Eastern Illinois University

New Course Proposal

Math 3420, Teaching Mathematics in Grades PreK-6

1. Catalog description

3420 MAT. Teaching Mathematics in Grades PreK-6. (2-2-2) F,S. The study of curriculum, methods, and materials for teaching mathematics in grades Pre-K through 6. Restricted to students in the early childhood, elementary, or special education curriculum. Prerequisites: MAT 1420 with a C or better, and MAT 2420G with a C or better.
   a) 3420 MAT
   b) Teaching Mathematics in Grades PreK-6
   c) (2-2-2)
   d) F,S
   e) Math Methods P-6
   f) The study of curriculum, methods, and materials for teaching mathematics in grades Pre-K through 6. Restricted to students in the early childhood, elementary, or special education curriculum.
   g) Prerequisites: C or better in both MAT 1420 and MAT 2420G.

2. Objectives and Evaluation of the Course

   a) Objectives of the course:
      1) To examine the goals and content of elementary school mathematics and the nature of effective mathematics teaching
      2) To develop competency with the content, methods, and materials (textbooks, resources, manipulatives, and technology) that comprise the elementary school mathematics curriculum.
      3) To develop skill with a variety of assessment tools for the purpose of assessing all students in mathematics at various grade levels.
      4) To develop skill in planning instruction based on results of assessment.
   b) Not a general education course.
   c) Methods of assessing students’ achievement of these objectives:
      Microteaching
      In-class observation of student participation
      Activities based on reading assignments
      Written examinations
      Written reflections
      Problem-solving assignments
      Projects
      Kits
   d) This course is not numbered 4750-4999.
   e) Not writing-active, writing-intensive, or writing-centered.

3. Outline of the Course

   a) See attached outline.
   b) Course will be offered in a traditional format.
4. **Rationale**

   a) **Purpose and need:** In June 2000, the Illinois Board of Education adopted new *Content-Area Standards for Educators* which establishes more demanding mathematics requirements for preservice teachers. The new *Standards* document calls for a broader curriculum with topics that did not previously receive much emphasis in the elementary mathematics curriculum and for more depth in many traditionally included topics. Performance-based assessment according to these standards is slated to begin in 2004. Performance-based assessment requires not only “exposure” to a topic, but that students are able to demonstrate proficiency. A study conducted in summer, 2001 by members of EIU’s Mathematics Educators faculty determined that when measured against the *Content-Area Standards for Educators*, the current program for elementary mathematics teachers falls short in the areas of algebra, statistics, probability, and technology. The current mathematics content courses are already overloaded. Of the several possibilities considered, the best alternative for meeting the new demands of the *Content-Area Standards for Educators* appears to be an expanded elementary methods course that addresses teaching methods for algebra, statistics, and probability, with a stronger technology component including both graphing calculator and more computer technologies.

   b) **Justification of the level of the course:** It is appropriate for the course to be a 3000-level course because it deals with teaching methods and should be taken shortly before student teaching. The 3000-level also provides an opportunity to work with transfer students who may have taken their mathematics content courses on other campuses.

   Justification of prerequisites: MAT 1420 Introductory Mathematics and Numeration with a C or better and MAT 2420G Introductory Geometry with a C or better. Elementary teachers need a solid understanding of appropriate mathematics on which to base understanding and skills for teaching mathematics.

   c) **This course would replace MAT 3520 (1-1-1) Teaching Mathematics in Grades K-6.**

5. **Impact on the program:** The proposed course would increase the mathematics requirements for elementary, early childhood, and special education majors by one semester hour. This change has been approved by the Department of Early Childhood, Elementary, & Middle Level Education.

   a) **Faculty members to whom the course may be assigned:**
   - Joyce Bishop
   - Allen Davis
   - Billie Dudley
   - Joan Henn
   - Marshall Lassak
   - Andrew White

   b) **Additional costs to students:** No additional expense for materials is anticipated.

d) Term to be offered first: Fall 2003

6. Community College transfer
   a) Not applicable

7. Date approved by Mathematics and Computer Science Department: 9/23/02

8. Date approved by COSCC: 11/8/02

9. Date approved by CAA: 12/5/02

New Math 3420 Outline

1. **Philosophical Foundation of Mathematics Education** 6 days - 300 min.

   “Imagine a classroom, a school, or a school district where all students have access to high-quality, engaging mathematics instruction. There are ambitious expectations for all, with accommodation for those who need it. Knowledgeable teachers have adequate resources to support their work and are continually growing as professionals. The curriculum is mathematically rich, offering students opportunities to learn important mathematical concepts and procedures with understanding. Technology is an essential component of the environment. Students confidently engage in complex mathematical tasks chosen carefully by teachers. They draw on knowledge from a wide variety of mathematical topics, sometimes approaching the same problem from different mathematical perspectives or representing the mathematics in different ways until they find methods that enable them to make progress. Teachers help students make, refine, and explore conjectures on the basis of evidence and use a variety of reasoning and proof techniques to confirm or disprove those conjectures. Students are flexible and resourceful problem solvers. Alone or in groups and with access to technology, they work productively and reflectively, with the skilled guidance of their teachers. Orally and in writing, students communicate their ideas and results effectively. They value mathematics and engage actively in learning it.”

