May 6, 2005

MEMORANDUM

TO: Edna Szymanski
    Dean, College of Education

FROM: Victor Korenman
    Associate Provost for Academic Planning and Programs

SUBJECT: Proposal to Modify the Curriculum of the M.Ed. Specialization in Mathematics Education in Curriculum and Instruction (PCC Log No. 04086)

At its meeting on May 6, 2005, the Senate Committee on Programs, Curricula, and Courses approved your proposal to modify the curriculum of the M.Ed. specialization in Mathematics Education in Curriculum and Instruction. A copy of the approved proposal is enclosed.

The changes are effective immediately. The College should ensure that the new requirements are fully described in the Graduate Catalog and in all relevant descriptive materials, and that all advisors are informed.

VK: sfm
Enclosure
Cc: Dr. Sylvester Gates, Chair, Senate PCC
    Dr. Mary Giles, University Senate
    Ms. Barbara Hope, Data Administration
    Dr. Stephen Koziol, College of Education
    Dr. Phyllis Peres, Undergraduate Studies
    Ms. Anne Turkos, Archives
    Dr. Donna Wiseman, College of Education
    Dr. Scott Wolpert, College of Computer, Mathematical and Physical Sciences
    Dr. Linda Yokoi, Records & Registrations
THE UNIVERSITY OF MARYLAND, COLLEGE PARK
PROGRAM/CURRICULUM PROPOSAL

DIRECTIONS: Provide one form with original approval signatures in lines 1 - 4 for each proposed action. Keep this form to one-page in length. Forms and appropriate attachments should be submitted to the Office of Academic Affairs, who will assign a Log Number to each proposal. Also submit an electronic version of as much of the proposal as is possible.

DATE SUBMITTED __March 29, 2005__

PCC LOG NO. 04086

COLLEGE/SCHOOL __Education__

DEPARTMENT/PROGRAM __Curriculum and Instruction__

PROPOSED ACTION (A separate form for each) ADD _____ DELETE _____ CHANGE ___X___

DESCRIPTION (Provide a succinct account of the proposed action. Details should be provided in an attachment. Provide old and new sample programs for curriculum changes.)

Modify the Curriculum of the EDCI M.Ed. Specialization in Mathematics Education. Create a new emphasis in Middle School Mathematics Teaching and Learning

JUSTIFICATION/REASONS/RESOURCES (Briefly explain the reason for the proposed action. Identify the source of new resources that may be required. Details should be provided in an attachment.)

See attached.

APPROVAL SIGNATURES

1. Department Committee Chair ___________ [Name] ___________ [Signature] ___________ [Date] 4/10/05
2. Department Chair ___________ [Name] ___________ [Signature] ___________ [Date] 4/13/05
3. College/School PCC Chair ___________ [Name] ___________ [Signature] ___________ [Date] 4/27/05
4. Dean ___________ [Name] ___________ [Signature] ___________ [Date] 4/27/05
5. Dean of the Graduate School (if required) ___________ [Name] ___________ [Signature] ___________ [Date] 4/27/05
6. Chair, Senate PCC ___________ [Name] ___________ [Signature] ___________ [Date] 05/06/05
7. Chair of Senate ___________ [Name] ___________ [Signature] ___________ [Date] 05/06/05
8. Vice President for Academic Affairs & Provost ___________ [Name] ___________ [Signature] ___________ [Date] 05/06/05

VPAAP Rev. 3/1/04
EDCI M.Ed. with Specialization in Mathematics Education
New Emphasis Proposal: Middle School Mathematics Teaching and Learning

Description:
The proposed emphasis in Middle School Mathematics Teaching and Learning would be an option in the current M.Ed. in Curriculum and Instruction with specialization in Mathematics Education (M.Ed. in Math Ed). The current M.Ed. in Math Ed is a 30 credit program that offers two emphases: one for secondary or high level mathematics teachers and one for elementary school teachers. This proposed third emphasis in Middle School Mathematics Teaching and Learning is also a 30 credit program and builds on the three courses in mathematics education and one research methods course, which are common requirements in the existing emphases. It requires three content courses in mathematics. These are curriculum-relevant studies in mathematics for middle school teachers; Algebra and Statistics and Data Analysis as outlined in the Maryland voluntary curriculum are assessed formally at the end of the Algebra I course; Geometry is assessed at the end of the Geometry course. The Algebra and Geometry content courses in the proposed program emphasis are adaptations of courses that the Mathematics Department has offered for certified teachers previously; the Statistics and Data Analysis course will be developed along similar design principles. The proposed emphasis also requires three content-pedagogy integrated courses, which will be newly developed courses offered initially under a special topics number, EDCI 688. Each of these three courses is being designed by EDCI math educators directed by Dr. Jim Fey with cooperation from Mathematics Department faculty and MCPS math education supervisors to provide an in depth treatment of the content topics in the middle school mathematics curriculum and the associated pedagogy to support student learning of those topics.

