will: • Maintain an online journal and participate in discussion forums reflecting thought-provoking, insightful comments on various topics during the course. • Critique and offer insightful interpretations in a group book study on technology integration and math instruction books. • Create a multimedia project for assessment and intervention of students in mathematics. • Create two original technology products designed to work with assessment and intervention of students given appropriate software and tools. • Design an intervention plan for a classroom of students, including a variety of formative assessments. • Create a Leadership Growth Plan for Assessment in Math and Technology.	• Online Journal • Discussion Forums • Assessment Make-Over • Technology Integration Products • Leadership Growth Plan for Assessment in Math and Technology	Implementation of the Multimedia Project and Technology Integration Products in individual classrooms or alternate setting (10 hours)	Leadership Plan for Assessment

Course	Course Objectives	Course Projects/ Assignments/Assessment	Field Experience (Hours/Activities)	Critical Performance Indicator
Choose two of the three following MATH courses:				
MATH411G: Problem Solving for Elementary and Middle Teachers (Graduate Level Section—undergraduate elementary education students do not take this course as a requirement)	Graduate students will be able to: • Further apply concepts in algebra, geometry, logic, statistics, probability, and elementary number theory. • Use problem-solving strategies, models, and technologies to solve problems. • Create problem solving problems of their own.	• Exams • Class work • group work • individual assignments • homework • quizzes • presentations • participation		
MATH 507: Math for Elementary Teachers	Graduate students will be able to: • Further apply concepts in algebra, geometry, logic, statistics, probability, and elementary number theory.	• Exams • Class work • group work • individual assignments • homework • quizzes • presentations • participation		
MATH 508: Number Concepts for Elementary and Middle Grades Teachers	Graduate students will be able to: • Further apply concepts in numeracy development.	• Exams • Class work • group work • individual assignments • homework • quizzes • presentations • participation		

2. Professional Code of Ethics

For those students completing the Teacher Leader master's program, the Kentucky Professional Code of Ethics is discussed in introductory coursework and candidate adherence to the code is reflected in Disposition data collected. Additionally, for EMS candidates, the code of ethics is followed in these courses by requiring teacher candidates to follow the honor code and be confidential with their work with students. The individual work of the EMS candidates should be the work of the individual.

3. Teaching of Writing (SB 1 Requirements)

The ELED courses are designed to incorporate reading and writing within the requirements for the courses. The Math and Technology Leadership Plan is a Critical Performance that will be continued from one course to another. This plan requires the students to apply mathematics and technology standards to Leadership, Diverse Learners, and Assessment – the themes for the three courses. This course assessment is heavily connected to writing. Another emphasis in this course is having the students reading articles and texts then writing critical responses to these through blog journals, discussion boards, and papers. The connection with writing to the Endorsement is irrefutable. Without the writing components of the courses, the rigor and depth would lessen.

B. Kentucky Teacher Standards Assessed

See Table 2 on the next page for a matrix that identified key program assessments (Critical Performances) aligned to the Kentucky Teacher Standards that are a part of the core endorsement courses.

C. Description of How Candidates are Prepared to Integrate and Assess Kentucky Core Academic Standards and the College and Career Readiness Standards

See Tables 3 and 4.

Table 2. Critical Performance Assessment Alignment Matrix for EMS

Core Education Courses	Kentucky Teacher Standards									
	1	2	3	4	5	6	7	8	9	10
	Content Knowledge	Designs/Plans	Learning Climate	Manages Instruction	Assessment	Technology	Reflection	Collaboration	Professional Development	Leadership
ELED 571		MT Leadership Plan						MT Leadership Plan	MT Leadership Plan	MT Leadership Plan
ELED 572			MT Diverse Learners Plan	MT Diverse Learners Plan		MT Diverse Learners Plan				
ELED 573	MT Assessment Plan				MT Assessment Plan		MT Assessment Plan			
MATH 411G, MATH 507, MATH 508										

