



Transforming East Alabama Mathematics

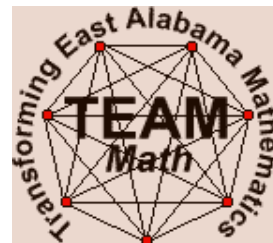
The East Alabama Partnership for the Improvement of Mathematics Education

ANNUAL TEAM-MATH PARTNERSHIP CONFERENCE PRE-SESSION

The Mathematical Education of Teachers

*Teacher Preparation Programs and Other Special Initiatives to Improve
Mathematics Education Offered by Institutions of Higher Learning*

Abstracts and Program



KELLOGG CONFERENCE CENTRE

TUSKEGEE UNIVERSITY

AUGUST 24, 2007

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PROGRAM

10:30AM – 11:00AM Registration Registration Desk

11:00AM – 11:45AM Opening and Lunch Ballroom A

11:45AM – 1:15PM Concurrent Presentations

Session I: *Issues in Elementary Education*

Moderator: Betty Senger Meeting Room A

11:45AM *Evolution of Counting and Measuring; PreK-5*
George Poole

12:15PM *JSU Prepares Teachers for Elementary School*
Rhonda Kilgo and Audria White

12:45PM *Re-Visioning Mathematics for Pre-Service Elementary Teachers*
Mary Johnson, Betty Senger, and Steve Stuckwisch

Session II: *Issues in Middle School Level and Secondary Education*

Moderator: Gayle Herrington Meeting Room B

11:45AM *New Opportunities in Secondary Teacher Preparation at JSU*
Jan Case and David Dempsey

12:15PM *Content Knowledge and Pedagogical Content Knowledge of Algebra Teachers*
Joy Black

12:45PM *Designing Measures for Assessing Teachers' Pedagogical Content Knowledge of Geometry and Measurement at the Middle School Level (Research Report)*
Agida Manizade

Session III: *School and University Collaboration to Improve Mathematics Education PK-20*

Moderator: Marilyn Strutchens Meeting Room D

11:45AM *What is Mathematics?: Teachers Exploring the Philosophy of Mathematics*
Kimberly White-Fredette and David W. Stinson

12:15PM *University and State Math Initiative Partnerships*
S. Kathy Westbrook and René Wilkins

12:45PM *Collaborative Initiatives to Improve Teacher Education*
Deborah Gober, Cindy Henning, Kenneth Jones and Brian Muse

Session IV: *Improving the Teaching of Mathematics at the Post Secondary Level*

Moderator: Gary Martin

Meeting Room E

11:45AM *New Graduate Programs for Teaching Undergraduate Mathematics*
Jim Gleason

12:15PM *How Can We Best Inform and Support Mathematicians in Teaching Mathematics
Content Courses for Pre-Service Elementary School Teachers?*
Cecilia Laurie

12:45PM *Learning from each Other Across Five Institutions: The Professional
Mathematics Educators' Forum*
Julie Cwikla

1:15PM – 1:30PM Break

1:30PM – 2:30PM Panel Discussions
Topics and Room Assignments as Above

2:35PM – 3:00PM Sharing Back / Wrap-Up / Evaluation

Ballroom A

Title: *Evolution of Counting and Measuring; PK-5*

Presenter: George Poole, Mathematics Department, East Tennessee State University

Abstract: Although I have been a member of the higher education community for 40 years, I have only been a partner with those who prepare prospective elementary teachers for six years. Following my “conversion experience” under Dr. Randy Philipp at San Diego State University six years ago, I have developed a very strong zeal and passion to learn how kids begin to build a make-sense mathematical world for themselves under the supervision of those teachers who built “their mathematical world” in a much manner. Helping kids construct their mathematical world in grades PK-3 is, in my opinion, the most difficult and awesome task of any elementary teacher. If we are going to help these PK-3 kids, we must begin helping their would-be teachers to recognize that kids are different. Kids think differently and learn differently, and that’s okay. A typical class of students in any grade will never be on the same page. These kids are at different stages of the mathematical construction process. Some kids have reached key ideas and landmarks before others. Some are adventures and rabbits, while others are artists and tortoises. It is the responsibility of those of us who teacher both pre-service and in-service teachers to make sure they are properly equipped (knowledge, attitude, professional development, manipulatives, understanding of different thought processes) to respond favorably to the different ways kids think and solve problems. This presentation is just a brief summary of the things I have learned to make sure my prospective teachers are properly equipped to create exciting mathematical learning workshops for their students.

