Math 322 – Mathematics Content and Methods for the Elementary School IV

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Wham 322M

OFFICE HOURS: Before and after class
By appointment

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CLASS MEETS: __________ in the Math Lab.

CATALOG DESCRIPTION [Same as Math 322 – the course is cross-listed in the two departments]: Modern approaches to mathematics instruction for the elementary grades. Mathematics content focuses on: algebra and algebraic thinking, geometry, relations and functions and their applications to real-life problems. Emphasis is placed throughout on reasoning, multiple representations of mathematical concepts, making connections and communication. [Prerequisites: CI/Math 120; CI/Math 220; CI/Math 321]

Objectives

The broad objectives of CI/Math 120-220-321-322 are to provide a sound basis in mathematics content and pedagogy for pre-service elementary school teachers. Upon completion of each course students will have mastered the mathematics content described in the specific course objectives and will be able to:

- evaluate and select the most effective resources, manipulatives, technologies, etc. to represent ideas and concepts in multiple ways;
- use varied approaches to mathematical concepts and procedures in order to meet the needs of students with diverse learning characteristics;
- adapt learning experiences and use alternate approaches suitable for individuals with disabilities.
- anticipate and build on students’ natural ways of thinking about mathematical ideas and concepts;
- anticipate misconceptions that may occur in students’ thinking about mathematical concepts and procedures, and design experiences to minimize these misconceptions;
- engage students in building their own mathematical knowledge through inquiry, investigation, group and individual work;
- use examples that are meaningful to their students (tied to students’ experiences);
- connect mathematics with students’ real-life experiences;
• integrate technology into classroom instruction (where that technology is available);
• design instructional experiences that promote communication of mathematical reasoning verbally and in writing.

Specific objectives of CI/Math 322 are as follows:

. translate between verbal, graphical and algebraic representations of a problem
. set up an algebraic model for a problem; explain what the model says
. solve an algebraic problem, explain the steps taken in the solution, discard solutions which may be “mathematically” acceptable, but which have no meaning in the “real life” application
. recognize such figures as lines, circles, ellipses, parabolas, and hyperbolas, lines of symmetry, etc.
. understand, explain and implement both algebraic and graphical techniques for solving a system of 2 (or more) linear equations (or inequalities) in 2 unknowns
. understand and explain the concepts of relation and function using various models and representations
. apply the concepts of relation and function in various situations
. experience linear, quadratic and exponential functions through “real world” examples
. experience, at least informally, the trigonometric functions in the context of ratios in similar triangles
. experience the construction of complex numbers
. have an intuitive understanding of the concept of “line of best fit” and “curve of best fit”; be able to estimate such curves geometrically; be able to find such curves using appropriate technology

Prerequisite: CI/Math 120, 220, 321

Overarching expectation of students

To take responsibility for your own learning

Overarching assumption

That pre-service teachers will take an active role in their own learning

Main spirit in the course

The content of the course will be directly related to the elementary/middle school mathematics curriculum

Overarching objectives in the course

. to improve students’ attitudes towards mathematics,
. to change students’ beliefs about what mathematics is,
. to reduce anxiety in doing mathematics and about mathematics,
. to re-learn, with understanding, much of the mathematical content of elementary/middle school mathematics,
. to learn new mathematical content and pedagogy directly related to the elementary/middle school mathematics curriculum,
. to learn to think in a correct way about teaching mathematics at the elementary/middle school levels

Overarching course themes

1. Openness in mathematics education:

Apply openness to problem solving – routine problems, that is, from the content of the traditional elementary/middle school mathematics curriculum, and non-routine problems; assessment [e.g., van den Heuvel and Becker (2003)]

Examples of problems and detailed lesson plans (some already available) or roughed out lesson plans (that can be made more detailed)

2. Mental computation:

Mental computation will be emphasized whenever possible in the course.

3. Children’s informal mathematics: [e.g., Becker and Selter; Carpenter et al., Cognitively Guided Instruction (CGI) materials]

4. Teaching aids … Representations

External representations can assist learners to develop their own internal representations. The general attitude towards teaching aids in the course will be to use them, but “less is more!”

There will be an emphasis on use of examples to illustrate how students (school and college) develop representations using their own natural thinking abilities to solve problems.

5. Importance of and appropriate ways to develop basic skills

The addition, subtraction, multiplication and division facts (while avoiding the “drill-to-kill” regime) and place value will be emphasized early in the course. There will be heavy emphasis on developing/maintaining computational skills.

Course outline [tentative – subject to some revision as we go along]:

Applications of algebra to real life problems. Translation into mathematical notation and back. Multiple representations of a problem. Basic solution techniques and rationale [1 week]

Basic properties of lines, circles, ellipses, parabolas and hyperbolas. Communication and reasoning will be highly visible. [1 week]
Real world situations which give rise to systems of linear equations (or inequalities) in 2 unknowns. Solution techniques and rationale. [1 week]

Relations and functions. Various ways to represent them (graphs, tables, equations, input-output machines). Connection to transformations already explored in geometry topics. [2 weeks]

Exploration of linear and quadratic functions. Exploration of the effect of changing an input $x$ to $x$ plus constant, changing an output $y$ to $y$ plus constant, etc. [2 weeks]

Real world examples in which linear and quadratic functions are the “tools of choice.” [2 weeks]

The basic trigonometric functions of an angle. Connection to similar triangles. The emphasis is on introducing the trigonometric functions as an important family of examples rather than on covering a lot of trigonometric formulas. Topics are related to mandated state and national standards. [2 weeks]

Introduction to complex numbers (e.g., from the point of view of needing some way of solving the equation $x$ squared + $1 = 0$). Exploration of the representation of complex numbers in the $xy$-plane. Geometric and algebraic representations of complex numbers. [2 weeks]

**Learning/teaching resources**

- Selected articles for reading
- Videotapes (e.g., Polished Stones, Project Mathematics, Kamii, TIMSS)
- Computers and software
- Calculators – basic functions and fraction calculators
- E-mail – Important reading information will be posted to students via e-mail to enable them to remain up-to-date on current issues in mathematics teaching. Students will also receive information on “hot” issues in education.
- World Wide Web – (a) Reform debates: MathematicallySane and MathematicallyCorrect websites; (b) listserves – math-teach, math-learn, NCSM, ICTM, others; (c) teaching resources: Eisenhower National Clearinghouse (ENC).

**Teaching aids / related print materials**

- Attendance in class – class attendance is required.
  - Taking responsibility for your own work
  - Appropriate behavior as a student, in class and out of class
  - Honesty in doing one’s work in the course – See student Conduct Code

**Requirements**

Come to every class session – a record of attendance will be kept
Do not be late for class – be in your seat and ready when the professor begins class – a record of tardiness will be kept

Be alert and pay attention in class

Maintain binder/portfolio of all course materials [3-inch, 3-ring binder]

Completion of all course work – there will be no grade assigned until all coursework is handed in. If any work is not handed in, a grade of INComplete will be assigned.

Do you own work in class work

Active participation in class activities – take responsibility for your own learning

Read and study the required hand-out materials

Resources
Your fellow students -- Books -- Math Lab resources -- Education Library on 5th Floor of Morris Library

OTHER IMPORTANT INFORMATION

• Check to know the last day to drop with refund and last day to drop (W grade; no refund):
• If you need to drop this class, make sure you do so with your Advisor. Students who simply stop attending class will receive a grade of WF. This counts as an “F” in computing the GPA.
• Be aware of the University policy regarding the grade of INC.