Rationale and Explanation

In the State of Maryland, teachers of subject areas such as mathematics at the middle school level may have attained their certification in elementary education (k-8) or secondary education (7-12). Most teachers certified in secondary mathematics in fact teach at the secondary level, meaning that most teachers teaching mathematics at the middle school level have elementary certification. Few of those had concentrations or majors in mathematics or substantial background in mathematics education as part of their initial certification studies. Moreover, mathematics content such as Algebra I and Geometry, which in the past were conceptualized as high school courses, are increasingly taught as part of the middle school curriculum, with high stakes end of course examinations. Montgomery County Public Schools sought out a partnership with UMCP Department of Curriculum and Instruction and Department of Mathematics aimed at addressing the serious need for highly qualified mathematics teachers at the middle school level. The target for this proposed M.Ed. emphasis within the specialization in Mathematics Education are middle school teachers who need additional studies in mathematics education and mathematics to become highly qualified and who want to obtain a master’s degree; these are teachers already certified in elementary education or special education. Such an emphasis is responsive to the needs in Montgomery County and forms the basis for a partnership agreement with MCPS; this emphasis is also useful for responding to the needs of other local school districts as well.

The architecture of this proposed track is based upon design principles drawn from research on effective teacher development for experienced teachers. First, candidates’ studies begin with an intensive consideration of the content and the instruction needed to meet the demands of the current curriculum; initial experiences are thus situated in the immediate and real work of the middle school teacher. Second, these curriculum-situated studies are enhanced by advanced studies in mathematics education which extend the candidates’ understanding of
broader curriculum issues, learning perspectives, assessment perspectives, and methodological perspectives and advanced studies in mathematics that deepen candidates’ understanding of topics in the content area beyond the basic needs for a specific curriculum or class. Third, candidates work together in cohorts from the onset of the program to build peer support and a professional community that extends beyond the classroom of the courses and the program. Fourth, the design sequences experiences coherently to support growth and development; the courses are offered in clusters of three grouped around the primary content area, with the initial course being the one situated in the content and pedagogy of the current curriculum and the second and third building on professional and academic knowledge respectively. Fifth, the design schedules experiences across time to provide practicing teachers with realistic opportunities to study and learn while continuing to be full time middle school teachers.

See below for details of the curriculum plan

Staffing: The initial offering of this track will be as an off-campus option at the Shady Grove facility. Staffing for EDCI courses will come from: (1) regular faculty teaching on overload, or (2) non-tenure stream lecturers, currently either full time or part time in EDCI, with the cost coming from tuition revenue from the program; these individuals either have doctorates or advanced degrees with extensive experience in mathematics and mathematics education. Staffing for Mathematics Courses will come from faculty or lecturers in the Mathematics Department or other qualified individuals selected by the Mathematics Department; costs will come from tuition revenue from the program. Staffing for the EDMS course will come from faculty or lecturers in the EDMS Department, as determined by that Department; costs will come from tuition revenue from the program.

The Dean of the College of Education and the Dean of the College of Computer, Mathematical and Physical Science have committed funding for the support of the course development and coordination/communication costs leading up to the start of the proposed emphasis option. For the initial cohort of MCPS teachers, which will be an off campus program option, all operating and instructional costs are expected to be covered through tuition revenue. There is no anticipated need for new campus resources to support the implementation of this initiative.