Title: *JSU Prepares Teachers for Elementary School*

Presenters: 1) Rhonda Kilgo, Department of Mathematical, Computing, and Information Sciences, Jacksonville State University

2) Audria White, Department of Mathematical, Computing, and Information Sciences, Jacksonville State University

Abstract: Preparing early childhood, elementary education, and collaborative teaching majors to teach mathematics is a vital part of Jacksonville State University's education program. Students must pass a College Algebra course with a C or better; then, they must begin a series of classes with the goal of giving them this preparation. This sequence, Mathematical Concepts, is taught in the mathematics department by mathematics instructors. It is taught in three parts, and upon completion, students have met the requirements to be considered "highly qualified."

These courses were set up in conjunction with the JSU education department who helped determine what our students needed to become successful teachers. The standards set by the National Council of Teachers of Mathematics were used to incorporate what subject matter should be covered. This helps to prepare students for the implementation of those standards when they move into public education. These courses are taught through a combination of lecture and group work with a major focus on the use of hands-on and virtual manipulatives. It is projected that the students in these courses will soon be taking part in research activities such as the College of Arts and Sciences Research Symposium at JSU. The research and work submitted will showcase mathematics topics, such as tessellations, that are covered in the Mathematical Concepts courses.

The Mathematical Concepts sequence includes three courses: Mathematical Concepts I (MS133), Mathematical Concepts II (MS 134), and Mathematical Concepts III (MS 135). The first course focuses on problem solving, set theory, number theory, real number operations, and the historical development and structure of number systems. This course serves as a prerequisite to the other two. Mathematical Concepts II is a thorough study of geometry, measurement, and statistics as recommended by the NCTM with an emphasis on problem solving and applications. The last course in the sequence is an even further study into the NCTM recommended math content including logic, probability, principles of counting, algebraic reasoning, and representation. The last two courses can be taken in any order.

The content and instruction in these courses has been valuable for JSU students. This is another example of Educators and Mathematicians Working More Closely Together.

Title: Re-Visioning Mathematics for Pre-Service Elementary Teachers

Presenters: 1) Mary Johnson, Department of Mathematics, Auburn University

2) Barbara Senger, Department of Curriculum and Teaching, Auburn University

3) Steve Stuckwisch, Department of Mathematics, Auburn University

Abstract: For the past four years, Auburn University, along with other K-20 partners, has been involved in TEAM-Math (Transforming East Alabama Mathematics), an NSF-funded Math-Science Partnership (MSP) program. As part of this systemic effort to improve the teaching of mathematics, the departments of Mathematics & Statistics and Curriculum & Teaching have been collaborating to improve the mathematical training of pre-service elementary education teachers.

In particular, this presentation reports on the evolution of the mathematics content courses for elementary pre-service teachers and reflects on the effects observed in methods classes and internships. The following topics will be covered: 1) How the mathematics content courses fit into the elementary education major curriculum, 2) A description of the changes made to the “Mathematics for Elementary Education” courses, 3) Some examples of the change in philosophy and methods of teaching these mathematics’ classes, and 4) Observed effects in subsequent education coursework.

Title: *New Opportunities in Secondary Teacher Preparation at JSU*

- Presenters:** 1) Jan Case, Department of Mathematical, Computing, and Information Sciences, Jacksonville State University
- 2) David Dempsey, Department of Mathematical, Computing, and Information Sciences, Jacksonville State University

Abstract: This report will outline efforts by mathematics faculty at Jacksonville State University (in Alabama) to improve the academic preparation of secondary mathematics teachers. One positive outcome over the past five years has been the addition of classes to the required course of study for future teachers, including courses in statistics, combinatorics, differential equations, advanced calculus, and computer science, so that every graduate is highly qualified with a major in mathematics. A highlight of our program revision has been the design and evolution of a senior capstone course, aimed at math education majors, which includes a significant writing component. There has also been increased collaboration with education faculty, especially in the areas of academic advisement and grant-writing. A successful joint venture in in-service professional development was launched in the summer of 2005—the EMCAT program (Exploring Mathematical Concepts through Applications of Technology).

Opportunities for student research at both the undergraduate and graduate levels have also been added. Two avenues open for student participation in research activities have been used with some success and will be discussed: (1) Incorporating research requirements into existing statistics courses, and (2) Sponsoring a student research symposium. In preparation for teaching mathematics, students at JSU are required to take at least one course in statistics. A required project involves posing a research question, collecting data, describing the data graphically, performing statistical analysis, and writing an abstract and report. Students are encouraged (but not required) to submit their work to the student research competition of the Alabama Academy of Science. In addition, pre-service and in-service teachers have been frequent participants in JSU's College of Arts and Sciences Symposium, sponsored for the purpose of developing and presenting research projects that are a part of the standard curriculum and for showcasing the best student work across the disciplines.

Providing research opportunities, revising curriculum, and writing grants are examples of Educators and Mathematicians Working More Closely Together at JSU.

