

EXECUTIVE SUMMARY

Title: Elementary Mathematics Add-on License

Type of Executive Summary:

- Action
- Action on First Reading
- Discussion
- Information

Policy Implications:

- Constitution _____
- General Statute # _____
- SBE Policy # _____
- SBE Policy Amendment
- SBE Policy (New)
- APA # _____
- APA Amendment
- APA (New)
- Other _____

Presenter(s): Dr. Rebecca Garland (Chief Academic Officer, Academic Services and Instructional Support)

Description:

Effective mathematics teaching is complex, requiring both a broad base knowledge and a special content knowledge for successful instruction. Yet most teachers of elementary mathematics are typically generalists, with minimal coursework in mathematics, lacking the knowledge of mathematics necessary to make informed pedagogical decisions. Often, these teachers have had only one or two mathematics courses in college. The proposed program of study for the Elementary Mathematics Add-on-License is an online graduate-level program of study focused on the mathematical knowledge needed for successfully teaching mathematics at the elementary level.

Resources:

NA

Input Process:

The proposed Elementary Mathematics Add-on-License is a coordinated effort between the North Carolina Department of Public Instruction, the University of North Carolina General Administration, statewide LEA representation at the school and district levels, and university faculty representation from colleges of education and arts and science.

Stakeholders:

LEAs, individuals seeking an Elementary Mathematics Add-on-License

Timeline For Action:

This item was presented as New Business at the April 2009 SBE meeting and will be presented for Discussion at the July 2009 SBE meeting.

Recommendations:

It is recommended that the SBE endorse the university designed add-on license for elementary mathematics.

Audiovisual equipment requested for the presentation:

- Data Projector/Video (Videotape/DVD and/or Computer Data, Internet, Presentations-PowerPoint preferred)
Specify: _____
 - Audio Requirements (computer or other, except for PA system which is provided)
Specify: _____
 - Document Camera (for transparencies or paper documents – white paper preferred)

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Motion By: _____ Seconded By: _____
Vote: Yes _____ No _____ Abstain _____
Approved _____ Disapproved _____ Postponed _____ Revised _____

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Elementary Mathematics Add-on License

Excellence in mathematics, science and technology education in the United States is integral to the country's ability to successfully compete, prosper and be secure in the global community of the 21st century. Effective mathematics teaching is complex, requiring both a broad base knowledge and a special content knowledge for successful instruction. Yet most teachers of elementary school mathematics are typically generalists, with minimal coursework in mathematics, lacking the knowledge of the mathematics content necessary to make informed pedagogical decisions. Often, these teachers have had only one or two mathematics courses in college.

One considerable obstacle to improving elementary school mathematics instruction is that many teachers simply do not have the necessary understanding of mathematics, of the process of learning mathematics, or of children's mathematical thinking. The 2000 National Survey of Science and Mathematics Education conducted by Horizon Research, Inc., for the National Science Foundation reported that only 60% of the elementary teachers in their survey felt qualified to teach mathematics. Surveys and interviews with North Carolina school division personnel indicate that teachers at the elementary school level lack profound understanding of the content, as well as a comprehensive knowledge of content pedagogy. To help their students learn at higher levels, teachers must be supported in deepening their own knowledge of the mathematics needed for teaching, along with the high leverage teaching practices have been shown to help children learn mathematics.

School-based leadership in mathematics has largely been limited to elementary school teachers who have developed an interest in mathematics teaching through randomly available professional development opportunities. While notable exceptions exist through federally and privately funded projects, there is a need for a sustained program to support the state needs. The challenge is to create a model that can be scaled up to impact the teaching and learning of mathematics in North Carolina's nearly 1500 elementary schools.

The Need for Elementary Mathematics Specialists

A growing number of national reports call for the placement of mathematics specialists in elementary schools. These reports (The Mathematical Education of Teachers, 2001; Adding It Up: Helping Children Learn Mathematics, 2001; National Council of Teachers of Mathematics Principles and Standards of School Mathematics, 2000; No Common Denominator, 2008; and Foundations for Success: The Final Report of the National Mathematics Advisory Panel, 2008) have converged around this common idea. Each report calls for qualified Elementary Mathematics Specialists to be placed in schools as a resource for improving instruction. States such as Virginia, Georgia, and Ohio have already established statewide licensure programs for elementary mathematics specialists. Projects such as the North Carolina Partnership for Improving Mathematics and Science (NCPIMS) have demonstrated that school-based Elementary Mathematics Specialists can serve as a resource in professional development, teaching, curriculum development and implementation, mentoring new teachers, and parent and community education. Some see this movement as paralleling the national Reading First Initiative with a mathematics initiative. But unlike reading, there is no infrastructure in place to support this effort in mathematics. Most elementary teachers are much less prepared to teach mathematics than they are to teach reading.

