

Vision - Potential

Vision Within Every Instructor - Potential Within Every Student

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[1] Contemporary College Algebra at Virginia Commonwealth University

Yvette Stepanian
Virginia Commonwealth University

Like many other institutions teaching college level algebra as a “Gateway Course,” Virginia Commonwealth University (VCU) has been testing different approaches to improve a desperately high “DFW” rate. We needed a College Algebra that would emphasize the applications of mathematics, enhance the awareness of connections among disciplines (and the world beyond the classroom), and stimulate active student involvement. We knew that “active student involvement” would re-

* Supported by the U.S. Military Academy.

quire much more than a new textbook (how many review copies did each of us receive?); it would require a drastic change in the way this course has been taught.

Talking with Don Small about the approach he advocates for Contemporary College Algebra (CCA) and participating in a CCA workshop in Miami in May 2004, convinced us to

- Restrict the time spent lecturing,
- Require most of the class work be done in groups,
- Expect students to talk, exchange ideas among themselves,
- Expect students, to be more adventurous when given a problem (not just to wait for an answer to be given).

Hence, we adopted Don Small’s term “exploratory learner” and used it to define our primary goal: To develop students to be Exploratory Learners.

Eight pilot sections of CCA were created, each with a maximum capacity of 35 students. Each section meets twice weekly for 75 minutes and once in the computer lab for 50 minutes. Also, each section has at least one undergraduate helper. We decided it was important to us to live this innovative experiment as a team, rather than having each instructor experimenting with the new teaching approach on his/her own. I was asked to be the head instructor because of my past experiments with teaching a course using active and cooperative learning methods (a college algebra pilot-course using *Earth Algebra*, by C. Schauffelle and N. Zumoff, and a course for Liberal Art students), because of my enthusiasm for Don Small’s method, and because of

my conviction that it is the right way to go!

Some of the instructors had experience using an active/cooperative learning method, while others had no experience at all with this teaching process.

My task is to think ahead for the team! I write weekly schedules and lesson plans for everyone, propose weekly quizzes (that individuals can modify), draft tests (that are discussed and modified many times!), provide graded homework, and class activities (graded small group activities). The schedules are flexible enough to respect each instructor's creativity and rhythm while providing enough guidelines so that everyone can cover the same material and prepare for the same tests/quizzes.

At our weekly meetings we discuss the content of assignments as well as the content of given sections. We share what didn't work and what kept the students thinking and talking. We share our frustrations ("I just couldn't stop lecturing today!" "I couldn't get anything out of them today!"), and our pride ("They didn't agree with each other on this example!"). We exchange exercises and hints on how to use some features of the calculator.

Overall, our meetings are very lively; we listen to each other's ideas and make decisions on a consensus basis.

Generally we are excited about the program; we have a sense of freedom and renewal. At times we are very much scared of the unknown ("How can I not lecture?" "How can I not give them the answer?") and sometimes we are filled with uncertainty ("What if the students don't get involved with this exercise?" "What if they don't get along in a group?" "What if I don't have time to cover this exercise?" "What if we don't spend time on their skills?"). Some days we try not to forget to use this exercise/example again.

Then some days we try not to forget never to use that exercise/example again.

As we gain more experience with teaching CCA and become more familiar with student responses, we might not need to meet weekly. Someone who has experience teaching this course might not need as much team support as a novice (although, even for an expert, nothing could be more refreshing than a discussion with a colleague). If we were to extend the number of sections offering CCA, we would only have the instructors, who are unfamiliar with the CCA, meet weekly and benefit from the team support.

So far, we are very satisfied with the results of the students enrolled in the CCA pilot sections:

- The attendance is generally good (much higher than in the more traditional sections);
- The students applied themselves on their first "Fun Project" (even the very few who had a "dysfunctional" group, were able to work out their differences and hand in the project);
- The students did well on the first test (less than 15% were in the D, F categories)

Even though the CCA approach does not emphasize teaching algebraic skills, we do present our tests in two parts: modeling and skills. We teach our students to think about a situation, use (or make up) a mathematical model to solve the problem, and then think about the accuracy or limitations of the results. We feel it is necessary that our students are comfortable working with traditional algebra questions, involving plain algebraic skills. First, because most of our algebra students will be taking one or more mathematical courses (Precalculus, Mathematics for Management) where these algebraic skills are required. Secondly, because the final exam for students enrolled in the CCA-pilot sections will contain some questions common to the traditional sections (these common

questions will be skill based questions). By asking common questions in the final exam, we enable ourselves to measure and compare students from the CCA pilot sections to students from the traditional sections.