Title: *Content Knowledge and Pedagogical Content Knowledge of Algebra Teachers*

Presenter: Joy Black, Department of Mathematics, University of West Georgia

Abstract: To evaluate and better understand the algebraic content and pedagogical content knowledge of secondary mathematics in a Multi-District Mathematics Systematic Improvement Program (MDMSIP) in East Alabama an algebraic content knowledge instrument was developed to administer as part of the initial data collection for the MDMSIP and as a part of a dissertation study. Administration was to be done with teachers prior to their participation in two weeks of summer professional development. Items for the instrument were developed considering the types of algebraic knowledge teachers should possess. References used for the development of the instrument were the RAND report (2003), Principles and Standards for School Mathematics (2000), CBMS report (2001), the Alabama Course of Study (2003) and the MDMSIP curriculum guide (2003). The content instruments developed by the IMT project (Hill, Schilling, & Ball, 2003) were considered as the type of format for the algebra content knowledge instrument so the researcher could get an overall picture of how teachers could solve mathematics problems that arise in the classroom. A pool of items was developed and field testing conducted prior to finalizing the algebra content knowledge instrument. In addition to having teachers solve problems; the researcher was also interested in the types of explanations the participating teachers would give for their answers. For this reason a majority of the questions on the algebra content knowledge instrument asked teachers to give an explanation for their answer choices or give additional ways for solving problems beyond the traditional procedural methods. Sixty-five teachers were administered the algebraic content knowledge instrument and the researcher's analysis of the instrument included correctness of answers as well as an analysis of the types of explanations given.

Title: *Designing Measures for Assessing Teachers' Pedagogical Content Knowledge of Geometry and Measurement at the Middle School Level (Research Report)*

Presenter: Agida Manizade, Clemson University

Abstract:

Introduction

There is a great need in the field of mathematics education to create measures of teachers' knowledge used in the process of teaching content. Due to the current lack of such valid and reliable assessment tools, mathematics educators today have difficulty assessing the effectiveness of current professional development efforts. Researchers in mathematics education have difficulty with identifying and tracking the effect of teachers' knowledge on student outcomes on a large scale. In the past, different versions of Van Hiele test have been used to formally assess a large population of teachers in geometry and measurement (Mayberry, 1983; Usinskin & Senk, 1990). Although these tests are reliable measures of teachers' content knowledge, they provide little or no information on their pedagogical content knowledge (PCK).

This study sought to (a) describe the pedagogical content knowledge in geometry and measurement of teachers at the middle school level with respect to a specific mathematical strand: decomposing and recomposing in one-dimensional and two-dimensional space; (b) develop measures (in a survey format) that would allow assessment of such PCK; (c) develop the evaluation rubric of the survey; and (d) ensure the reliability of the survey. Theoretical Framework This study was conducted from a social constructivist perspective and focused on teachers' knowledge known as pedagogical content knowledge in geometry and measurement. PCK includes knowledge of students' understanding, the mathematical content and curriculum, and instructional strategies (Grossman, 1990; Shulman, 1987). In particular, researchers described a need in mathematics education research to identify measures for assessing middle school teachers' PCK in geometry and measurement (Ball, 2004; Hill, Rowan, & Ball, 2005). Such valid and reliable measures do not exist. Most recent efforts in this area of research address the mathematical content such as numbers and operations, and algebra (Hill, Schilling, & Ball, 2004; Hill et al., 2005).

In creating PCK measures the researcher considered the following assumptions:

1. Teachers' PCK implemented in instructional practice affects student achievement (Morine-Dershimer, 2001; Medley, 1987).
2. To produce usable measures of geometry teachers' PCK in geometry and measurement at the middle school level, the measures should (a) be based upon content that middle school teachers might be facing in teaching geometry and measurement, (b) produce data that allows for discrimination among teachers' capabilities to teach the content, (c) be ideologically free (not favoring any approach of teaching), and (d) be mathematically unambiguous and appropriate for grades 6 through 8 (Hill, Schilling, & Ball, 2004; Hill et al, 2005).

Methods

The Delphi methodology used in this study to design the measures of PCK accommodated for aforementioned assumptions. The method involved repeated (3 times) sampling of 20 volunteer experts (5 geometry education researchers, and 5 teacher educators, and 5 teacher leaders, and 5 expert teachers) in the field of mathematics education. Delphi methodology allowed an opportunity for experts to receive a feedback and to modify or refine their judgments based upon their reaction to the collective views of the group. To operationalize (process whereby this researcher specified empirical evidence that can be taken as indicators of PCK components) the instrument was tested on a random population of 100 middle school teachers. The qualitative analysis of data (using NVIVO) provided a composite scale representing the concept. To ensure reliability of each item on the instrument the researcher used the instrument with 100 members of a target population of teachers randomly selected then conducted a confirmatory factor analysis on the data collected from the teachers. The same process was used to ensure the reliability of the scale created during the operationalization process. The methodology used in the study aligned with social constructivist perspective of the researcher. It facilitated professional consensus and helped to increase the validity and reliability of the instrument.