Management: Oversight for this program option will be with a senior faculty member in the EDCI Mathematics Education Program, Dr. Daniel Chazan. Dr. Chazan will be advised by a steering committee, which will include himself, one representative from the Mathematics Department and one representative from MCPS mathematics instructional unit. The Steering Committee will meet at least once per semester to review progress, make policy and procedures recommendations, and guide program assessment data collection for this initiative. These recommendations and findings are reviewed by the EDCI Mathematics Education Program Area faculty, with subsequent review and action by appropriate committees as necessary and appropriate. Formal staffing assignments are made by the respective Department Chairs based upon recommendations from the Steering Committee. Reviews of portfolios and research/inquiry papers will be carried out by the EDCI Mathematics Education Program Area faculty according to procedures already in place for other M.Ed. candidates.
M.Ed. in EDCI: Mathematics Education Specialization – Proposal for an emphasis in Middle School Mathematics Teaching and Learning

3/08/05

Intended Audience: middle school teachers of mathematics whose certification is in elementary education or special education and who need an advanced degree that supports their identification as High Quality Teachers of mathematics at the middle school level

Start Date: Summer of 05

Degree: M.Ed. in EDCI – specialization in Mathematics Education, 30 credits minimum for Degree

Degree Framework

The current M.Ed. in EDCI with specialization in Mathematics Education provides the framework for the proposed new track. The current program requires a minimum of 30 credits including:

- Math Ed courses – minimum of 9 credits, including EDCI 650
- Research Methods - EDMS 645 or appropriate substitute – 3 credits
- Electives in Education or Mathematics - 18 credits
  Note: at least 15 credits must be at the 600 level or above

The current M.Ed. in EDCI with specialization in Mathematics Education supports two emphases/Tracks, one for teacher of secondary or higher level mathematics and one for elementary teachers.

The curriculum framework for the Middle School Mathematics Teaching and Learning emphasis requires a minimum of 30 credits; admissions and other requirements remain the same as the current program. This new emphasis has the following requirements:

Mathematics/Mathematics Education Integrated Courses - 3 courses, 9 credits

These are curriculum-referenced courses in mathematics education that focus on the content taught as part of that curriculum and the design, pedagogy, and student learning issues associated with the effective implementation of the courses. These would be offered at the 600 level as special topics courses. For the initial cohort aimed at serving the EDCI-MCPS Partnership, these new courses are being developed jointly by EDCI-Math Ed faculty and Math Department faculty with consultation from MCPS. These courses assume completion of undergraduate degrees and teaching experience at the middle school. As a result, these courses can treat issues of teaching and learning with far greater rigor and specificity than is possible with pre-service candidates who have no classroom experience. Course activities include analyses of student learning, examination of implemented lessons, and curriculum analyses. These activities make use of the enrolled teachers’ classrooms as important sites for teacher learning.

Mathematics Courses (related to Integrated courses) - 3 courses, 9 credits

These are three content courses that are intended to deepen the middle school teacher’s understanding of the subject matter beyond that specific to a particular middle school level course of study. Two of the courses, the one on Algebra and the one on Geometry, will be adaptations of courses offered by the Mathematics Department for classroom mathematics teachers previously; the third course, Statistics and Data Analysis, is under development. They will be offered at the 400 level.
Mathematics Education Curriculum and Pedagogy – 3 courses, 9 credits

These are courses on issues, assessment and curriculum that are part of the M.Ed. Program in Mathematics Education and in which the candidates will study positions and review theory and research that helps them see themselves in relation to the broader field of mathematics education.

Research/Inquiry Methods – 1 course, 3 credits

This course provides for the foundations in quantitative and/or qualitative inquiry and analysis and engages the candidate in the completion of a classroom-based inquiry project. This is the same as the current program.

Other Requirements: comprehensive exam or professional portfolio

One research/inquiry seminar paper
Curriculum Schedule for the EDCI-MCPS Partnership Cohort

This curriculum schedule has been designed to provide for a coherent sequence of studies spread across years to support professional and academic development for middle school teachers in mathematics education. Studies are clustered around the three main content topic areas in the mathematics curriculum during the middle school years.