Table 3. Integration of Core Math Standards/Practices into EMS

Kentucky Core Mathematics Standards – Practices	EMS Coursework Preparation	ELED 571	ELED 572	ELED 573	MATH411G, MATH 507, or MATH 508
1. Make sense of problems and persevere in solving them.	Candidates will work on these skills in all of their courses by learning about and experiencing problem solving and implementing problem solving problems, lessons, and a school-wide problem solving plan.	EMS Candidates work on problems, examine student work, and discuss on Discussion Board.			EMS Candidates work on problem solving perseverance in Math courses.
2. Reason abstractly and quantitatively.	Candidates learn how to instill these skills in their classroom through the math content course they choose and by planning for more rigorous instruction that allows for the intentional opportunity for students to reason abstractly and quantitatively.	EMS Candidates work on problems, examine student work, and discuss on Discussion Board			EMS Candidates work on problems in Math courses requiring abstract reasoning.
3. Construct viable arguments and critique the reasoning of others.	Candidates will learn how to embed opportunities for students to provide viable arguments and critique reasoning through the Advanced Elementary Math Methods course where they learn "Talk Moves" to improve discourse in the classroom. The "Talk Moves" are expected to be used in the field in all pedagogy courses.	EMS Candidates work on problems, examine student work, and discuss on Discussion Board			EMS Candidates work on problems in Math courses and critique/analyze reasoning.
4. Model with mathematics.	Candidates will learn how to model with mathematics in the classroom by the requirements of the field in each of the courses.		EMS Candidates apply modeling strategies in the field with P-5 students.		EMS Candidates work on problems in Math courses with the modeling strategy.
5. Use appropriate tools strategically.	Candidates will grow in their understanding of resources to choose from and what constitutes good quality in technology, textbook resources, and manipulatives.		EMS Candidates learn appropriate tools to use for instruction in the field with P-5 students.	EMS Candidates learn appropriate tools to use for assessment in the field with P-5 students.	EMS Candidates work on problems in Math courses regarding applying manipulatives.
6. Attend to precision.	Candidates will learn the importance of precision in mathematics and learn how to assess for this in student learning. In the courses, an emphasis is place on students learning with meaning and not for rote memorization purposes. We discuss the importance of computational fluency, but also discuss the importance of not solely focusing on this.		EMS Candidates apply precision instruction strategies in the field with P-5 students.	EMS Candidates apply precision assessment strategies in the field with P-5 students.	EMS Candidates work on problems in Math courses regarding attention to precision.
7. Look for and make use of structure.	Candidates will learn how to teach students the patterns in mathematics and how the math brain works.		EMS Candidates apply structure instruction strategies in the field with P-5 students.	EMS Candidates apply structure assessment strategies in the field with P-5 students.	EMS Candidates work on problems in Math courses regarding structure.
8. Look for and express regularity in repeated reasoning.	Candidates will learn how to focus students reasoning in this way in experiencing their own math content course and in understanding how the brain learns.		EMS Candidates apply repeated reasoning instruction strategies in the field with P-5 students.	EMS Candidates apply repeated reasoning assessment strategies in the field with P-5 students.	EMS Candidates work on problems in Math courses regarding repeated reasoning.

Table 4. Integration of College Readiness Standards into EMS

College Readiness Standards (Score Range 16-19 Standards for 8th Grade EXPLORE)	**ELED 571**	**ELED 572**	**ELED 573**	**MATH411G, MATH 507, or MATH 508**
Basic Operations and Applications • Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent • Solve routine two-step arithmetic problems	Learn how to plan Professional Development for Colleagues in Awareness of College Readiness Standards	Design Differentiation Plan in this Content	Design Assessment Plan in this Content	Learn Mathematics at Deeper Level in Each of these Content Areas
Probability, Statistics, & Data Analysis • Calculate the average of a list of numbers • Calculate the average given number of data values and the sum of data values • Read tables and graphs • Perform computations on data from tables and graphs • Use the relationship between the probability of an event and the probability of its complement				
Numbers: Concepts & Properties • Recognize one-digit factors of a number • Identify a digit's place value				
Expressions, Equations, & Inequalities • Substitute whole numbers for unknown quantities to evaluate expressions • Solve one-step equations having integer or decimal answers • Combine like terms (e.g., 2x + 5x)				
Graphical Representations ***Expressions, Equations, & Inequalities*** • Locate points on the number line and in the first quadrant				
Properties of Plane Figures • Exhibit some knowledge of the angles associated with parallel lines				
Measurement • Compute the perimeter of polygons when all side lengths are given • Computer the area of rectangles when whole number dimensions are given				

D. Program Faculty

See Table 5 on the next page

Table 5. Program Faculty

Faculty Name	Highest Degree, Field, & University	Assignment: Indicate the role(s) of the faculty member[1]	Faculty Rank[2]	Teaching Assignment	Relationship of the Faculty to the Program	Scholarship[3], Leadership in Professional Organizations, and Service[4]: List up to 3 major contributions in the past 3 years[5]	Faculty Status: WKU/PEU/EMS
Bateiha, Summer	Ph.D. Candidate (degree expected May 2010) Instructional Leadership and Academic Curriculum, Mathematics Education, U of Oklahoma	Mathematics Faculty	Assistant Professor	MATH 411G, 507, 508	Mathematics Faculty Committee to design EMS	Bateiha, S. (2009). Book Review: Mathematics on the Internet: A resource for K-12 teachers (3rd ed). *Oklahoma Journal for School Mathematics,* (1), 16-17. Bateiha, S. (In Press). Teaching social justice mathematics across all grade levels. *Oklahoma Journal for School Mathematics.* Conference Presentation: Bateiah, S. (June 2010) Rewriting traditional mathematics problems into inquiry-based ones, Oklahoma Council for Teachers of Mathematics. Oklahoma City, Oklahoma	FT/PT/PT
Marchionda, Hope	Ph.D., Mathematics Education, Clemson University	Mathematics Faculty	Assistant Professor	MATH 411G, 507, 508	Mathematics Faculty Committee to design EMS	Principal Investigator: WKU Science and Mathematics Recruiting and Retention of Teachers (WKU SMARRT), Robert Noyce Teacher Scholarship Program, 0934804, National Science Foundation, $898,781, Funded. (award June 16, 2009). Partner: K-5 Math Alliance, Kentucky Department of Education Grant, Grant Coordinator: Liz Story (2008-present); Partner: K-82: An Expanded Alliance, Kentucky Department of Education Grant, Grant Coordinator: Liz Story (2007-present) Association of Mathematics Teacher Educators, January 2010 "Moving Beyond Word Problems -- What is true Problem Solving?" with Janet Tassell, and Travis Olson.	FT/PT/PT