Results

The final version of the instrument was designed to elicit information about a teacher's pedagogical content knowledge of geometry and measurement at the middle school level. It consisted of 10 items that included a mathematical scenarios and follow up questions for teachers. This instrument then underwent operationalization process and reliability checking. One of the items of the instrument is presented below. Ms. Wilson asked her seventh grade class to compare the areas of the parallelogram and the triangle below. Both of the shapes have the same height. Two groups of students in Ms. Wilson's class came to the correct conclusion that the areas are the same. However their explanations were different. The groups of students used the following diagrams to explain their answer:

Solution of Group 1

Solution of Group 2

Based on what you know as a classroom teacher: (a) What are some of the important mathematical ideas that the students might use to answer this question correctly? (b) Ms. Wilson is not sure that both of their explanations are correct. What do you think? Why? (c) Does either group present a mathematical misconception? If yes, what underlying mathematical misconception leads the students to this error? If no, how do these two groups of students differ in their thinking? (d) What instructional strategies and/ or tasks would you use during the next instructional period? Why?

The item listed above is an example of a typical item of the instrument created by the researcher. All 10 items of the instrument focused on a different aspect of PCK, and various mathematical ideas. As a result of the study researcher created valid and reliable instrument of teachers' PCK with respect to a specific topic in geometry and measurement.

Discussion

Valid and reliable measures of teachers' PCK in geometry and measurement will provide (a) a useful tool that might be used for the evaluation of professional development efforts in geometry and measurement, and (b) additional information for investigating links between teacher's PCK and student achievement.

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Title: What is Mathematics?: Teachers Exploring the Philosophy of Mathematics

Presenter: 1) Kimberly White-Fredette, Griffin Regional Education Service Agency

2) David W. Stinson, College of Education, Georgia State University

Abstract:

Background

Visions of effective mathematics teaching and learning are going through tremendous change (e.g., see Kilpatrick, Martin, & Schifter, 2003). The National Council of Teachers of Mathematics (NCTM) calls for changes to curriculum and evaluation (1989), teaching (1991), and assessment (1995). An accumulated summary of these changes is provided within the pages of the NCTM's *Principles and Standards for School Mathematics* (2000). The *Principles and Standards* describes a vision of mathematics education that is highly ambitious—a mathematics education that “requires solid mathematics curricula, competent and knowledgeable teachers who can integrate instruction with assessment, education policies that enhance and support learning, classrooms with ready access to technology, and a commitment to both equity and excellence” (p. 3). In general, constructivist learning, student-centered classrooms, worthwhile tasks, and reflective teaching are all a part of NCTM's vision of mathematics education in the 21st century (e.g., see Stein, Smith, Henningsen, & Silver, 2000).

To reform mathematics teaching and learning, mathematics educators need to look beyond the traditional view of mathematics as fixed and rigid, a subject of absolute truths, what Lerman (1990) termed an *absolutist* view of mathematics. In other words, constructivist teaching and inquiry-based learning demands a new view of mathematics, the *fallibilist* view, which “focuses attention on the context and meaning of mathematics for the individual, and on problem-solving processes...[and positions] mathematical knowledge...[as a] library of accumulated experience, to be drawn upon and used by those who have access to it” (Lerman, 1990, p. 56). Recent studies have explored teacher change, examining teacher beliefs and mathematical reform (e.g. see Wilson & Goldberg, 1998). This study, however, unlike many previous studies (e.g., see Fennema & Nelson, 1997), examined teachers' philosophies regarding mathematics, not simply their beliefs; it sought to understand how teachers philosophically understand mathematics and how this understanding affects their philosophies of mathematics teaching and learning and their pedagogical practices.

Purpose and Research Questions

The changes within mathematics education recommended by the NCTM are ambitious. How can teachers teach children mathematics in ways that are radically different from the ways that they were taught—in student-centered classrooms, using investigative problem-solving approaches, employing rich mathematical discourse (see Hiebert, 2003, for a discussion of “traditional” curricula and pedagogy)? How can teachers challenge traditional beliefs about mathematics as a competitive, individualistic subject that they transmit to a “chosen” few students, into a subject that is explored with all students (Stinson, 2004)? In general, do teachers ever question the philosophical basis of the subject they teach?