Summer 05: 6 credits
- EDCI 688a – 3 credits  Teaching and Learning Algebra in the Middle School
- EDCI 650 – 3 credits  Trends in Mathematics Education

Fall 05: 3 credits
- Math 498a – 3 credits  Algebra for Middle School Teachers

Spring 06: 3 credits
- EDCI 688b - 3 credits  Teaching and Learning Statistics and Data Analysis in the Middle School

Summer 06: 3-6 credits
- Math 498b - 3 credits  Statistics and Data Analysis for Middle School Teachers
- EDMS 645 or EDCI 685 or EDCI 698 - Research Methods/Inquiry course – 3 credits (option for this semester)

Fall 06: 3 credits
- EDCI 657 – 3 credits  Understanding and Engaging Students’ Conceptions of Mathematics

Spring 07: 3 credits
- EDCI 688c – 3 credits  Teaching and Learning Geometry in the Middle School

Summer 07: 6 credits
- EDCI 654 – 3 credits  Assessing Mathematical Understanding
- Math 498c – 3 credits  Geometry for Middle School Teachers

Fall 07: Research Methods/Inquiry course – 3 credits, if not taken previously.
This masters program is designed to help a student audience with little advanced mathematical training, but experience in teaching, gain both mathematical and pedagogical expertise that will enable them to teach elementary high school level mathematics. The courses in this program have been designed with this audience in mind, as well as the recommendations and practices of groups like the Conference Board of the Mathematical Sciences (with their Mathematical Education of Teachers document), the Educational Testing Service (with their Middle Grades Praxis II exam), the National Board for Professional Teaching Standards (with their guidelines for Middle Grades Mathematics Teacher Recognition), the State of Maryland (and its voluntary state curriculum), as well as Montgomery County (with its county curriculum). The eighteen-month process of designing these courses and their role in the program has involved the county curriculum leadership of Leah Quinn and Theresa Cepitis, the Mathematics Department with representation of Scott Wolpert, Denny Gulick, and Mike Fitzpatrick, and the Department of Curriculum and Instruction with representation of Steve Koziol, Daniel Chazan, Aisling Leavy, and Jim Fey (one of the authors of CBMS’s MET document).

As is suggested by the CBMS:

"Teachers need mathematics courses that develop a deep understanding of the mathematics they will teach. The mathematical knowledge needed by teachers at all levels is substantial, yet quite different from that required by students pursuing other mathematics-related professions." (2003, Recommendation 1).

This recommendation guides many of our choices in designing the program and coursework outlined in these documents. Teachers’ mathematical knowledge is expanded both through explicit instruction in mathematics, as well as curriculum related courses focused on issues of teaching and learning.

Below are descriptions of all of the courses that will be used in this emphasis area. Descriptions of existing courses are brief. Supporting documents for courses being developed to support this track are more extensive.

EDCI 688a – 3 credits Teaching and Learning Algebra in the Middle School

When they meet abstract mathematics, like the symbols x and y in school algebra, students often ask seemingly naive questions like “What is algebra and why is it important?” “Why is a negative times a negative a positive?” and more. The ideas of algebra pose predictable cognitive obstacles for many students. Teachers need to know about these obstacles, to have thought about these questions, and to have knowledge and strategies that will help them with their students. Course goals include gaining: enhanced understanding of the mathematics of school algebra, insight into the critical learning challenges that algebra students face, understanding of various pedagogical models for teaching school algebra, and skill in applying knowledge about mathematics teaching and learning to lesson planning and classroom practice. Course activities include: analyses of cases of student learning, lesson study of an implemented lesson, and curriculum analyses.

This course will enhance the pedagogical and content knowledge in algebra of elementary certified teachers. Topics whose learning challenges and instructional strategies will be covered include:
• Solving linear and non-linear (polynomial, rational, and exponential) equations, inequalities, and systems of equations and inequalities.
• Equations, formulas, and identities: Different sorts of mathematical statements and how they form parts of school algebra
• Variables, Unknowns, and Parameters: Different uses of letters in school algebra
• Naming, Identity, and Comparison, rather than a sign to operate: The equal sign in school algebra as opposed to school arithmetic
• Modeling with algebraic equations: What can and cannot be accomplished
• Learning to write with symbols
• What your calculator can and cannot do, how it does what it can do, and how you can use this in the classroom

A draft syllabus is provided in Appendix A.

EDCI 650 – 3 credits   Trends in Mathematics Education

This course focuses on recent developments in educational thinking and practice that have affected the curriculum in mathematics. Students will have an opportunity to examine the National Council of Teachers of Mathematics Principle and Standards documents. For the purpose of the MCPS cohort partnership, the course will focus especially on developments at the middle grades.