[3] *Scholarship* is defined by NCATE as systematic inquiry into the areas related to teaching, learning, and the education of teachers and other school personnel. Scholarship includes traditional research and publication as well as the rigorous and systematic study of pedagogy, and the application of current research findings in new settings. Scholarship further presupposes submission of one's work for professional review and evaluation.

[4] *Service* includes faculty contributions to college or university activities, schools, communities, and professional associations in ways that are consistent with the institution and unit's mission.

[5] For example, three contributions of scholarship, leadership, and service might be 1) Scholarship - article published in a specific journal, 2) Leadership - officer of a state or national association, and 3) Service - an evaluation of a local school program. NOTE: You MUST provide evidence of SCHOLARSHIP.

Moody, Vivian	Ph.D., Mathematics Education, University of Georgia	Mathematics faculty	Associate Professor	MATH 411G, 507, 508	Mathematics Faculty Committee to design EMS	What Mathematics Kentucky Pre-Service Middle School Teachers Are Expected to Know, 2007 Annual Meeting of the Association of Mathematics Teacher Educators, Irvine, CA, January 2007 (with William S. Bush and Maggie McGatha). Co-Chair, Algebra I Working Group, Secondary Formative Assessment Project, (Dr. Bill Bush Project Director), in collaboration with the Kentucky Department of Education, 2009-present. Reviewer, Manuscripts submitted for publication, Journal for Research in Mathematics Education, NCTM, 2001-present. Principal Investigator. African-American Students'; Voices on Succeeding in Mathematics. (2002-2003). Principal Investigator; Project VOICE: Listening to African-American Mathematics Students' Voices About Their Mathematical Experiences. (1999-2001). Principal Investigator; RAAME--Research on African-American Students' Mathematical Experiences. (1998-1999 (Co-Principal Investigator with Patricia S. Moyer).	FT/PT/PT
Tassell, Janet	Ph.D., Mathematics Ed Indiana	Faculty	Assistant Professor	ELED 571, 572, 573	Director of the Elementary Mathematics Endorsement Committee to design EMS Teacher for: ELED 571, 572, 573	*Kloosterman, P., Tassell, J. L., Essex, K., and Ponniah, A. (2008). Perceptions of Mathematics and Gender. School Science and Mathematics, 108, 149-162. *Tassell, J., Bishop, T. (October, 2008). Using Locally Developed Formative Benchmarks and Assessments to Improve Student Learning. Paper presented at National Evaluation Institute CREATE Conference, Wilmington, NC. Grants: *Provost PIE Grant – Math Comic Books *Javits Grant – The Center for Gifted Studies Leadership: SKyTeach Steering Committee *Middle Grade EPSB Folio Co-Chair for development	FT/FT/PT
Weidemann, Wanda	Ed.D. Mathematics Education, Vanderbilt University	Mathematics Faculty	Professor	MATH 411G, 507, 508	Mathematics Faculty Committee to design EMS	Member, Kentucky Committee on Mathematics Achievement (instituted by KY Legislature, 2002) Presentation: Olson, Travis; Marchionda, Hope; Tassell, Janet; & Weidemann, Wanda (Jan. 2010) "Mathematics Content Courses for Elementary and Middle Grades Teachers: Identifying the Necessary and the Sufficient. , Association of Mathematics Teacher Educators, Pomona, CA Co-Chair, Algebra I Working Group, Secondary Formative Assessment Project, (Dr. Bill Bush Project Director), in collaboration with the Kentucky Department of Education, 2009-present	FT/FT/PT

E. WKU Curriculum Contract

Elementary Mathematics Specialist (EMS) Endorsement, P-5

Admission Requirements: To be admitted into this program, candidates must meet all minimal criteria described on the "Transition Points" page under "Transition Point 1."

Professional Education Core—0-19 hours

The Elementary Mathematics Specialist endorsement classes may be taken as a certification-only program or as a part of a master's or specialist degree or as courses within a Rank I program. The endorsement in Elementary Mathematics Specialist (EMS) certifies teachers to provide services for young people in grades P-5.