Mathematicians and philosophers, over the past few decades, have challenged society's perception and philosophy of mathematics (e.g., see Davis & Hersh, 1981; Ernest, 1998; Hersh, 1997; Tymoczko, 1998). These challenges have positioned mathematics as a human activity, an activity not based on rote rules and procedures, but guided by intuition, exploration, and investigation (Dossey, 1992). But this philosophy is not held consistently among mathematicians (e.g. compare Russell, 1919/1993, to Lakatos, 1976), let alone among mathematics teachers and teacher educators. The lack of a common philosophy of mathematics has serious ramifications for both the practice and teaching of mathematics; it often silences even a discussion of differing philosophies (Dossey, 1992). But, without discussing philosophy, can reform truly take hold in school mathematics? Ernest (2004) asks mathematics educators to explore five essential questions about their subject: What is mathematics? How does mathematics relate to society? What is learning mathematics? What is teaching mathematics? What is the status of mathematics education as a field of knowledge? These questions challenge educators to not only reflect on their pedagogical practices, but also to question their own beliefs about mathematics and mathematical teaching and learning.

This study examined the philosophies of mathematics held among practicing mathematics teachers (P-K–College) and describes how those philosophies develop as they participated in a graduate-level, seminar that explored the philosophical development of mathematics. Three questions guided the study: How can teachers develop an understanding of their personal philosophies of mathematics? How do these philosophies change (or not) as teachers explore the writings of various philosophers from various traditions of Western mathematics? How do these philosophies impact (or not) their philosophies of mathematics teaching and learning and pedagogical practices?

Methodology

The participants of the study were 15 graduate students enrolled in an elective, 3-credit hour, graduate-level seminar offered at Georgia State University, a large urban research university in Atlanta, GA. The 6-week seminar (summer semester 2007) was reading intensive, engaging the students in a number of philosophical writings: Davis and Hersh's (1981) *The Mathematical Experience*, Russell's (1919/1993) *Introduction to Mathematical Philosophy*, Lakatos' (1976) *Proof and Refutations: The Logic of Mathematical Discovery*, Tymoczko's (1998) *New Directions in the Philosophy of Mathematics*, and Hersh's (1997) *What is Mathematics, Really?* The focus of the seminar was to challenge teachers' conceptions of mathematics and to assist them in exploring new and different philosophies of Western mathematics and, consequently, mathematics teaching and learning. Class sessions were student centered; in that, students summarized and presented the seminar readings and facilitated the class discussions.

The participants include students who were earning a Specialist or Doctor of Philosophy degree in mathematics education. Among the participants were elementary, middle, high school, and college and university mathematics teachers, school mathematics coaches, and full-time graduate students.

[Note: The study is ongoing.]

Data collection included an initial, 3–5 page, reflective essay regarding each participant's personal philosophy of mathematics; reading journals from each participant that include written summaries of each reading during the seminar, participant-selected significant quotations from each reading, and comments regarding the participant's struggles with each reading and how it

might (or might not) assist in her or his teaching (and research); a final 8–10 page, reflective, academic essay, outlining each participant's philosophy of mathematics and positioning her or his pedagogical practices within that philosophy; and scribed notes taken during each class discussion (the scribe notes were a rotating responsibility completed by the students).

In addition, three participants were selected for two individual, in-depth interviews. The three participants were selected purposively (Silverman, 2000) among the students who were secondary mathematics teachers. The first interview was a face-to-face, semi-structured, traditional, question-and-answer interview (Hollway & Jefferson, 2000), conducted at the end of the seminar (last week of July 2007); the second interview was a narrative interview (Hollway & Jefferson, 2000), conducted 3 months after the end of the seminar. This interview asked the participants to explain how the seminar changed (or not) their pedagogical practices. The interviews were recorded and transcribed; narrative analysis (Riessman, 1993) served as the data analysis methodology.

Findings and Conclusions

[Note: We will have initial findings and conclusions to report by August 24, 2007.]

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Title: *University and State Math Initiative Partnerships*

Presenters: 1) S. Kathy Westbrook, College of Education and Mathematics Department,
University of South Alabama

2) René Wilkins, Math Specialist University of South Alabama AMSTI Site

Abstract: The goal of this session is to share the collaborative work of the Mobile site of the Alabama Mathematics, Science, and Technology Initiative (AMSTI) and the University of South Alabama's College of Education and College of Arts and Sciences.

Rene' Wilkins, mathematics specialist, Mobile AMSTI center, will be present to respond to questions about the focus and work of AMSTI. Dr. Kathy Westbrook, from the University of South Alabama will discuss the collaborative work done during the 2006-2007 year between AMSTI and University mathematics methods classes.

AMSTI is the Alabama Department of Education's initiative to improve mathematics and science K-12 teaching, primarily through professional development. With financial support of NASA, the first AMSTI center was established in 2002 and the number of AMSTI centers in Alabama has grown to eleven in 2007. Funding has become a priority of the current governor to continue this initiative supported by improved test results from practicing AMSTI schools.

Undergraduate and graduate mathematics methods classes offered by the local university are an appropriate setting to explain the purpose and scope of regional mathematics initiatives. At the University of South Alabama, methods students are informed of the resources and professional development opportunities available to them through AMSTI, and encouraged to talk to their associates and colleagues about these resources and recommended teaching practices. Furthermore, practicing teachers who have completed AMSTI's summer professional development are encouraged to become mentors to student and first year teachers.

