

## AMATYC Project ACCESS –

**Title:** Math is all about Problem Solving

**Project Member(s):** Mark Monroe

**Describe the problem, issue, or area of interest and the context.** Students who are not math/science/engineering type majors nearly universally hate math word problems. But that is what math outside of a math class is about, solving life problems. In class we traditionally focus more on how to solve an equation for  $x$ , than on how to take a word problem and represent it with an equation. So, what use is algebraic manipulation to someone that doesn't know how to model a problem with an equation?

**Define your desired goals, or “outcomes.”** Working with my Math for Liberal Arts classes (math for non math/science majors):

- Students will have increased confidence in their ability to understand and solve word problems.
- Students will significantly improve their ability to dissect a word problem to determine what they know and what they need to find out.
- Students will significantly improve their ability to model problems and solve them.

**Describe your “indicators” of success.** I used a set of pre and post assessments to test student's ability to solve a wide range of word problems. Methods I used to assess three goals were:

- Did the student make an attempt to solve the problem? A failed attempt shows that they were trying. Whether that is improved confidence, or just leaning to do what the instructor wants, is difficult to measure. However, I can also see the change in students' expressions, and attitudes.
- As part of their answers on assessments, students are to write down what they know and what they need to find out.
- Did they accurately model the problem: using a diagram, equation(s), or other methods? And were they able to use their model to solve the problem correctly?

**Describe your project.** My class has a nine week long project where students simulate functioning as the president of a business that makes Cell phone/MP3 players. Based on information given to them, they must model the production costs, as well as the impact of research and advertising spending. Once they have modeled the business, they run it for 8 months, turning in a month's decisions once a week. This project provides a theme for the course, rather than the usual bunch of unconnected math problems. It also provides many opportunities to practice what they are learning. Finally, and outside of my defined project scope, it forces them to perform what-if analysis, answering questions that they have posed to themselves, rather than ones that I have asked.

I start the course with a long look at problem solving techniques, with special emphasis on creating a model to represent a problem. Throughout the rest of the course, as we learn a new technique, we spent extra time on understanding when and how to use the technique. It means that fewer chapters covered, but students are more able to USE the techniques that are cover.

**Describe your results.** I am never completely satisfied with any outcome, so we will start with that understanding:

Did I accomplish my goals? Mostly. Early assessments had numerous un-attempted problems, and very poor modeling. Later assessments had no, or almost no un-attempted problems and a noticeable improvement in modeling. Noticeable means statistically significant, but I'm not taking the class to a national competition. Many students dreaded the business simulation, and felt that the first month's decision was agonizing. However, by the end of the simulation, students were actively competing with each other, and some asked if they could submit a ninth month in order to hit a self imposed goal. Comment's like "This is fun", and "I wish other math classes did stuff like this", were very affirming.

Will I do the project again? Definitely. I already did it a second time during the summer session, with various modifications, and am tweaking more for the fall.

**Describe your evaluation methods.** The problem solving assessments were part of larger assessments. One student, who achieved 0% on the first problem solving portion of the assessment, got over 60% on the full assessment. The problem solving portions were designed to have a wide range of problems, from easy to difficult. I expected few, if any, students to get them all correct.

How do I know if it was successful? On the first problem solving assessment, given immediately after presenting the methods, but before practicing them, students scored an average of 37.5%. Scores on the final two problem solving assessments averaged 76.1% and 69.5%. Likewise, on the initial assessment 16% of questions were not even attempted, while the last two assessments had 0% un-attempted. There were still a few rather feeble attempts, but well under 16%.

What am I working on to improve the results? I need to continue to improve the assigned materials, especially early in the semester. Students took on "writing down what you know and what you need to find out" with reluctance. They could do

it, but didn't want to bother. But the bigger hurdle was getting them to TRY to model the problem. Most want to sit and stare at the word problem, rather than getting the pencil moving. I really have to encourage the idea that it is okay to write down things that may or may not lead to a solution. Many worry about revealing their poor thinking to the instructor. Many also feel that they are completely incapable of creating an equation. To them, that is what math "geniuses" do.

I also plan to continue to improve my selection of problems on problem solving assessments. I want each assessment to have the same level of difficulty as all of the others. Each assessment also needs a uniform distribution of easy, medium and hard problems. However, I cannot simply repeat the same types of questions with new numbers, as I will simply be testing how well they have learned those problems.