Math 498a – 3 credits Algebra for Middle-School Teachers

"Algebra for Middle-School Teachers" is designed to discuss in some depth the mathematics that relates to the subject of algebra as it is taught in the schools, so that algebra teachers will be able to understand the concepts well enough so that they can teach the subject with confidence and can address potential student misconceptions and answer relevant student questions. The course begins with an introduction to the usual decimal, real-valued number system and a comparison with the complex number system. The second basic topic concerns the notion of function, with discussions of different interpretations (both analytic and geometric) of functions, special features of functions, and various famous examples of functions. A draft syllabus is provided in Appendix B.

EDCI 688b  – 3 credits Teaching and Learning Statistics and Data Analysis in the Middle School

Statistics and Data Analysis are newer content in the school mathematics curriculum, and many elementary certified teachers have themselves had little opportunity to study this material, yet arguably this content is some of the most important content in school mathematics. To be a literate consumer and member of our society, it is useful to understand statistical reasoning and be able to read representations of statistical information. In this course, teachers will be able to explore ways to ask statistical questions of comparison and will learn how to use techniques to answer statistical questions. They will also learn about difficulties students have as they engage statistical thinking that is in some ways quite different from other mathematical thinking. This course will enhance the pedagogical and content knowledge of elementary certified teachers. Topics whose learning challenges and instructional strategies will be covered include:

• Methods for representing data
• What do descriptive statistics describe
• Comparing samples of unequal size using measures of central tendency
• Other ways to compare samples of unequal size
• How to lie with statistics
• Statistics and Proportional Reasoning
• Working on algebra through statistics and vice versa
• What your calculator can and cannot do and how that can be valuable

Math 498b – 3 credits – Statistics and Data Analysis for Middle-School Teachers

"Statistics and Data Analysis for Middle-School Teachers" is designed to discuss in some depth the mathematics that relates to the subject of statistics and data analysis as it is taught in the schools, so that teachers will be able to understand the concepts well enough so that they can teach the subject with confidence. Material will include: tests of statistical hypotheses; applications to before-and-after and matched pair studies; events, probability, combinations, independence; binomial probabilities, confidence limits; random variables, expected values, median, variance; tests based on ranks; the law of large numbers, normal approximation; and estimates of mean and variance.

EDMS 645 or EDCI 685 - Research Methods course – 3 credits (option for this semester)

EDCI 657 – 3 credits Understanding and Engaging Students’ Conceptions of Mathematics

This course reviews research related to K-14 students' common errors in and (mis)understandings of mathematics. It also indicates instructional strategies useful in building on errors and amending students' conceptions. For the purpose of this program, the course will focus on middle school students’ conceptions of number.

Algebra for Middle School Teachers

EDCI 688c - 3 credits Teaching and Learning Geometry in the Middle School

The study of Euclidean geometry has been a part of schooling since its inception in the United States. Geometry is where students first are expected to reason rigorously and to justify their mathematical assertions in some approximation of the ways in which mathematicians reason. In order to be effective with their students, teachers who will teach students to reason in the context of Euclidean geometry need both an in-depth understanding of this subject matter, as well as understandings of the difficulties this sort of reasoning may pose to their students. This course will provide elementary certified teachers with opportunities for in-depth engagement with geometrical reasoning, as well as opportunities for pedagogical conversations about the teaching of reasoning and proof. This course will enhance the pedagogical and content knowledge in geometry of elementary certified teachers. Topics whose learning challenges and instructional strategies will be covered include:

• Comparisons of shapes: Congruence, Similarity, Equal Areas and Perimeters
• Pictures, diagrams, constructions, and dynamic constructions: Different images in the geometry classroom
• Dynamic construction programs: Their characteristics and pedagogical utility
• Conjecturing: What is it and how do we help students do it
• Empirical and Deductive argumentation: Differences between them and their respective roles in geometry instruction
EDCI 654 – 3 credits – Assessing Mathematical Understanding

This course is premised on the notion that assessment viewed as an ongoing part of instruction. In the course, students will have opportunities to learn techniques of assessing K-12 students’ understanding of mathematics - including standardized tests, but focusing on alternative forms such as individual interviews, writing tasks, performance tasks, portfolios.

Math 498c - 3 credits Geometry for Middle-School Teachers

"Geometry for Middle-School Teachers" is designed to discuss in some depth the mathematics that relates to the subject of geometry as it is taught in the schools, so that geometry teachers will be able to understand the concepts well enough so that they can teach the subject with confidence. The course begins with axiom systems in geometry, including the usual Euclidean geometry as well as other geometry systems. Early in the course the notion of proof and reasons for proof are examined. A draft syllabus is provided in Appendix C.
Appendix A: EDCI 688a Teaching and Learning Algebra in Middle School

Prerequisites: Admission to UM-MCPS Middle School Mathematics Partnership or permission of department.