The Preparation of Elementary Mathematics Specialists

The specialist role requires comprehensive and rigorous preparation—Elementary Mathematics Specialists require deep knowledge of how children learn mathematics, the use of various assessments in diagnosing student learning in mathematics, and the designing of instruction for diverse learners. They must be able to create learning trajectories that identify a specific mathematical goal, a developmental path along which children develop to reach that goal, and a set of individual activities that help children move along that path. Individuals in specialist positions require graduate level preparation, including significant practice-based coursework on the mathematical content knowledge needed to teach. Their teaching must model the orchestrating of productive mathematical discussions by anticipating, monitoring, selecting, sequencing, and making connections between student responses. They must be prepared to provide local leadership—communicating effectively with colleagues, parents, and other stakeholders in the school.

The proposed Elementary Mathematics Add-on License is a coordinated effort between the North Carolina Department of Public Instruction (NCDPI), the University of North Carolina General Administration (UNCGA), statewide LEA representation at the school and district levels, and university faculty representation from colleges of education and arts and science. The collaborative statewide effort began last spring when, through funding from the Burroughs Wellcome Fund and the Cisco Learning Institute, the NCDPI co-sponsored a weeklong retreat to design an Elementary Mathematics Specialist Program-of-Study for the North Carolina State Board of Education's consideration. This initial effort gained focus and direction through the leadership of UNCGA. In response to questions and suggestions regarding the teaching of elementary school mathematics raised by Judge Howard Manning last summer, the UNCGA expanded their analysis of the preparation and development of middle grades mathematics teachers to focus on the preparation and development needs of teachers of

elementary school mathematics. Based on the recommendation of the deans of the UNC colleges of education in August 2008 and a meeting with campus teams of faculty from UNC colleges of education and arts and science in Fall 2008, the UNCGA established an elementary mathematics advisory committee. The advisory committee (with representation from UNC faculty, NCDPI, the UNCGA and LEA mathematics specialists) met weekly to draft the design of a program of study that could potentially support an elementary mathematics add-on license. Feedback for this effort was provided at a focus meeting of fifty invited representatives including the UNCGA, the NCDPI, UNC mathematicians and mathematics educators, district-level mathematics specialists and elementary school mathematics teachers.

Based on the recommendation of the advisory committee, the UNCGA is prepared to support the design, development, and implementation of an online graduate-level program of study (six courses) focused on the mathematical knowledge needed for successfully teaching mathematics at the elementary level.

The Elementary Mathematics Add-On License Program-of Study

The proposed program-of-study for the Elementary Mathematics Add-On License includes 18 hours of graduate coursework that will be offered by approved UNC universities. Based on specific masters degree requirements at the universities, some or all of the courses may be applied towards existing degree programs.

All courses will:

- Include graduate level expectations and accountability that balance direct instruction with project-oriented teaching methods.
- Stress mathematical content needed to support the teaching of elementary mathematics, illustrating how a deeper understanding of subject matter can actually enhance problem solving, critical thinking, and other 21st century skills. Mathematical content strands include: number systems and operations; rational numbers and operations; spatial orientation and visualization; measurement and data analysis; fostering the development of algebraic reasoning, including patterns structure, conjecture, generalizations and proof; and algebraic operations as generalized arithmetic. Courses will stress the mathematical connections and representations across content strands.
- Provide connections to practice and the NC Standard Course of Study with a focus on a thorough development of basic mathematical ideas and skills, with an emphasis on understanding the sequential nature of mathematics and the mathematical structures inherent in the content strands.
- Balance the needs of K-2 and 3-5 teachers with links to the mathematics content and skills students need to successfully learn middle grades mathematics.
- Enable 21st century professional learning communities for teachers that model the kinds of classroom learning that best promotes 21st century skills for students.
- Cultivate teachers' ability to identify students' particular learning styles, intelligences, strengths and weaknesses.
- Help teachers develop their abilities to use various strategies (such as formative assessments) to reach diverse students and to create environments that support differentiated teaching and learning.
- Encourage knowledge sharing among communities of practitioners, using face-to-face, virtual and blended communications.
- Support the use of technology to improve teaching and learning mathematics.

Beyond these features that support improving the teaching and learning in an individual's classes, the program of study includes coursework that helps teachers develop as school-based leaders:

- Collaborating with teachers through co-teaching, mentoring, and coaching;
- Identifying colleagues' individual professional development needs, and individualize staff development efforts to include both formal and job-embedded professional learning experiences; and
- Facilitating staff development in mathematics content, mathematics pedagogy, and assessment of student learning.

The Elementary Mathematics Add-on License Courses

The program of study includes six courses. Each course is distinguished by a focus on a high-leverage teaching practice, a primary area of mathematics necessary for successfully teaching elementary school mathematics and a secondary area of mathematical content. The primary content area provides the context for exemplifying the high-leverage teaching practice. The secondary content area provides the context for demonstrating the transfer of the high-leverage teaching practice to other

content strands. For example, the understanding and applying knowledge of learning trajectories is initially developed for rational numbers and their operations. The generalization of the role and application of learning trajectories is modeled using measurement as the secondary curriculum area. Each course also identifies the profound understanding of fundamental mathematics teachers will develop and demonstrate through the program of study. The following chart provides an overview of the six courses.