The collaboration between the university and AMSTI has been mutually beneficial. Newly certified and practicing teachers are informed of professional development opportunities available to them and encouraged to form networks of support, mentors, and coaches among teachers who have successfully implemented standards-based teaching practices.

Title: *Collaborative Initiatives to Improve Teacher Education*

Presenters: 1) Debbie Gober, Teacher Education Department, Columbus State University

2) Cindy Henning, Mathematics Department, Columbus State University

3) Brian Muse, Mathematics Department, Columbus State University

4) Kenneth Jones, Columbus Regional Mathematics Collaborative

Abstract: All speakers have previous experience teaching high school mathematics and are currently members of the faculty at Columbus State University. They have been involved in various local, institutional, and state initiatives to improve the teaching and learning of mathematics.

Faculty in the College of Education and College of Science at Columbus State University have been working together over the last several years on various K-20 initiatives to improve the teaching and learning of mathematics. In this presentation, we will provide a brief overview of some of these initiatives and their impact on mathematics education. The initiatives that we will highlight are described below. In this presentation, we will highlight the collaboration that has made possible some of our successes in improving the teaching and learning of mathematics.

PRISM and Project SMART

The Partnership for Reform in Science and Mathematics (PRISM) is an initiative funded by the National Science Foundation designed to increase science and mathematics achievement for all P-12 students by enhancing teacher quality, raising expectations for all stakeholders, and closing the achievement gaps through the collaboration of P-16 partners. Funding from PRISM has allowed CSU to support K-20 mathematics teachers in our service region through workshops, conferences, scholarships, and the acquisition of resources for teaching mathematics.

Project SMART (Support, Mentoring, and Resources for Teachers of Mathematics) was created through a grant funded by the Calculus Consortium for Higher Education to provide support, mentoring, and resources for middle grades and secondary mathematics teachers. The program provided mentoring for mathematics teachers in their first five years of teaching and professional development for all participants. Lesson ideas and teaching strategies were exchanged through a variety of activities including monthly meetings, conferences and workshops, an e-mail network of mathematics teachers, and working with mentors.

Evaluations of activities associated with these grants have been very positive. With the implementation of the new Georgia Performance Standards (GPS), teachers are very interested in professional development focusing on the implementation of the GPS. Teachers have indicated that the professional development opportunities made possible through funding from these grants have enhanced their content knowledge and teaching.

Columbus Regional Mathematics Collaborative

The Columbus Regional Mathematics Collaborative (CRMC) is a P-16 resource center for pre-service and in-service educators. Through support from local school systems, Columbus State University, and Teacher Quality grants, CRMC has provided professional development and support to teachers in west central Georgia for the past seventeen years. The CRMC provides professional development promoting Standards-based teaching practices for P-16 teachers and works in conjunction with the COE Partner-School Network for teacher preparation and development.

Currently, the CRMC is implementing three projects funded by Teacher Quality grants that provide opportunities for elementary, middle, and high school teachers to increase their knowledge of mathematics and improve their teaching. A week-long summer camp for middle school girls, a series of Math Days at the Columbus Public Library, and lesson studies with teachers in schools will provide opportunities for teachers to test new lessons with K-12 students. These activities are designed to improve teachers' abilities to effectively implement the content and process standards from the Georgia Performance Standards in mathematics. Ongoing follow-up and support will be provided throughout the school year.

Math & Science Learning Center

Like many college and universities across the nation, there is a shortage of qualified secondary math and science teachers graduating from Columbus State University. To address this need, we have proposed the development of a Math and Science Learning Center (MSLC). The MSLC would be devoted to the recruitment and development of undergraduates interested in the fields of math and science education. The MSLC would be a venue for pre-service teachers and campus instructors to collaborate and participate in professional development activities, to develop a social and academic support network, and to provide academic support for math and science courses. We believe the creation of the MSLC will support the recruitment and retention of students, expand current tutorial services, and enhance existing programs.

The MSLC will provide:

- ❖ **Collaborative opportunities** to integrate math and science learning and teaching through resources and demonstrations that utilize a model lab and encourage integration of lessons that access the existing Centers of Excellence.
- ❖ **A library** of pedagogical materials, including videos on best practices, lab materials, current technological tools and mathematical manipulatives.
- ❖ Opportunities for all math and science majors (education and non-education) to engage in **pre-teaching instructional experiences** including tutoring, group study sessions, etc.
- ❖ Resources on **scholarships, grants, and fellowships**, particularly those that would focus on underrepresented groups.
- ❖ A social support network, including **student organizations** affiliated with the National Science Teacher Association and the National Council of Teachers of Mathematics.