Specialization Component—15 hours

Pedagogy requirements - 9 hours

ELED 571: Leadership, Math, and Technology Education (3 credit hours)
ELED 572: Math and Technology Methods for Diverse Learners (3 credit hours)
ELED 573: Math and Technology Assessment (3 credit hours)

Mathematics content requirements – 6 hours (selected with advisor approval)

*MATH 411G: Problem Solving for Elementary and Middle Grades Teachers (3 hours)
*Required (unless student completed MATH 411 as part of baccalaureate program): (0-3 hours)

Restricted elective(s): (3-6 hours)
MATH 507: Math for Elementary Teachers (3 hours)
OR
MATH 508: Number Concepts for Elementary and Middle Grades Teachers (3 hours)

Note: Students who completed MATH 411 as undergraduates must take both MATH 507 and 508.

Completion Requirements: To complete this program, candidates must meet all minimal criteria described on the "Transition Points" page under "Transition Point 3."

Candidate's Name (printed)	Education Advisor's Signature/Date
Candidate's Signature/Date	Specialization Advisor's Signature/Date

Transition Points –Elementary Mathematics Specialist P-5 Endorsement

Transition Point 1: Admission to Education Preparation Programs			
Data Reviewed	Minimal Criteria for Admission/Continuation	Review Cycle	Reviewed By
Unit Level Data: ▪ Admission Application ▪ Undergraduate Degree ▪ Teaching Certificate	▪ Completion of application ▪ Evidence of degree ▪ Evidence of certificate	Each Month	Graduate Studies
Transition Point 2: Endorsement Progress Monitoring			
Data Reviewed	Minimal Criteria for Exit	Review Cycle	Reviewed By
Program Specific Data ▪ Grade Point Average ▪ Critical Performance Scores	▪ GPA of 3.0 or above with letter grade of B or above in each course ▪ Each CP score is 3 or 4 out of a possible 4 points	Each Semester	EMS Program Director
Transition Point 3: Exiting the Endorsement			
Data Reviewed	Minimal Criteria for Exit	Review Cycle	Reviewed By
Program Specific Data ▪ MT Plan with all three components – Leadership, Diverse Learners, and Assessment	▪ MT Plan score is 3 or 4 out of a possible 4 points	Upon Completion	EMS Program Director

F. Syllabi

The following course syllabi associated with this program are available for review at http://edtech.wku.edu/peu/course-syllabi-epsb.htm:

ELED 571
ELED 572
ELED 573
MATH 411G
MATH 507
MATH 508

G. Mode of Delivery

The delivery method for this endorsement program is primarily web-based instruction. Blackboard is used to post announcements and course documents as well as to provide a venue for discussion boards.

V. Specific Endorsement Requirements

A. Courses and Experiences

See Table 6 below.

Table 6. Course Alignment to Specific Endorsement Requirements

Required Experiences	**ELED 571**	**ELED 572**	**ELED 573**	**MATH411G, MATH 507, or MATH 508**
A. depth of knowledge beyond elementary preparation				EMS Candidates work on problems in Math courses and critique/analyze reasoning.
B. learn how to provide professional development in math	EMS Candidates learn from a professional development program module and prepare a professional development plan for their school.	EMS Candidates learn from a professional development program module and prepare a professional development plan for their school.	EMS Candidates learn from a professional development program module and prepare a professional development plan for their school.	
C. deepen understanding of how math procedures work	EMS Candidates work on problems, examine student work, and discuss on Discussion Board			EMS Candidates work on problems in Math courses to further develop math procedure understanding.
D. promote mathematical reasoning, sense making, problem solving, computational fluency, justification		EMS Candidates learn how to design lessons that require higher levels of thinking in solving problems.	EMS Candidates design assessments that require higher levels of thinking in solving problems.	EMS Candidates work on problems in Math courses that promote mathematical reasoning, sense making, problem solving, computational fluency, justification.
E. how to use different texts and design instruction to meet individual learning needs	EMS Candidates analyze math textbooks.	EMS Candidates learn how to design individualized instruction and apply the tactics in the field.		
F. learn how to determine what students know and understand, using formative assessments as guide			EMS Candidates apply formative assessment strategies in the field with P-5 students.	

G. provide strategies and resources for teaching mathematics, including differentiated instruction		EMS Candidates learn how to design differentiated instruction and apply the tactics in the field.		
H. ensure understanding of vertical nature of mathematics K-8		EMS Candidates work on problems design an problem solving instruction plan that is scaffolded.	EMS Candidates work on problems design an assessment plan that is scaffolded.	

B. Alignment to National Council of Teachers of Mathematics (NCTM)/NCATE Standards for Elementary Mathematics Specialist and American Mathematics Teacher Educators (AMTE) Elementary Mathematics Specialist Standards

See Tables 7 and 8 below.

