Vision - Potential

Vision Within Every Instructor - Potential Within Every Student

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[1] A New Semester— A Classroom of New Challenges

A few years ago John Dawson sold his poultry business and bought a hardware store. John had been very successful in building up a profitable poultry business. He had overcome numerous difficulties, but now, with his business firmly established, he felt that he was stagnating and he needed to find a new set of challenges to fuel his own personal growth. His answer was to change fields. In one of our conversations about careers and personal growth, I mentioned to John that teachers were fortunate in that every semester we had new students, each one of which presented a unique challenge. We are indeed fortunate as our challenges come to us.

The teaching profession offers numerous opportunities that combine service with personal growth, opportunities that fuel the flames of creativity, create energy, and enhance the desire to learn. Working within professional associations, creating outreach programs (e.g., to schools and other community organizations), teaching different courses, developing curriculum are a few examples of activities that complement the challenges presented each semester from new students. We don't need to buy a hardware store!

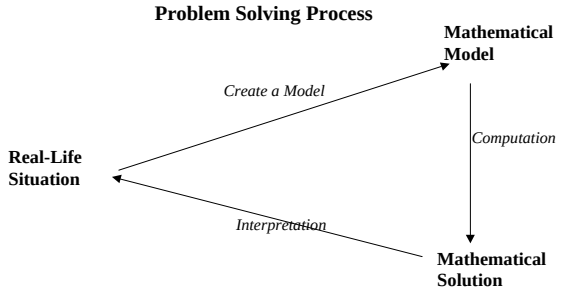
The Contemporary College Algebra program is an excellent example of what can result when a group of teachers take a hard look at what they are teaching and ask: "Why?" "What are our goals and are we meeting them?" "Are the goals appropriate?" "Are there better ways to engage students in their learning?' "Is the content appropriate?" "Can we do better?" The Contemporary College Algebra team has continued to struggle with these and similar questions in creating a vibrant, forward looking program aimed at educating students for the future rather than training them for the past.

* Supported by the U.S. Military Academy.

[2] Problem Solving

Problem solving in the modeling sense as illustrated in the following diagram is playing a larger and larger role in refocusing curriculums. Thanks to technology that can free us from the burdens of computation, we have the time to place more and more emphasis on creating models of real-life situations and

interpreting solutions in light of the original settings. In short, we are pursuing the *objective of leveraging the power of humans to create and validate while using the power of technology to compute.*



The following quote from the Preface of *How to Solve It* by George Polya, Princeton University Press, first published in 1945 and reissued in 2004, describes the journey we are on.

> "A teacher of mathematics has a great opportunity. If he fills his allotted time with drilling 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."

The challenge is clear, particularly for a college gateway course such as college algebra.

[3] Puzzles

Occasionally taking a portion of a class period to challenge the problem solving skills of students with a puzzle can be very beneficial and well worth the time. Many people, possibly even a majority, enjoy the challenge of a puzzle whether they find a solution or not. Thus including puzzles directly addresses the goal of making math enjoyable. Puzzles are also a good way to develop certain problem solving skills such as formulating and implementing a plan and then critiquing it. Many puzzles ask for a *best* solution which leads students to question and *what if* their approach looking for other possible solutions. Communication is another important course objective addressed by working on puzzles. Understanding a problem requires careful reading; and explaining an approach requires organizing one's thoughts in a logical manner. Both of these are important characteristics of good communication skills.

Here is a selection of fun puzzle problems with comments.

Note, drawing a picture or diagram to display a process is a helpful problem solving heuristic as the following two puzzles illustrate.

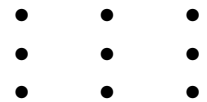
1. How can you bring up from a river exactly 6 quarts of water when you have only two containers, a four quart pail and a nine quart pail to measure with?

2. The game is to repeatedly flip a "fair" coin—equally likely to land as either Heads or Tails. A winner is declared when the same flip result occurs two times in a row or the same flip result occurs a total of three times. Will the game always end? If so, how many different sequences of coin flips are possible?

As a follow-on puzzel, consider changing the rules the rules so that a winner results only when the same flip result occurs two times in a row. How many different possible outcomes are there?