This has been a very challenging and very rich experience so far. As we approach the end of the semester I can confidently affirm that the CCA approach is an effective way to involve students with their learning experience.

[2] **Going on a Diet?**

LTC Jack Picciuto
U.S. Military Academy

Solving this problem involves the three major segments to problem solving in the modeling sense—creating a model, solving the model, and then interpreting the results. In creating the model, a system of three equations in three unknowns, it is important for students to clearly define the unknowns. It is expected that students will use technology to solve the system of equations.

Problem. Suppose a certain diet calls for 7 units of fat, 9 units of protein, and 16 units of carbs for a particular meal. You have three foods to choose from for your menu (you can combine the foods):

Food 1: Each ounce of this food, contains 2 units of fat, 2 units of protein, and 4 units of carbs

Food 2: Each ounce of this food, contains 3 units of fat, 1 unit of protein, and 2 units of carbs

Food 3: Each ounce of this food, contains 1 unit of fat, 3 units of protein, and 5 units of carbs

How many ounces of each food type do you need to exactly meet your dietary needs?

Interpretation:

Does the solution make sense in terms of the problem?

How realistic is this problem? What could

go wrong with similar diet type problems? What happens if Food 1 now provides 4 units of fat instead of 2?

What happens if Food 2 now provides 1 unit of fat instead of 3 ?

Make up a similar problem based on calories rather than fats.

[3] **Puzzle**

Two ladies who had not seen each other for several years held the following conversation.

Lady 1: Yes, I'm married and have three fine sons.

Lady 2: That's wonderful! How old are they?

Lady 1: Well, the product of their ages is 36.

Lady 2: Hmmm. That doesn't tell me enough. Give me another clue.

Lady 1: The sum of their ages is the number on the building across the street.

Lady 2: (after a few minutes of thinking): Aha! I've almost got the answer, but I still need another clue.

Lady 1: Very well. The oldest one has red hair.

Lady 2: I've got it.

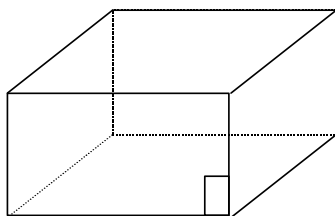
What are the ages of the three sons? (all are integers)

[4] **Storage Shed**

To help students develop their confidence and competence as problem solvers, we should occasionally give them ill posed problems: Problems that require them to make assumptions in order to make the problem tractable. Making and defending the reasonableness of the assumptions is part of the modeling aspect of problem solving.

Problem. Your task is to minimize the cost of a humidity controlled storage facility. The facility is to have 6000 ft³ of space. The cost of the floor materials is \$2 per ft², the cost for wall material is \$4 per ft², and the cost for

ceiling material is $\$3 \text{ ft}^3$. The facility's roof is flat and the door into the facility is made of the same material as the walls.



- a. What is the function that determines the overall cost of materials for the building?
- b. What are the dimensions and the total cost of materials for the least expensive facility? Briefly describe how you solved the problem.

[5] Test Questions

- a. Create a scenario that can be modeled with a decreasing function that is never zero and then sketch the function.
- b. Create a scenario that can be modeled with a periodic function and then sketch the function.
- c. Dianna opened an ice cream shop in her house one block from the main street of a small town. Sketch a graph showing her sales

from April through August. Explain your reasoning in drawing the graph in the shape that you did.

- d. Determine a quadratic equation whose graph contains the points: $(0,5)$, $(2,0)$, $(4,3)$.

[6] Notices

1. Past issues of the *Vision - Potential* Newsletter are available on our website: www//ContemporaryCollegeAlgebra.org.
2. Deadline for contributions to the January Newsletter is Monday, January 3, 2005. 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.