Table 7. EMS Program Alignment to NCTM Learned Society Standards

NCATE/NCTM Elementary Mathematics Specialist Standards (2003) ***Standards for Elementary Mathematics Specialists***	**ELED 571**	**ELED 572**	**ELED 573**	**MATH411G, MATH 507, MATH 508**
Standard 1: Knowledge of Mathematical Problem Solving *Candidates know, understand, and apply the process of mathematical problem solving.* 1.1 Apply and adapt a variety of appropriate strategies to solve problems. 1.2 Solve problems that arise in mathematics and those involving mathematics in other contexts. 1.3 Build new mathematical knowledge through problem solving. 1.4 Monitor and reflect on the process of mathematical problem solving.				Assessed using exams, homework, assignments, individual or group projects, and discussion boards
Standard 2: Knowledge of Reasoning and Proof Candidates reason, construct, and evaluate mathematical arguments and develop an appreciation for mathematical rigor and inquiry. 2.1 Recognize reasoning and proof as fundamental aspects of mathematics. 2.2 Make and investigate mathematical conjectures. 2.3 Develop and evaluate mathematical arguments and proofs. 2.4 Select and use various types of reasoning and methods of proof.				Assessed using exams, homework, assignments, individual or group projects, and discussion boards
Standard 3: Knowledge of Mathematical Communication Candidates communicate their mathematical thinking orally and in writing to peers, faculty, and others. 3.1 Communicate their mathematical thinking coherently and clearly to peers, faculty, and others. 3.2 Use the language of mathematics to express ideas precisely. 3.3 Organize mathematical thinking through communication. 3.4 Analyze and evaluate the mathematical thinking and strategies of others.	Assessed – Discussion Boards and Blog Journals			
Standard 4: Knowledge of Mathematical Connections Candidates recognize, use, and make connections between and among mathematical ideas and in contexts outside mathematics to build mathematical understanding. 4.1 Recognize and use connections among mathematical ideas. 4.2 Recognize and apply mathematics in contexts outside of mathematics. 4.3 Demonstrate how mathematical ideas interconnect and build on one another to produce a coherent whole.				Assessed using exams, homework, assignments, individual or group projects, and discussion boards
Standard 5: Knowledge of Mathematical Representation Candidates use varied representations of mathematical ideas to support and deepen students' mathematical understanding. 5.1 Use representations to model and interpret physical, social, and mathematical phenomena. 5.2 Create and use representations to organize, record, and communicate mathematical ideas. 5.3 Select, apply, and translate among mathematical representations to solve problems.				Assessed using exams, homework, assignments, individual or group projects, and discussion boards
Standard 6: Knowledge of Technology Candidates embrace technology as an essential tool for teaching and learning mathematics. 6.1 Use knowledge of mathematics to select and use appropriate technological tools, such as but not limited to, spreadsheets, dynamic graphing tools, computer algebra systems, dynamic statistical packages, graphing calculators, data-collection devices, and presentation software.	Assessed through Lesson Design	Assessed through Lesson Design	Assessed through Assessment Design	

NCATE/NCTM Elementary Mathematics Specialist Standards (2003) ***Standards for Elementary Mathematics Specialists***	**ELED 571**	**ELED 572**	**ELED 573**	**MATH411G, MATH 507, MATH 508**
Standard 7: Dispositions Candidates support a positive disposition toward mathematical processes and mathematical learning. 7.1 Attention to equity 7.2 Use of stimulating curricula 7.3 Effective teaching 7.4 Commitment to learning with understanding 7.5 Use of various assessments 7.6 Use of various teaching tools including technology	Assessed through MT Leadership Plan			
Standard 8: Knowledge of Mathematics Pedagogy Candidates possess a deep understanding of how students learn mathematics and of the pedagogical knowledge specific to mathematics teaching and learning. 8.1 Selects, uses, and determines suitability of the wide variety of available mathematics curricula and teaching materials for all students including those with special needs such as the gifted, challenged and speakers of other languages. 8.2 Selects and uses appropriate concrete materials for learning mathematics. 8.3 Uses multiple strategies, including listening to and understanding the ways students think about mathematics, to assess students' mathematical knowledge. 8.4 Plans lessons, units and courses that address appropriate learning goals, including those that address local, state, and national mathematics standards and legislative mandates. 8.5 Participates in professional mathematics organizations and uses their print and on-line resources. 8.6 Demonstrates knowledge of research results in the teaching and learning of mathematics. 8.7 Uses knowledge of different types of instructional strategies in planning mathematics lessons. 8.8 Demonstrates the ability to lead classes in mathematical problem solving and in developing in-depth conceptual understanding, and to help students develop and test generalizations. 8.9 Develop lessons that use technology's potential for building understanding of mathematical concepts and developing important mathematical ideas.	Assessed through multiple venues: Discussion Board, Blog Journal	Assessed through multiple venues: Discussion Board, Blog Journal	Assessed through multiple venues: Discussion Board, Blog Journal	
Standard 9: Knowledge of Number and Operation Candidates demonstrate computational proficiency, including a conceptual understanding of numbers, ways of representing number, relationships among number and number systems, and the meanings of operations. 9.1 Develop the meaning of addition, subtraction, multiplication, and division and provide multiple models for whole number operations and their applications. 9.2 Recognize the meaning and use of place value in representing whole numbers and finite decimals, comparing and ordering numbers, and understanding the relative magnitude of numbers. 9.3 Demonstrate proficiency in multi-digit computation using algorithms, mental mathematics, and computational estimation. 9.4 Analyze integers and rational numbers, their relative size, and how operations with whole numbers extend to integers and rational numbers. 9.5 Demonstrate knowledge of the historical development of number and number systems including contributions from diverse cultures.				Assessed using exams, homework, assignments, individual or group projects, and discussion boards
Standard 10: Knowledge of Different Perspectives on Algebra Candidates emphasize relationships among quantities including functions, ways of representing mathematical relationships, and the analysis of change. 10.1 Explore and analyze patterns, relations, and functions. 10.2 Recognize and analyze mathematical structures. 10.3 Investigate equality and equations. 10.4a Use mathematical models to represent quantitative relationships. 10.5 Analyze change in various contexts.				Assessed using exams, homework, assignments, individual or group projects, and discussion