ECE Math Courses

In the fall of 2000, Columbus State University began requiring all Early Childhood Education majors to take 12 hours of mathematics beyond the core. The four required mathematics courses were developed jointly by faculty in the College of Education and College of Science. During the past two years, these courses have been revised and aligned with the new Georgia Performance Standards. The courses focus on numbers and operations, algebra, geometry and measurement, and data analysis and probability. Pre-tests and post-tests are being administered in these courses to help determine their impact on prospective teachers' content knowledge. The *Learning Mathematics for Teaching (LMT)* instruments are being used for the pre- and post-tests and a faculty member in the Mathematics Department has been trained to analyze the data from these instruments. Preliminary analysis of pre- and post-test data indicates a gain in content knowledge of prospective teachers taking the four mathematics courses. These findings are supported by prospective teachers' strong performance on the Georgia Assessment for Certification of Educators test. The number of CSU students passing the GACE Test II for Early Childhood far exceeds the state pass rate.

Title: *New Graduate Programs for Teaching Undergraduate Mathematics*

Presenter: Jim Gleason, Department of Mathematics, University of Alabama

Abstract: In an effort to improve teaching at colleges and universities throughout the southeast, the Department of Mathematics at The University of Alabama has created new graduate programs to prepare individuals to teach in mathematics departments at community colleges, four-year colleges, or universities. The Master's degree program can be completed in less than two years as a full time student, or three years taking courses part time in the evenings and during the summer. Following completion of the Master's program, students would be able to complete their Ph.D. in two additional years as a full time student.

During the 20-minute talk, I will discuss this program and answer questions from the participants.

Title: *How Can We Best Inform and Support Mathematicians in Teaching Mathematics Content Courses for Pre-Service Elementary School Teachers?*

Presenter: Cecelia Laurie, Department of Mathematics, University of Alabama

Abstract: The term “professional development” has been used to describe growth and change for teachers in schools but not so often for faculty at colleges and universities. The role of a faculty instructor in content courses for pre-service teachers is very similar to the role of a math teacher. We have found that the challenges and tensions are comparable. In particular, the use of new curriculum materials has created an opportunity for promoting faculty learning, supporting faculty practice and expanding faculty mathematical knowledge for teaching.

The RAND mathematics study panel (RAND, 2003) proposes a program of research and development in mathematics education to achieve mathematical proficiency for all students. The first strand of this program focuses on the mathematical knowledge required for teaching mathematics and the key resources needed to use that knowledge in teaching (p.15). Mathematicians like H. Bass (2005) recognize that this type of knowledge is not known by many mathematically trained professionals, such as, research mathematicians (p. 429). For most elementary teachers, their mathematical knowledge comes from the content courses taken in college, taught by mathematicians who are not always familiar with the specialized mathematical knowledge required for teaching. This gap shows the clear need for mathematicians and mathematics educators to explore deeply the meaning, development and use of this knowledge in teacher preparation.

The questions to be explored in this session are: What are effective ways to bridge the aforementioned gap? How can we best inform, support and engage faculty in teaching mathematics content courses for pre-service elementary school teachers? We will present results from qualitative research based on interviews and engage participants in discussion of the issues.

A total of thirteen faculty, instructors, and graduate students from the University of Alabama and Auburn mathematics departments were interviewed. Both mathematics departments redesigned the mathematics content courses for pre-service elementary teachers approximately 3 years ago. Each person interviewed had taught the redesigned courses. The interview questions began with general perception questions: *Describe what you believe to be the purpose/philosophy for courses for pre-service elementary teachers; Describe some ways to help you reach those goals; What influenced your perception of or development of your response to the previous question? How has it developed further from teaching the courses?; How did you prepare for teaching these courses for the first time? What was or might have been helpful? How was it helpful? Why?; What was helpful to you as you were teaching these courses? How was it helpful? What else could have been helpful?; How would you describe your experience in teaching these courses?.* The interview continued with more specific questions about supports.

The presentation will center on the varied perceptions of the purpose/philosophy of the pre-service mathematics content courses, what influenced these philosophies, and how the philosophies informed subsequent responses to interview questions. The ultimate goal is to

explore the implications of this research in designing effective “professional development” for mathematicians teaching mathematics content courses for pre-service elementary teachers.

Bass, Hyman (2005). Mathematics, mathematicians, and mathematics education. *Bulletin of the American Mathematical Society*, Volume 43, No. 4, 417-430

RAND Mathematics Study Panel (2003), *Mathematical Proficiency for All Students*. Science and Technology Policy Institute, RAND Education

Note: Our work at the University of Alabama during the last several years has been a collaboration between the Department of Mathematics (two mathematicians, Dr. Cecelia Laurie and Dr. Wei Shen Hsia) and the Teacher Education Program in the College of Education (one mathematics educator, Dr. Cristina Gomez). When we started our work, there was only one math content “grab-bag” course specifically for elementary school mathematics at the University of Alabama. Based on results from research available and recommendations of national organizations (such as NCTM and the CBMS Mathematical Education of Teachers report (2001)), we developed three mathematics courses designed specifically for pre-service elementary teachers (along with developing some curriculum materials). The need to involve other mathematicians in teaching the courses led to consideration of the need to inform and support faculty in the process of understanding specialized knowledge for teaching elementary mathematics. We have done this through short general information faculty workshops, a more intensive three day workshop focusing on the number and operations course, and intensive mentoring of faculty teaching the courses for the first time.