This course will enhance the content and pedagogical knowledge in algebra of middle school mathematics teachers by focusing on learning challenges and instructional strategies relevant to school algebra topics. Topics whose learning challenges and instructional strategies will be covered include:

- Solving linear and non-linear (polynomial, rational, and exponential) equations, inequalities, and systems of equations and inequalities.
- Equations, formulas, and identities: Different sorts of mathematical statements and how they form parts of school algebra
- Variables, Unknowns, and Parameters: Different uses of letters in school algebra
- Naming, Identity, and Comparison, rather than a sign to operate: The equal sign in school algebra as opposed to school arithmetic
- Modeling with algebraic equations: What can and cannot be accomplished
- Learning to write with symbols
- What your calculator can and cannot do, how it does what it can do, and how you can use this in the classroom

Course Goals

When mathematics teachers have responsibility for a middle or high school course like Algebra or Geometry, their work is usually guided and assisted by resources including curriculum guides, student textbooks, teaching guides, and test item banks. They often have access to technology like calculators and computers and concrete instructional materials. However, even with the best of print, electronic, and hands-on teaching resources, effective teaching requires creative and thoughtful use of those materials in response to the challenges of guiding learning by diverse groups of students.

Students often ask seemingly naïve questions about mathematics. They want to know answers to broad questions like “What is algebra?” and “Why is algebra important?” and to specific puzzling aspects of the subject like “Why is negative times negative positive?” and “Why does 0.3333… = 1/3?” Of course, teachers need to have their own answers to these types of questions, but perhaps more importantly they need to be able to respond to such questions as mathematical questions that indicate how their students are learning. A number of key ideas in algebra pose predictable cognitive obstacles for many students, like the transition from use of letters to represent unknowns in equations like 3x+5 = 17 to the use of letters to name variables in formulas like \( d = rt \). To address such obstacles, strategies for effective use of teaching tools like calculators and hands-on manipulatives are not always obvious.

Teachers who can help students resolve the puzzles that occur in their attempts to learn algebra need deep understanding of the subject and its uses as well as its place in the K-
mathematics curriculum. They need deep understanding of the psychological principles that explain learning of mathematical ideas and skills, and they need a repertoire of effective strategies for teaching. Teachers begin developing this knowledge of mathematics for teaching in teacher preparation coursework (content and methods), in their early field experiences and internship training, and in their first years of full classroom responsibility. However, truly professional teachers continue development of knowledge and practical expertise throughout their careers, especially when they are preparing to take on new teaching responsibilities.

The goal of the teacher education and professional development programs at the University of Maryland is to prepare reflective practitioners for classrooms of diverse learners through research-based inquiry into practice. This course focused on the teaching of algebra is designed to enhance the pedagogical and content knowledge of middle school mathematics teachers. The course provides students training in mathematics for teaching, and exposure to the research literature on student understanding, assessment, and pedagogical strategies. Students are required to read, investigate and report on mathematics curricula and materials related to algebra, important algebraic concepts and skills, and the development of student understanding in algebra.

Course Objectives

- To gain enhanced understanding of the mathematics of school algebra
- To gain insight into the critical learning challenges that algebra students face
- To gain understanding of various pedagogical models for teaching school algebra
- To develop skill in applying knowledge about mathematics teaching and learning to lesson planning and classroom practice

Course Activities to Attain Objectives

To develop understanding of key challenges in teaching algebra and a repertoire of instructional and assessment strategies for facilitating algebra learning by middle grades students, the in-service teachers in this course will engage in the following kinds of activities:

- Mathematical explorations and problem solving to enhance understanding of the big ideas, reasoning methods, and techniques of algebra;

- Mathematical analysis of common questions raised by algebra students in order to enhance teacher expertise in explaining how and why algebra works as it does;

- Analysis of curriculum materials and recommended teaching plans to identify critical learning challenges for students;

- Study of supplementary instructional resource materials to identify opportunities for enhancing teaching activities;
- Study of sample classroom video records and student work to identify productive instructional strategies and student learning difficulties;

- Analysis of technology and concrete manipulative resources for algebra teaching to identify strategies for enhancing and differentiating instruction to meet needs of students with diverse learning styles;

- Design and implementation of classroom activities that address student proficiency with algebra and address the learning needs of students.