Note, good problem solver must be alert to not "reading" additional constraints into the statement of the problem (such as staying within the square in the following puzzle). Puzzle solving can help us develop this alertness.

3. Identify the fewest number of lines required to connect the following 9 dots without lifting your pencil off the paper.



Note, listing and then exhausting possibilities is a useful heuristic for problem solving. The following hat problem illustrates this.

4. Three blindfolded men (A, B, and C) each choose a hat from a barrel that contains three black and two white hats. They stand in a line with B behind C and A behind B. The men remove their blindfolds and remain facing forward. A can see the colors of B's and C's hat, B can only see C's hat, and C cannot see any hats.

A says, "I do not know what color my hat is."
B says, "I do not know what color my hat is."
What color is C's hat?

Readers, please send me examples of puzzles that you think are particularly appropriate for college algebra classes that you would like to share through the *Vision - Potential* Newsletter.

[4] Population Growth

(This problem could be used in the first hour test as the computations only involve straight forward arithmetic. It does require important thinking skills including organization and developing a plan, converting from one system to another, and developing a rate of growth expression.)

At twelve o'clock noon on August 25, 2004 the U.S. Census Bureau estimated the population of the United States to be 294,097,611. The Census Bureau's Population Division estimates

One birth every - - - - - - - - 8 seconds
One death every - - - - - - - 12 seconds
One migrant (net) every - - 25 seconds

Using these estimates determine:

a. The increase in the population in one year (365 days).

b. The population growth rate for this next year.

[5] Milk Fat—1%, 2%, ?

Milk fat is a primary source of dietary energy in milk as well as providing the rich taste of milk. In past years, dairy people were paid a premium for the high fat content of their milk. Today the opposite is true. With health concerns about saturated fats and especially cholesterol, the emphasis is on lowering dietary fat while increasing protein content. Unfortunately for the milk industry, milk fat and protein content are positively correlated, meaning that as one increases so does the other.

Milk is mostly made up of water, in fact approximately 87% is water. The remaining 13% is a complex mixture of lactose, fat, protein, minerals, and vitamins. The fat globules in raw milk will rise in the milk, forming cream at the top of the container. This is the basis for the comment "Cream rises to the top." that is sometimes said to compliment the good work of a student. The process of homogenization breaks up the fat globules into small enough pieces to keep them in solution. Milk is pasteurized by heating it to 145 C for a few seconds to kill bacterial contaminants, sterilizing the milk.

The following data that was taken from the nutrition labels of half-gallon milk containers. The data is for one serving and is based on a 2000 daily calorie diet. The percentage figures shown in parenthesis is the percentage of the daily recommend value

Milk	Total Fat (g)	Saturated Fat (g)
0 % (skim)	0	0
1 %	2.5 (4%)	1.5 (7.5%)
1.5 %	3.75 (6%)	2.25 (11.25%)
2 %	5 (8%)	3 (15%)

Some interesting questions come to mind.

a. Plot the data for total fat. Do the points appear to fall on a straight line? If so, what is the equation of the line?

b. Repeat part a for saturated fat.

c. Whole milk contains 8 grams/serving of total fat. What is the corresponding percentage of saturated fat?

d. Compare the total fat content (in grams) of 1% milk to whole milk, What is the percentage amount of decrease in fat? (E.g., fill in the xxx in the following sentence. 1% milk has xxx % less fat than whole milk.)

e. What is the percentage of saturated fat in 0.5% milk? In 3% milk?

f. Is the density of milk fat smaller or larger than the density of water? Why?

[6] Queries

a. How many ways can you express 42 using only the integers 2, 3, 4, and 9 and only the operations of addition and multiplication?

b. How many different ways can you express 36 as a product of three integers?

[7] Notices

1. Past issues of the *Vision - Potential* Newsletter are available on our website: www//ContemporaryCollegeAlgebra.org.

2. Deadline for contributions to the October Newsletter is Monday, October 4, 2004. Opinion articles, suggestions for writing assignments, small group in-class activities, small group out-of-class projects, Queries, announcements, etc. are welcomed.

3. To subscribe to this Newsletter, write to Don Small, Department of Mathematics, U.S. Military Academy, West Point, NY 10996 or contact him via e-mail at don-small@usma.edu.