   Principles and Standards for School Mathematics, National Council of Teachers of Mathematics, 2000, p. 3.

   The vision of school mathematics described by the National Council of Teachers of Mathematics provides the guiding principles for the course outlined here. It is the goal of the course to share this vision with preservice teachers and prepare them to implement the vision expressed in the Principles and Standards for School Mathematics.

   Historical perspective
   Reform in mathematics education
   National Council of Teachers of Mathematics standards
   Illinois Learning Standards
   Math anxiety
   Equity
   Problem solving (also integrated with content)
   Role of technology

   Resources:
   NCTM power point presentation on Principles and Standards
   Burns video – pattern blocks, for ex.
   Equity activity based on Annenberg Foundation video
   Equity vignettes from website
2. **Methods of Instruction**  
5 days – 250 min, &  
Interspersed throughout the course

To reach the goal of developing mathematical power for all students requires teachers who are more proficient in:

- Selecting mathematical tasks to engage students’ interests and intellect;
- Providing opportunities to deepen their understanding of mathematics;
- Orchestrating classroom discourse in ways that promote the growth of mathematical ideas;
- Using, and helping students use, technology and other tools to pursue mathematical investigations;
- Seeking, and helping students seek, connections to previous and developing knowledge;

The role of the mathematics teacher is changing, and this course is designed to help preservice teachers appreciate the changing role. The course will help them develop the attitudes and skills that will enable them teach in a manner that supports the vision of mathematics teaching described in the *Principles and Standards for School Mathematics* and the *Professional Standards for Teaching Mathematics*.

Understanding how children learn mathematics

- Constructivism
- Procedural and conceptual knowledge
- Learning styles
- Constructivist-based instructional Models
  - Problem-based learning
  - Cooperative problem solving
  - Discovery learning
  - Student-centered learning

Issues with traditional teaching

- Planning for instruction
- Appropriate use of Manipulatives (and integrated with content)
- Math Literature
- Technology (website exploration, also integrated with content)
- Peer teaching (integrated throughout)

**Resources:**

- NCTM and other websites
- Cognitively Guided Instruction problem types, strategies, and videos

3. **Interaction of Assessment and Instruction**  
3 days – 150 min.

Assessment should be an integral part of instruction that informs and guides teachers as they make instructional decisions. It should convey a message to students about what kinds of mathematical knowledge and performance are valued. Feedback from assessment should help students set goals, accept responsibility for their own learning, and become more independent learners.

Assessment processes

- Observation
- Questioning techniques
- Interviews
- Evaluation of computational assignments
- Error patterns
- Evaluation of problem-solving assignments
  - Performance assessment
  - Rubrics
  - ISAT examples
  - NAEP example
- Assessment portfolio
- Student self-assessment
- Teacher-made tests
- Tests from textbook publishers
During the early years of a child’s mathematical development, teachers must help students strengthen their sense of number, moving from the initial development of basic counting techniques to more sophisticated understandings of the size of number, number relationships, patterns, operations, and place value. Preservice teachers will know and understand how to model, explain, and develop the concepts of number, number sense, and place value. Teachers should regularly encourage students to demonstrate and deepen their understanding of numbers and operations by solving interesting, contextualized problems and by discussing the representations and strategies they use.

Kinds of knowledge

Constructivism
Prenumber concepts
  Classification
  Order and seriation
  Sequence and pattern
  Spatial sense

Manipulatives: Attribute blocks for sorting and classifying, patterns
Types of numbers and ways to use numbers
  1 to 1 correspondence
Representations of numbers
Estimation
Readiness for place value concepts
Base 10 materials
Manipulatives: Base 10 blocks for whole number concepts and decimals, base 5 blocks
Place value activities:
  Postage stamp
  Mayan numbers
  Base 5
Calendar activities

4. Whole Number Operations

5 days – 250 min.
The preservice teacher will have an understanding of operations. The preservice teacher will understand how to model, explain, and develop these rules, facts, and algorithms in many ways and will be able to teach the connections among these operations.

Operation sense
Basic facts
Algorithms

Manipulatives: Unifix cubes, beans, Base 10 blocks, Cuisenaire rods, and Base 5 blocks.

Resources:
  Cognitively Guided Instruction: problem types, strategies, videos
  Error Patterns in Computation
  Knowing and Teaching Elementary Mathematics, Liping Ma: Profound understanding of fundamental mathematics
  Annenberg video series

5. Rational Numbers

9 days – 450 min.
Preservice teachers should be able to model, explain, and develop rational numbers, particularly integers, fractions, and decimals. They should understand and represent commonly used fractions and should be able to promote understanding of fractions as parts of unit wholes, as parts of a collection, as locations on number lines, and as divisions of whole numbers. They should recognize and generate equivalent forms of commonly used fractions, decimals, and percents, and
should compute fluently and estimate addition and subtraction with fractions and decimals. Preservice teachers should understand how these concepts form a basis for proportional reasoning.