NCATE/NCTM Elementary Mathematics Specialist Standards (2003) ***Standards for Elementary Mathematics Specialists***	**ELED 571**	**ELED 572**	**ELED 573**	**MATH411G, MATH 507, MATH 508**
10.6 Demonstrate knowledge of the historical development of algebra including contributions from diverse cultures.				boards
Standard 11: Knowledge of Geometries Candidates use spatial visualization and geometric modeling to explore and analyze geometric shapes, structures, and their properties. 11.1 Use visualization, the properties of two- and three-dimensional shapes, and geometric modeling. 11.2 Build and manipulate representations of two- and three-dimensional objects using concrete models, drawings, and dynamic geometry software. 11.3 Specify locations and describe spatial relationships using coordinate geometry. 11.4 Apply transformations and use symmetry, congruence, and similarity. 11.5 Demonstrate knowledge of the historical development of Euclidean and non-Euclidean geometries including contributions from diverse cultures.				Assessed using exams, homework, assignments, individual or group projects, and discussion boards
Standard 12: Knowledge of Data Analysis, Statistics, and Probability Candidates demonstrate an understanding of concepts and practices related to data analysis, statistics, and probability. 12.1 Design investigations that can be addressed by creating data sets and collecting, organizing, and displaying relevant data. 12.2 Use appropriate statistical methods and technological tools to analyze data and describe shape, spread, and center. 12.3 Apply the basic concepts of probability. 12.4 Demonstrate knowledge of the historical development of probability and statistics including contributions from diverse cultures**.**				Assessed using exams, homework, assignments, individual or group projects, and discussion boards
Standard 13: Knowledge of Measurement **Candidates apply and use measurement concepts and tools.** 13.1 Select and use appropriate measurement units, techniques, and tools. 13.2 Recognize and apply measurable attributes of objects and the units, systems, and processes of measurement. 13.3 Employ estimation as a way of understanding measurement units and processes. 13.4 Demonstrate knowledge of the historical development of measurement and measurement systems including contributions from diverse cultures.				Assessed using exams, homework, assignments, individual or group projects, and discussion boards
Standard 14: Field-Based Experiences Candidates complete field-based experiences in mathematics classrooms. 14.1 Engage in a sequence of planned opportunities prior to student teaching that includes observing and participating in elementary mathematics classrooms under the supervision of experienced and highly qualified teachers. 14.2 Experience full-time student teaching in elementary-level mathematics that is supervised by an experienced and highly qualified teacher and a university or college supervisor with elementary mathematics teaching experience. 14.3 Demonstrate the ability to increase students' knowledge of mathematics.	Assessed through Problem Solving Task	Assessed through Differentiation Lesson Plan	Assessed through Assessment Plan	

Table 8. EMS Program Alignment to AMTE Learned Society Standards

Association of Mathematics Teacher Educators (AMTE) Standards for Elementary Mathematics Specialist	ELED 571	ELED 572	ELED 573	MATH411G, MATH 507, MATH 508
I. Content knowledge for teaching mathematics: Deep understanding of mathematics for grades K–8. Elementary mathematics specialists are expected to acquire the habits of mind of a mathematical thinker and use mathematical practices such as precision in language, construction and comparison of mathematical representations, conjecturing, problem solving, reasoning, and proving. They need to able to use these practices in the following domains: Number and Operations • Pre-number concepts: Non-quantified comparisons (less than, more than, the same), containment (e.g., 5 contains 3), 1-to-1 correspondence, cardinality, ordinality. • A comprehensive repertoire of interpretations of the four operations of arithmetic and of the common ways they can be applied. • Place value: The structure of place-value notation in general and base-10 notation in particular; how place-value notations efficiently represent even very large numbers, as well as decimals; use of these notations to order numbers, estimate, and represent order of magnitude (e.g., using scientific notation). • Multi-digit calculations, including standard algorithms, mental math, and non-standard ways commonly created by students; informal reasoning used in calculations. • Basic number systems: Whole numbers (non-negative integers), integers, non-negative rational numbers, rational numbers, and real numbers. Relationships among them, and locations of numbers in each system on the number line. What is involved in extending operations from each system (e.g., whole numbers) to larger systems (e.g., rational numbers). • Multiplicative arithmetic: Factors, multiples, primes, least common multiple, greatest common factor. Proportional reasoning and rescaling. Algebra and Functions • Axioms: Recognize commutativity, associativity, and distributivity, and 0 and 1 as identity elements in the basic number systems; understand how these may be used in computations and to deduce the correctness of algorithms. The need for order-of-operations conventions. • Algebraic notation and equations: Literal symbols, as shorthand names for mathematical objects, or, in the case of numerical variables, as indicating an unspecified member of some class of numbers (the “range of variation”). The process of substitution of particular numbers into variable expressions. The solution set of an algebraic equation or relation. • Transformations of equations (or relations) that do not change the solution set. • Modeling of problems, both mathematical and “real world,” using algebraic equations and relations.				Assessed using exams, homework, assignments, individual or group projects, and discussion boards

