Math 3307/5V06
Butts, Spring 2006

Mathematical Problem Solving for Teachers Overview

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Office hours: MW 3:00pm- 5:00pm ; 7:00p – 8:00pm [in CB]
T Th 4:00pm - 6:00 pm and by appt. **1/09/06A**

Text: There is no textbook. You should get a loose-leaf notebook for notes which will be distributed. These notes may eventually become a textbook.

You may wish to purchase Crossing the River With Dogs - Problem Solving for College Students, Johnson, Kerr, Kysh, Key College Publishing, 2004 [ISBN 1-931914-14-1]. This text contains some basic information about problem solving and several classical problems and is recommended for those seeking certification in 4-8 mathematics. [You should be able to find a used copy through Amazon.com]

Assessments: [graduate students will have additional/different work TBA]
1. Three quizzes containing problems to solve. Each quiz will be partially take-home.
Tentative dates: Feb. 8, Mar. 15, Apr. 12 [30%]

2. Several assignments containing problems to solve , problems to create, and journal writing items. Class attendance and participation. [40%] Differentiated assignments will given.

3. A final portfolio on **"You as a Problem Solver"** due at the time of the scheduled final exam. There will be some new problems to solve [Quiz 4] and some guidelines asking you to choose problems previously considered during the course and comment on your experiences with them. [30%] **More details later in the course.**

Working Together: It is beneficial to work together on homework problems when everyone can contribute by critiquing each other's ideas, but you should write up your own solutions. It would be best for your understanding if you put aside your discussion notes and wrote up the solutions entirely from scratch. Working together on exams, of course, is forbidden.

George Polya: I consider myself a disciple of the "father" of modern mathematical problem solving, George Polya, who eloquently described the importance of problem solving in the introduction to his classic book **How to Solve It** published in 1943:

"A great discovery solves a great problem but there is a grain of discovery in the solution of any problem. Your problem may be modest; but if it challenges your curiosity and brings into play your inventive faculties, and if you solve it by your own means, you may experience the tension and enjoy the triumph of discovery. Such experiences at a susceptible age may create a taste for mental work and leave their imprint on mind and character for a lifetime.
Thus, a teacher of mathematics has a great opportunity. If he fills his allotted time with drilling his students in routine operations he kills their interest, hampers their intellectual development, and misuses his opportunity. But if he challenges the curiosity of his students by setting them problems proportionate to their knowledge, and helps them to solve their problems with stimulating questions, he may give them a taste for, and some means of, independent thinking. Also a student whose college curriculum includes some mathematics has a singular opportunity. This opportunity is lost, of course, if he regards mathematics as a subject in which he has to earn so and so much credit and which he should forget after the final examination as quickly as possible. The opportunity may be lost even if the student has some natural talent for mathematics because he, as everybody else, must discover his talents and tastes; he cannot know that he likes raspberry pie if he has never tasted raspberry pie. He may manage to find out, however, that a mathematics problem may be as much fun as a crossword puzzle, or that vigorous mental work may be an exercise as desirable as a fast game of tennis. Having tasted the pleasure in mathematics he will not forget it easily and then there is a good chance that mathematics will become something for him: a hobby, or a tool of his profession, or his profession, or a great ambition."

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NCTM Problem Solving Standard

The 1989 NCTM [National Council of Teachers of Mathematics] Standards for School Mathematics contained the statement "**Problem solving should be the central focus of the mathematics curriculum.**"

In the 2000 NCTM, this statement has been expanded:

"The ability to solve problems is not only a purpose for learning mathematics but also a major means of doing so. As students use problem-solving approaches in their investigations of mathematical content, they can develop new mathematical understandings and strengthen their abilities to use the mathematics that they know. Problem solving means engaging in a task for which the solution method is not known in advance. In order to find a solution, students must use their knowledge in different ways and, through this process, may develop new knowledge. Problem solving is an integral part of all mathematics learning, not an isolated part of the mathematics program."

"The teacher plays an important role in the development of problem-solving ability by creating an environment in which students are encouraged to explore, take risks, share failures and successes, and question one another. .... the development of problem-solving dispositions is part of the natural business of learning and doing mathematics. "

Instructional programs from prekindergarten through grade 12 should enable all students to—

- build new mathematical knowledge through problem solving;
- 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 the process of mathematical problem solving.

Competency 015 for Texas mathematics teachers

The teacher understands mathematical reasoning and problem solving.

The beginning teacher:

•Demonstrates an understanding of proof, including indirect proof, in mathematics.
•Applies correct mathematical reasoning to derive valid conclusions from a set of premises.
•Demonstrates an understanding of the use of inductive reasoning to make conjectures and deductive methods to evaluate the validity of conjectures.
•Applies knowledge of the use of formal and informal reasoning to explore, investigate, and justify mathematical ideas.
•Recognizes that a mathematical problem can be solved in a variety of ways and selects an appropriate strategy for a given problem.
•Evaluates the reasonableness of a solution to a given problem.
•Applies content knowledge to develop a mathematical model of a real world situation and analyzes and evaluates how well the model represents the situation.
•Demonstrates an understanding of estimation and evaluates its appropriate uses.

In order to adopt the sort of problem-solving philosophy of teaching advocated by these two sets of standards, it is evident that all effective mathematics teachers need an opportunity to fully develop their own ability to solve mathematical problems – hence this course.

Students will learn about the science and art of problem solving. They will develop their abilities to make conjectures; to solve mathematics problems [involving number theory, algebra, combinatorics, probability and statistics, ...]; to pose problems and problem extensions; to communicate mathematical arguments; and to write about the problem-solving process.

The aim of this course is not to impart any specific body of knowledge, but rather to foster the students' understanding that mathematics is the science of identifying and solving problems.

Academic Honesty: In this course students will conform to the University rules for academic honesty. For more information see http://www.utdallas.edu/judicialaffairs/index.html

Students with disabilities: Information from this course can be provided to students with disabilities through University services. For more information see http://www.utdallas.edu/student/slife/hcsvc.html