Integers
  Uses of integers
  Models for integers
    Two-color counters
    Algeblock model
  Operations with integers
  
  Manipulatives: two-color counters, Algeblocks

Fractions
  Fraction foundational concepts
    Meaning of fractions
    Order of fractions
    Equivalent fractions
    Partitioning
    Concept of unit
  Fraction number sense
  Models, manipulatives for fractions
    Continuous (or area) model
      Pattern blocks, circles, squares, Fraction Factory,
      Fraction Island, geoboard, drawings
    Linear
      Adding machine paper, Cuisenaire rods, number line
    Discrete
      Chips, Unifix cubes
  Operations with fractions
  
  Manipulatives: pattern blocks, Cuisenaire rods, fraction circles,
  Fraction Islands, beans, fraction squares or fraction factory

Decimals
  Extending the place value system
  Models for decimals
    Base 10 blocks
    10 x 10 geoboard
  Ordering decimals
  Decimal number sense
  Fraction/decimal connection
  Operations with decimals
  Money
  
  Manipulatives: Base 10 blocks with Decimal Factory

Percent.
  Percent is another name for hundredths
  Percent/decimal/fraction connection
  Estimation with percents
  Operations with percents
  
  Manipulatives: 10 x 10 geoboard for percents, 10 x 10 grid, 8 x 8 grid

Ratio and proportion, and proportional reasoning
  Ratios in different contexts
    Fractions as ratios
    Comparing two parts of same whole
    Ratios as rates
    Geometric ratios
  Proportion as a statement of equivalent ratios
    Intuitive methods for solving proportions
    Proportional reasoning
      Activities to develop proportional reasoning
        Equivalent ratio selections
        Within and between ratios
Scaling activities
Construction and measurement activities
Percent problems as proportions


6. Patterns, Relationships, Generalization, and Early Algebra 8 days – 400 min.
Preservice teachers should know how to help children recognize and extend patterns, model situations that involve the addition and subtraction of whole numbers, and should describe qualitative and quantitative change. Preservice teachers should describe and make generalizations about geometric and numeric patterns, should express mathematical relationships using equations, and should investigate how a change in one variable relates to a change in a second variable.

What is algebra?
Standards for algebra
Conceptual approaches to algebra
Generalization
Patterns
Generalizing Relationships
Problem Solving
Variables
Equations
Solving problems with variables and equations
Relationships and Functions
Relationships
Classes of functions according to different patterns of rate of change
Linear functions
Constant slope
Exponential functions
Quadratic functions

Teaching familiar mathematics from an algebraic perspective
Manipulatives: bears and balances – variable, relationships
Hands on Equations, Algeblocks

7. Data and Statistics 4 days – 200 min.
The preservice teacher will know how to collect, organize, and represent data in a variety of ways and will understand the ideas of randomness, bias, population, sampling, reliability and validity when data is collected. The preservice teacher will be familiar with the concepts of line of best fit and normal curves.
Organizing and representing data
Stem and leaf, pie chart, histogram
Measures of central tendency
Box-and-whisker plot
Asking questions and collecting data
Randomness, populations, samples, bias, reliability, validity
Normal curve
Scatterplots and line of best fit
Resources: graphing calculator for scatter plot, graphs, line of regression
Annenberg K-4 video #12 Ladybugs, Woodpecker Habitat
Annenberg K-4 video #13 Bubble Gum Contest

8. Probability 4 days – 200 min.
The basic concepts of probability are addressed with an emphasis on the way that probability and statistics are related. Through the grades, students should be able to move from situations for which the probability of an event can be readily determined to situations in which sampling and simulations help them quantify the likelihood of an uncertain outcome. Preservice teachers will understand counting techniques and the meaning of probability. Preservice teachers will understand the meaning of theoretical and empirical probability and will have fluency with basic counting techniques and terminology associated with probability. Preservice teachers will be able to perform simulations for the purpose of computing probabilities of independent and dependent events.
Definition
Outcomes, Events
Equally likely
Not equally likely
Sample spaces
Randomness
Theoretical v. Empirical
Independent v. Dependent
Counting techniques
Manipulatives: Dice, coins, counters
Resources: Annenberg K-4 video #13 Dice Toss

9. **Geometry**  
What is geometry?
Van Hiele levels
Geometric thinking
Standards for geometry
Spatial visualization
Symmetry
Congruence
Similarity
Two- and three-dimensions
Manipulatives: Mira

10. **Measurement**  
Preservice teachers need to understand what a measurable attribute is and to become familiar with the units and processes that are used in measuring attributes. They should become proficient in using appropriate measurement tools, techniques, and formulas in a range of situations.
Estimation
Standard and non-standard units of measure
English
Metric
Time
Scale
Accuracy and error
Resources: Annenberg K-4 video #10 Windows, Dinos, and Ants

11. **Assessment activities**  
Microteaching
In-class observation of student participation
Activities based on reading assignments
Written examinations
Written reflections
Problem-solving assignments
Projects
Kits