

# Math 499E

*Senior Seminar (3 credits)*

Fall 2009

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## **Course Rationale: Why should I teach with problems?**

Hiebert and others describe one of the essential principles for mathematics instruction as building understanding in mathematics: Make the subject problematic. Instruction ought to allow students to wonder why things are, to inquire, to search for solutions, and to resolve incongruities. In a problem-based approach, students are expected to solve problems or make sense of mathematical situations for which no well defined routines or procedures exist. In introductory activities, as well as in application settings, students are expected to explore problems, make conjectures, and draw generalizations about mathematics concepts and processes. Students can also make connections between mathematical ideas that are familiar to them by solving new problems in a variety of different settings. Although no one claims the existence of one correct way to teach, using good problems to plan instruction with the focus on student thinking and reasoning is one strategy that holds promise. Problem-based instruction in its simplest is summarized by Gail Burrill as; Good teachers foster an environment in which the students do the work!

The educational outcomes of a problematic approach to mathematics education are:

- Build new mathematical knowledge through solving problems.
- Solve problems that arise in mathematics and in other contexts.
- Apply and adapt a variety of appropriate strategies to solve problems.
- Monitor and reflect on process of mathematical problem solving.

## **If it is so important to teach with problems why don't more mathematics teachers use problems?**

A problematic approach to teaching mathematics is not without its problems and controversies. Lynn Steen explains the dilemma of building a curriculum around problems as both philosophical and pedagogical. In mathematics itself the context is obscures structure, yet when mathematics connects with the world, context provides meaning. Even though mathematics embedded in context often loses the very characteristic of abstraction and deduction that makes it useful, when taught without relevant context it is all but unintelligible to most students. Even the best students have difficulty applying context-free mathematics to problem arriving in the realistic situations. This emphasis on teaching through problems in context presents both opportunity and challenge for learning to teach. In selecting problems to drive the work of students the teacher is the architect of the curriculum. Teachers must be engaged in teacher education programs allowing opportunities to actually be involved in doing mathematics through interesting problem situation that embody important mathematical ideas. Such opportunities allow teachers to explore how mathematics can be used to represent situations, so that they can look for patterns, make conjectures, look for evidence to support those conjectures, and craft this evidence into logical arguments. Such contextualized problems provide opportunities to use mathematical analyses to make predictions or reach conclusion supported by the evidence. Problem contexts can compel a learner to invent new ways to use mathematical knowledge and skill to solve problems and connect ideas across school subject areas and with real world problems.

## **How does a teacher become a better problem poser?**

A dilemma mathematics teacher face is that being a good problem solver is not enough. They must be guided to abstract from experience with solving problems the common mathematical concepts, ideas, skills, procedures, and structures that have more universal applications. Experiences with abstracting and making explicit the embedded mathematics are critical to learning how to teach through big problems. Without this step in the process of problem solving, learners are left with a set of isolated problem experiences that may not be connected in their minds nor associated with important mathematical content that was the original learning goal. While the payoff for the students can be great, teaching through big problems increases the complexity of classroom instruction of the teachers. For this reason teachers must understand the connection between mathematical concepts and procedures in a more complete way.

Posing mathematical tasks in a way that promotes inquiry creates new classroom roles for instructors. Traditional practices offer a sense of accomplishment for teachers. Things get done. Student and teacher move through mathematical material in an orderly way. Teachers explain, demonstrate, and monitor student practices. Students listen, observe, and practice skills and procedures that can be applied to specific kinds of problems. However, it is not just the amount of engagement with content that matters. The quality of the experience, the way in which students learn and think determines the usefulness of the educational experiences.

### **Course Description: What are the goals and outcomes of this course?**

#### Course Goals

1. Assess the student's mathematical knowledge in mathematical content areas.
2. Give student experiences with solving problems using many different strategies
3. Create learning activities where problems are posed to engage students in meaningful mathematics.
4. Create assessment methods that give clear insight into the students' understanding of mathematical concepts.