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HIGH-LEVERAGE MATHEMATICS TEACHING PRACTICES	MATHEMATICAL CONTENT
Selecting, Designing, and Using Mathematical Tasks	Primary (80%): Number Systems & Operations (Place Value) Secondary (20%): Number Theory and Rational Numbers
Understanding and Applying Knowledge of Learning Trajectories	Primary (80%): Rational Numbers and Operations Secondary (20%): Measurement
Orchestrating Classroom Interactions	Primary (80%): Data Analysis Secondary (20%): Measurement
Fostering Reasoning through Discourse and Questioning	Primary (80%): Algebraic Reasoning; Including Patterns Structure, Conjecture, Generalizations and Proof Secondary (20%): Number Systems & Operations
Assessing Student Knowledge (Diagnosis and Intervention)	Primary (80%): Spatial Orientation And Visualization Secondary (20%): Early Number Concepts
Helping Teachers Develop as School-based Leaders	Primary (80%): Connecting, Relearning, and Integrating Content Areas—Mathematical Modeling Secondary (20%): From Number to Algebra

Recommendations for the Elementary Mathematics Add-on License

The Elementary Mathematics Add-On License should be viewed as one component in the professional development continuum of a leader in the teaching and learning of elementary school mathematics. It should build on a teacher's pre-service coursework in mathematics and the teaching and learning of mathematics. At a minimum, any teacher seeking the add-on license will be expected to have at least six credit hours of undergraduate coursework in mathematics and/or the teaching of mathematics. It is further expected that the license will be practice based. All graduate level course work will build on a teacher's elementary school classroom experience.

In order to receive an Elementary Mathematics Add-On License, an applicant must:

- Have a minimum of three years teaching experience (i.e., hold a Standard Professional 2 NC Teaching License).
- Successfully complete an approved Elementary Mathematics Add-On License Program-of-Study. The Program-of-Study will be developed and offered by the University of North Carolina System in collaboration with the NC Department of Public Instruction. To assure consistency of program, any university approved by the UNC System to offer the program-of-study will need to include all six courses. Credit for the six courses will be transferable among the participating UNC institutions. The successful completion of the program-of-study will require grades of B or better on all courses.
- Earn a passing grade on a comprehensive exam of their understanding of mathematics fundamentals for the teaching of elementary mathematics, of the process of learning elementary mathematics, and of children's mathematical thinking. The exam will draw on national models and will be aligned with challenging state academic content standards and student achievement standards and developed in consultation with core content specialists, teachers, principals and school administrators.
- Complete a portfolio that gives an overview on what the candidate has learned and how it has affected his or her teaching. Through reflection the candidate will answer the following questions: *Why did you choose these artifacts? Taken together, why are these artifacts evidence of meeting this objective? How has what you've described had an impact on students' learning?* Specific objectives to be addressed by the portfolio include:

Objective I: Content and Pedagogical Knowledge – Demonstrate advanced knowledge of the mathematical pedagogy and content appropriate for the student in certification level by:

- Exhibiting knowledge of that level and a level beyond, and exhibiting knowledge of appropriate teaching methodologies for the mathematics and students of the certification level
- Using appropriate technology to support student learning
- Using different assessment strategies that will effectively measure student learning and understanding

- d. Helping students connect the content that they are studying to their existing mathematical knowledge, to other disciplines, and to the “real” world

Objective II: Issues of Diversity – Respond effectively to difference in how students learn by:

- a. Respecting differences among students due to exceptionalities, learning styles, cultural and socioeconomic backgrounds, and gender
- b. Using different instructional strategies that take into account the different learning styles of students
- c. Employing assessments that are equitable, open, coherent processes that measure important mathematics and by which the teacher can make valid inferences of student learning

Objective III: The Teacher as a Learner – Improve capabilities and initiative to becoming more responsible for personal and professional growth by:

- a. Taking responsibility for their own learning
- b. Setting and maintaining high standards for their own learning
- c. Setting and maintaining high standards for own instructional performance
- d. “Critically reading” professional literature including current research in content, learning theories, pedagogy, and assessment

Objective IV: The Teacher as Leader – Serve as an educational leader by:

- a. Taking an active role in professional organizations
- b. Taking an active role on school advisory teams
- c. Serving as role models and mentors for less experienced teachers
- d. Working collaboratively with parents and the school community
- e. Taking advantage of community resources to enhance class instruction and student

Assuring a Scalable, Sustainable, and Successful Implementation

The UNC System will work with the NC Department of Public Instruction to design a model for implementation and support that assures that elementary school teachers in all districts will have access to the required coursework. In addition to the evaluation of the individual teachers seeking licensure described above, the program will be evaluated based on an analysis of the performance on the mathematics EOG exams of the students of the participants prior to beginning the program of study, while the participants are completing the program of study, and for three years after the program is complete.