• The concept of a function as defining one variable uniquely in terms of another. Familiarity with basic types of functions, including constant, linear, exponential, and quadratic. Representations and partial representations of functions: Formula, graph, table; or, when the variable is discrete, by recursion. • Finding functions to model various kinds of growth, both numerical and geometric. Geometry and Measurement • Visualization: Geometric objects are pictured on a 2-dimensional page; for 3-dimensional objects this requires perspective or projection renderings. Producing and reading such representations calls for special skills, both mathematical and drawing. • Composing and decomposing: A geometric figure can be assembled by joining together various component figures. Conversely, a geometric figure may be decomposed into pieces, for example decomposing a polygon into an assemblage of triangles. • Congruence and similarity: Congruence is the basic concept of geometric "sameness." Similarity has to do with rescaling: Two figures are similar if one of them is congruent to a rescaling of the other. For example, all circles are similar, as are all squares and all isosceles right triangles. • Geometric measurement is a way of attaching a numerical quantity to a geometric figure. Doing this involves a choice of some standard figure (the "unit") and then the measurement is a kind of ratio of the given figure to the unit, or, put differently, how many copies of the unit does it take to compose the given figure? It follows that if a geometric figure is decomposed, then its measure is the sum of the measures of its components. Changing the unit has the effect of multiplying all measurements by a constant (relating the two units). For example, relating feet to inches, or to meters. • Common units of geometric measurement: Linear: The unit may be the interval [0, 1] on the number line. Area: The unit is a unit square. Volume: The unit is the unit cube. Angle: Draw a unit circle centered at the vertex of the angle, and consider the arc of the circle cut out by the angle. The radian measure of the angle is the length α of that arc. The degree measure of the angle is $360\alpha/2\pi$, i.e. 360 times the fraction of the circumference of the circle formed by the arc. • Basic geometric figures in each dimension: Dimension 1: Line segments, arcs of circles; Dimension 2: Polygons, circles; Dimension 3: Polyhedral solids, cylinders, cones, spheres. Elements of these figures, e.g., vertex, edge, face. Properties of regularity and symmetry. Definitions, names, and classification. Various kinds of measurement, and some basic formulas; invariance under congruence, and behavior under rescaling. • Plane coordinates: How they are introduced, and how they support algebraic expression of geometric objects and relationships. Reciprocally, how they afford geometric interpretation of algebraic relations. • Transformations: Reflections, rotations, translations, dilations; symmetry and its expression in terms of transformation (e.g., reflection through a line of symmetry). • Proof: Making and proving conjectures about geometric shapes or relations. Data Analysis and Probability • The nature and uses of data: What kinds of questions require data for their answers, and what kinds of data are required? How are relevant data sets created and organized? Designing an investigation, including specification of how the data collected support analysis responsive to the question(s) under investigation. • Distinguish categorical (discrete) data (e.g., gender, favorite ice cream flavor) from measurement (continuous) data. • Appropriate types of representation of data, and what they afford: For categorical data, relative frequencies. For measurement data, displays of shape, center, and spread. • Basic concepts of probability and ways to represent them; making judgments under conditions of uncertainty; measuring likelihood; becoming familiar with the concept of randomness. • Drawing conclusions: Understand which representations best support communication of inferences from data, use probability models when appropriate, and account for variability. Understand the limits of generalizability due to non-randomness of a sample population.				