#### Learner Outcomes--Student will be able to:

- Solve problems in each of the content areas in the mathematics-teaching program.
  - Numbers, Number Theory, and Number Systems
  - Analysis using functions
  - Algebra and Functions
  - Geometry and Spatial Visualization
  - Discrete Mathematics
  - Probability and Statistics
  - Calculus
- Solve problems that arise in mathematics and in other contexts.
- Apply and adapt a variety of appropriate strategies to solve problems.
- Monitor and reflect on process of mathematical problem solving, communication, reasoning, and making connections.
- Create lessons where problems are posed that engage students in a specific mathematical concept or process.
- Create assessment methods that clearly reveal their students' understanding of lessons' outcomes.
- Reflect on the philosophical and pedagogical practices of teaching mathematics.

### **What do the students need to do to show they have met the course outcomes?**

Students will demonstrate their ability to meet the outcomes of this course through reading, reflecting, and writing about problems posed. Writing in mathematics helps the writer consolidate their thinking because it requires the writer to reflect and clarify their thoughts. Communication is part of NCTM's call for mathematical literacy, which asserts that communication plays an essential role in assessing and developing understanding. Communication can take the form of various oral and written endeavors, but the primary goal remains to enhance the writer's mathematical reasoning and making of connections. Students will continue construction of the mathematics education electronic portfolio to meet all the program, NCATE, NCTM, CTL's Conceptual Framework, and Washington State Standards for secondary mathematics teachers.

**Course Text and equipment:** Blackboard Course Math 499E and a TI 83+ graphing calculator is required to solve and teach the problems. Livetext account use the Teaching Secondary Mathematics Portfolio.

**Assessment:** Students will show their ability to meet the performance outcomes by completing the following assessments:

- Students will be given 6 sets of problems to solve and write-up. Each paper is worth 10 points and a common rubric is on Blackboard. These papers will have their final evaluation in the livetext portfolio.
- Students will be given 6 teaching papers. Students will need to reflect on the problem information and write a paper that is both mathematically correct but also pedagogically insightful. Each teaching paper is worth 10 points and the rubric for each paper is attached. After the student has written the paper they will attach it to the discussion board on Blackboard that they have been assigned for peer and instructor feedback. Student will receive the full 10 points if they attach the paper and complete peer reviewers by

the given due dates. These papers will have their final evaluation in the livetext portfolio.

- Some of the teaching papers require lesson plans and use will teach at least one of these lessons. The rubric for the lesson plans are in the assessment section of Blackboard. You will be asked to teach at least one of your lesson plans in a local classroom.
- Twelve sets of exercises covering the basic concepts and procedures from each of the six mathematical content areas will be given. These are take-home assignments and must be completed and explained in writing by the next class meeting (10 points). Each student will be asked to explain two of the problems on these take-home quizzes (10 points).
- Six quizzes worth 20 points each covering the basic concepts and procedures from each of the seven mathematical content areas will be given.
- The final in this course is to complete the Math 499E section of the livetext portfolio and write the corresponding reflections (100 points). Start by reading the first question and all the articles and statement that are in its folder. After you thought about the problem write a response using the guidelines outlined in the folder. The livetext portfolio must be completed to receive a grade for the course.

Grading--Grades will be determined by the following percents:

93-100% = A, 90-93% = A-, 87-90% = B+, 83-87% = B, 80-83% = B- , 77-80% = C+, 73-77% = C, 70-73% = C-, 67-70% = D+, 63-67% = D, 60-63% = D-, 0-60% = F.

**Schedule/Rules:** The instructor has a class schedule for the quarter but it is subject to change depending on the needs of the students. If a student misses class, it is their responsibility to find out what was covered announced or assigned. In case of emergencies, it is their responsibility to contact the instructor as soon as possible. If a course deadline was missed, assessment alternatives are left up to the discretion of the instructor.

**How to succeed:** Take the responsibility for your own achievement of these performance objectives. Use the activities, assignments, assessments and people such as the instructor to insure that you understand the mathematical teaching concepts and can demonstrated this understanding in the form of the performance objectives.

"Students with disabilities who wish to set up academic adjustments in this class should give me a copy of their "Confirmation of Eligibility for Academic Adjustments" from the Disability Support Services Office as soon as possible so we can meet to discuss how the approved adjustments will be implemented in this class. Students with disabilities without this form should contact the Disability Support Services Office, Bouillon 205 or [dssrecept@cwu.edu](mailto:dssrecept@cwu.edu) or 963-2171 immediately."