This variety of classroom activity forms will engage the course instructors and the participating in-service teacher students in small-group and whole group problem solving and discussions. Specific course project assignments will develop the material addressed in those class sessions through out of class work and subsequent presentations. The nature of those assignments is described in the next section of the syllabus.

**Course Requirements/Projects**

1. **Case Analysis:** Analyze a case in which students are learning a new concept in algebra. After having taken time to explore the content that is addressed in the case perform an analysis of the case in terms of student learning and teacher action.
   a. Examine the way(s) in which student understandings are being developed and link this development to the activity in the scenario.
   b. Consider the teacher's actions (including initial plan for instruction, questioning techniques, and the way in which he/she responds to activity in the class). Determine what actions seem to be effective in helping students to develop conceptual understanding and those that are not effective. Make suggestions that might help develop student understanding. Use evidence from the case to support analyses and suggestions.

2. **Lesson Study:** Work in a group to develop a lesson that addresses a topic from the MCPS Algebra 1 curriculum. Technology and/or manipulatives should be used in the lesson. One person in the group will teach the lesson. As the lesson is taught, the other group members will observe. After implementation, group members will make suggestions for change that are based on observations. These changes will be incorporated into a revised lesson plan. Additional details about this assignment will be provided.

3. **Curriculum Analysis:** Develop expertise in one aspect of the MCPS Algebra 1 curriculum. Analyze curricular materials to identify key mathematics content objectives and potential student misconceptions/difficulties. Identify and evaluate useful supplementary resources. Share this research with classmates in a handout and 20 minute presentation. Additional details about this assignment will be provided.
4. Participation in class activities, completion of assigned readings, and other short assignments.

Evaluation

Final grades will be assigned based on the percentage of points earned out of possible points. The scale used in grading will reflect the following guidelines and the distribution of total point scores (i.e., persons separated by one or two points will receive the same grade). In no case will you receive a grade lower than the scale indicates.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>A</td>
<td>90-100%</td>
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<tr>
<td>B</td>
<td>80-89%</td>
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<tr>
<td>C</td>
<td>70-79%</td>
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<tr>
<td>D</td>
<td>60-69%</td>
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All major assignments (1, 2, and 3 above) will be graded according to a rubric. There will be opportunities to receive feedback from peers and instructors prior to final submission of these assignments.

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Final Copy Due Date</th>
<th>Points Possible</th>
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<tbody>
<tr>
<td>Case Analysis</td>
<td>July 11</td>
<td>30</td>
</tr>
<tr>
<td>Lesson Study</td>
<td>August 4</td>
<td>40</td>
</tr>
<tr>
<td>Curriculum Analysis (inc. presentation)</td>
<td>July 28</td>
<td>100</td>
</tr>
<tr>
<td>Participation and other assignments</td>
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<td>30</td>
</tr>
</tbody>
</table>

It is expected that papers are word processed. Punctuation, grammar, expression, and proper citation of sources are the responsibility of the author and are part of the grade on an assignment. These mechanics are expected to reflect graduate level work, i.e., meet academic standards for professional papers.

Extra credit work will NOT be accepted. Only in very exceptional cases is it possible to change a grade by repeating or correcting an assignment. Unexcused late assignments will receive reduced credit.

Miscellanea

University of Maryland courses operate under an honor code. Unless you are specifically advised to the contrary, the Honor Pledge statement should be handwritten and signed on the front cover of all papers, projects, or other academic assignments submitted for evaluation in this course. Students who fail to write and sign the Pledge will be asked to confer with the instructors.

The Honor Pledge reads:
I pledge on my honor that I have not given or received any unauthorized assistance on this assignment/examination.
Plagiarism is, unfortunately a common form of dishonesty. If you have any questions about the definition or seriousness of this, please read http://www.jpo.umd.edu/SHC/students.html


If you have a documented disability and wish to discuss academic accommodations, please contact the instructor as soon as possible.