Association of Mathematics Teacher Educators (AMTE) Standards for Elementary Mathematics Specialist	ELED 571	ELED 572	ELED 573	MATH411G, MATH 507, MATH 508
I. Content knowledge for teaching mathematics: Specialized mathematics knowledge for teaching. EMS professionals must have mathematical knowledge that enables them to: • Support the development of *mathematical proficiency* as characterized by conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition (National Research Council, 2001). • Be able to create opportunities learners to develop mathematical practices and to critically evaluate their selection and use of these practices. • Diagnose mathematical misconceptions and errors and design appropriate interventions. • Decide whether, how and how far, to utilize specific oral or written responses from learners. • Recognize, evaluate, and respond to multiple, often non-standard solutions to problems. • Choose and/or design tasks to support the learning of new mathematical ideas or methods, or to test learners' understanding of them.				Assessed using exams, homework, assignments, individual or group projects, and discussion boards
II. Pedagogical knowledge for teaching mathematics: Learners and learning. • Utilize and build upon learners' existing knowledge, skills, understandings, conceptions and misconceptions to advance learning. • Understand learning trajectories related to particular topics in mathematics (e.g., Sarama & Clements, 2009) and use this knowledge to organize and deliver instruction that is developmentally appropriate and responsive to individual learners. • Understand cultural differences among learners (e.g., algorithms or learning practices familiar to different groups of learners) and utilize this knowledge to motivate and extend learning opportunities for individuals and groups of learners. • Create social learning contexts that engage learners in discussions and mathematical explorations among peers to motivate and extend learning opportunities.		Assessed through multiple venues: Discussion Board and Blog Journal; Differentiated Lesson Plan		
II. Pedagogical knowledge for teaching mathematics: Teaching. • Design, select and/or adapt worthwhile mathematics tasks and sequences of examples that support a particular learning goal. • Support students' learning of appropriate technical language associated with mathematics, attending to both mathematical integrity and usability by learners. • Construct and evaluate multiple representations of mathematical ideas or processes, establish correspondences between representations, and understand the purpose and value of doing so. • Use questions to effectively probe mathematical understanding and make productive use of responses. • Develop learners' abilities to give clear and coherent public mathematical communications in a classroom setting. • Model effective problem solving and mathematical practices—questioning, representing, communicating, conjecturing, making connections, reasoning and proving, self-monitoring and cultivate the development of such practices in learners. • Use various instructional applications of technology, judiciously, in ways that are mathematically and pedagogically grounded. • Analyze and evaluate student ideas and work, and design appropriate responses. • Develop skillful and flexible use of different instructional formats—whole group, small group, partner, and individual—in support of learning goals. • Manage diversities of the classroom and school—cultural, disability, linguistic, gender, socio-economic, developmental—and use appropriate strategies to support mathematical learning of all students.		Assessed through multiple venues: Discussion Board and Blog Journal; Differentiated Lesson Plan		

Association of Mathematics Teacher Educators (AMTE) Standards for Elementary Mathematics Specialist	ELED 571	ELED 572	ELED 573	MATH411G, MATH 507, MATH 508
II. Pedagogical knowledge for teaching mathematics: Curriculum and assessment. • Know learning trajectories related to mathematical topics and use this knowledge to sequence activities and design instructional tasks. • Uses multiple strategies, including listening to and understanding the ways students think about mathematics, to assess students' mathematical knowledge. • Understand the importance of careful sequencing and development of mathematical ideas, concepts, and skills in the preK–middle grades curriculum; be able to engage in discussions and decision-making to establish appropriate benchmarks for learning goals from grades K to 8. • Select, use, adapt, and determine the suitability of mathematics curricula and teaching materials (e.g., textbooks, technology, manipulatives) for particular learning goals. • Evaluate the alignment of local and state curriculum standards, district textbooks and district and state assessments, and recommend appropriate adjustments to address gaps. • Know the different formats, purposes, uses, and limitations of various types of assessment of student learning; be able to choose, design, and/or adapt assessment tasks for monitoring student learning. • Use the formative assessment cycle (administer a formative assessment task, analyze student responses to the task, and design and reteach lessons based on this analysis) and be able to find or create appropriate resources for this purpose. • Analyze formative and summative assessment results, make appropriate interpretations and communicate results to appropriate and varied audiences.		Assessed through multiple venues: Discussion Board and Blog Journal; Differentiated Lesson Plan	Assessed through multiple venues: Discussion Board and Blog Journal; Assessment Plan	
III. Leadership knowledge and skills. • Use professional resources such as professional organization networks, journals, and discussion groups to be informed about critical issues related to mathematics teaching and learning, e.g., policy initiatives and curriculum trends. • Select from a repertoire of methods to communicate professionally about students, curriculum, instruction, and assessment to educational constituents—parents and other caregivers, school administrators, and school boards. • Plan, develop, implement, and evaluate professional development programs at the school and district level and support teachers in systematically reflecting and learning from practice. • Evaluate educational structures and policies that affect students' equitable access to high quality mathematics instruction, and act professionally to assure that all students have appropriate opportunities to learn important mathematics. • Use leadership skills to improve mathematics programs at the school and district levels, e.g., develop appropriate classroom- or school-level learning environments; build relationships with teachers, administrators and the community; develop evidence-based interventions for high and low-achieving students; collaborate to create a shared vision and develop an action plan for school improvement; partner with school-based professionals to improve each student's achievement; mentor new and experienced teachers to better serve students.	Assessed through multiple venues: Discussion Board and Blog Journal; MT Leadership Plan			

C. Common Core State Mathematics Standards: Standards for Mathematical Practice and Content Standards

EMS candidates are required to incorporate the AMS and Common Core State Standards for Math Practice and Content throughout the coursework. The candidates will show this through their Blog Journals, Discussion Board, Lessons, Units, and the Math and Technology Plan that addresses Leadership, Diverse Learners, and Assessment. See Tables 3 and 4 for more information.