Title: *Learning from Each Other Across Five Institutions: The Professional Mathematics Educators' Forum*

Presenter: Julie Cwikla, Department of Mathematics, University of Southern Mississippi

Abstract: The National Council of Teachers of Mathematics and the National Science Teachers Association advocate professional teaching standards that support learning environments that are contextual and meaningful for the learner, are student-centered, and involve the learner as an active participant in their education. The empirical data that support these recommendations are not only applicable to the K-12 environment but also to higher education and undergraduate studies. However, little empirical data have accumulated to guide the professional development for faculty members in higher education and how they might learn to teach to these Standards. This session will (1) detail an ongoing five year project that involves five institutions in Mississippi to provide support for the professional development of mathematics faculty in higher education and (2) allow for the exchange of ideas about professional development in higher education.

Long-term retention and understanding for undergraduate students are most likely to develop from student-centered, question-generating exercises (King, 1992) and inquiry based learning in the collegiate classroom. An interview study of university students further supports student-faculty interactions as critical for student learning, concluding that for students' learning, meaningful classroom interactions with the professor ranked as one of the six most important classroom features (Clarke, 1995). However, in a study of university faculty and the stresses in their profession, "interactions with students" were found to be one of the facets of their profession that brought about the most angst (Gmelch, Wilke, & Lovrich, 1996).

Sherman, Armistead, Fowler, Barksdale, & Reif (1987) describe a four-step developmental process faculty members undergo as they improve their teaching. Faculty members begin by simply presenting information to their classes in the first stage. It is not until the fourth stage that the faculty member can facilitate a classroom that involves meaningful interactions between the students, the content, and themselves. Based on these findings it is likely that there are many undergraduate students who are dissatisfied with their university courses because (1) faculty might have limited interactions with students and (2) it is not until the fourth stage of faculty development that their teaching reaches a level to incorporate meaningful classroom interactions with the student and content.

Universities and teachers' colleges nationally are concerned about elementary mathematics teacher preparation. These students in general are not exceptionally strong mathematically (Ball, 1990; Post, Cramer, Harel, Kieren, & Lesh, 1998; Silver, & Stein, 1996) and in most cases did not learn K-12 mathematics in a standards-based environment. But these future teachers will be expected to facilitate a reform-minded mathematics classroom. Therefore, it is the task of the preservice program and this project's Professional Mathematics Educators' Forum (PME) to help future teachers shift their views about mathematics learning as well as extend and/or correct their understanding of the content.

The faculty members (N=18) who are part of this forum called the Professional Mathematics Educators Forum (PME) are the focus of this presentation. The eighteen faculty members'

educational backgrounds vary from masters level mathematicians and computer scientists to doctorates in mathematics education. These faculty members' classroom practice is not uniform in the group, varying from traditional lecture format to student-centered group investigation. Similarly their beliefs about teaching and learning vary widely. Their beliefs and current practice are being monitored and used as a lens to examine their reactions and reflections on Standards based practice, the ways they analyze and then use K-8 video excerpts in their mathematics education courses, and how they learn from watching classroom videos of other PME members. Despite their differences, they are all serving the same student population, future K-8 teachers, and share a common language.

I am attempting to partially answer the global questions: How can faculty in higher education develop a better rapport with their students and better serve them as learners in a Standards based learning environment? This National Science Foundation Early CAREER funded project is exploring this question by fostering a professional learning community that will help faculty members: (1) be more attentive to their students' understanding of the content, (2) provide a more inquiry based learning environment for undergraduate students, and (3) better address the learning needs of their undergraduate students. The PME educators are discussing the parallels between their practice and the local elementary teacher, and beginning to understand the multiple nests within the educational frame. Several faculty members are also making strides with regard to content "coverage" and beginning to collaboratively design activities that incorporate several concepts in greater depth than their previous lecture and practice format.

The professional experiences and growth of the mathematics faculty members in the PME will be shared during this presentation. It is hoped this session will provide a presentation and discussion of insights from this study and others in the audience to elaborate issues and constraints unique to professional development in higher education.

Session Timetable

1. Five year project overview & background information– 5 minutes
2. Professional development for mathematicians, data collection, and analyses – 10 minutes
3. How the findings are informing changes in our practice with the PME and in the classroom and group discussion – 5 minutes

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