Appendix B: Algebra for Middle-School Teachers - 4-4-05

The course "Algebra for Middle-School Teachers" is designed to discuss in some depth the mathematics that relates to the subject of algebra as it is taught in the schools. The goal is for algebra teachers to understand the concepts so that they can teach the subject with confidence and can address potential student misconceptions and answer relevant student questions. In addition to the basic concepts, there are discussions of a more theoretical nature, such as the use of calculus concepts in analyzing possible solutions to algebraic equations, and analysis of which polynomials can and which cannot be factored.

The course begins with an introduction to the usual decimal, real-valued number system, and a comparison with the complex number system. The second basic topic concerns functions: different interpretations (both analytic and geometric) of functions, special features of functions, modeling of functions from data, various special kinds of functions (including exponential and logarithm functions), creation of new functions from known functions. The next major topic involves equations, including the process of solving linear and quadratic equations, and systems of equations and inequalities. Manipulatives such as algebra tiles and cups and cubes will be incorporated into the discussion. The final major topic will involve various issues relating to divisibility of numbers and polynomials.

During the course there will be regular homework assignments, two or three exams, and two or three projects. The grade will be determined from the performance on these items.

Potential text: Mathematics for High School Teachers, by Usiskin, Peressini, Marchisotto, and Stanley, Prentice Hall, 2003. This book was the text for Math 498C during Summer 2004, and will be the text for Math 498C in Summer 2005. From the preface: "The book … [has] been used in a variety of ways, ranging from junior and senior (capstone) or graduate mathematics courses for pre-service secondary mathematics education majors to graduate professional development courses for teachers." It includes a substantial number of project-type exercises.

MAJOR TOPICS:
Number systems:
Basic operations in arithmetic and algebra
Basic properties and types of real numbers; decimal representation, rational vs. irrational, periodic and delayed-period decimals.

Complex numbers: operations, representations and graphing; De Moivre's theorem; solving quadratic equations and relation to graphing quadratic equations

Functions

Interpretations of function: ordered pair vs rule definition; ways of representing a function

Graph of a function: zeros/roots, vertical and horizontal asymptotes

Operations to create new functions: domains, composition and inverses

Creating new functions from known functions, modeling functions from data, various special kinds of functions (including exponential and logarithmic functions)

Equations and inequalities

Process of solving equations, solutions of linear and quadratic equations and systems of equations and inequalities

Deeper problem solving: mixture problems, classic box problem, rate problems, arithmetic and harmonic means

Modeling algebraic expressions and solving equations; algebra tiles, cups and cubes

Divisibility of numbers and polynomials
"Geometry for Middle-School Teachers" is designed to discuss in some depth the mathematics that relates to the subject of geometry as it is taught in the schools, so that geometry teachers will be able to understand the concepts well enough so that they can teach the subject with confidence.

The course begins with axiom systems in geometry, including the usual Euclidean geometry as well as other geometry systems. Early in the course the notion of proof and reasons for proof are examined. Then attention is drawn to "neutral geometry," which is geometry without the parallel postulate (or its negation). Much of the course is devoted to results in neutral geometry. At the end, hyperbolic geometry is introduced.

Visual images of geometric objects play an integral role in the course. Geometer's Sketchpad is used throughout the course (by the teacher and the students), as a tool for such visualization, to help formulate certain proofs, and in projects assigned to the students.


During the course there will be regular homework assignment, two or three exams, and probably three projects. The grade will be determined from the performance on these items.

Axiom Systems
Fano's Geometry
Incidence Geometry
   Axioms and consequences
   Non-Euclidean model
Euclidean geometry
   Problems with Euclid's postulates
   A modern set of postulates

Proof
   What is needed?
   How to present proof?
What is needed in a definition?
   Basic Constructions
   The parallel postulate:
      Parallel line theorems

Neutral geomtry
   Basics
   Triangle Congruence theorems
   Alternate Interior angle theorem
   The place of the parallel

Quadrilaterals
   Congruence and area

Similarity
   Similarity theorems
   Dividing line segment into n congruent pieces
   Right triangles and triangle trigonometry
   Concurrent lines, collinear points
   Ceva's Theorem, Menelaus' Theorem

Circles
   Angles and circles
   Inscribed and circumscribed polygons
   Circles and triangles, Euler line

Transformations
   Translations, rotations, reflections
   Isometries and congruence
   Dilations and similarity
   Inversion in a circle
   Analytic form

Lénárt Sphere
   Intro to spherical geometry
   Area of spherical triangle

Hyperbolic geometry
   Poincaré Disk model
   definition of area