Vision - Potential

Vision Within Every Instructor - Potential Within Every Student

Newsletter of the HBCU College Algebra Reform Consortium*
Number 88, February 2009
www.ContemporaryCollegeAlgebra.org

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[1] Clickers in Courses Below Calculus

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Over the past decade the idea of using Concept Tests in a collegiate classroom has been popularized by the work done by Eric Mazur of Harvard University in the area of Physics. Concept Test questions used in conjunction with a personal response system, sometimes referred to as a clicker unit, allows an instructor to promote active learning in a classroom by asking students to participate in the learning process. An instructor can present his/her students with a mathematical question and the students use their clickers to vote. Each student response is sent to a base station, and the instructor is instantly informed of what the students know or do not know about the topic being covered in class. Results of student responses to the question can be revealed to the class after everyone has had an opportunity to vote. Once the votes are shared with the class, it opens up a great opportunity for the instructor to incorporate both communication and reasoning into the course.

We began using clickers in our teaching about two years ago when the university made a campus-wide purchase of clickers. Since we are one of the few schools around that still uses a textbook rental service, the clickers are checked out to the students when they pick up their textbooks at the beginning of the semester. At other schools, students might be required to purchase them in the bookstore. There are multiple brands of clickers on the market, hence different units offer different features to the user. The units we have at UW-River Falls are the "i-clicker" brand. They are the size of a television remote and they allow the user to vote on multiple choice and true/false questions. Other units allow users to enter numeric answers as well as perform computations like a calculator.

Although clickers could be used strictly as an assessment tool, such as a commercial version of a computerized homework system, we have found that clickers are well suited for allowing students a better insight into their conceptual understanding of a topic. It is also quite beneficial to encourage students to self-reflect on their thinking and to assist them in challenging and changing their thinking when they

* Supported by the U.S. Military Academy.

hold a misconception about a topic. This is very important for many of the students we work with in the courses below Calculus. Question selection during the clicker portion of class is of great importance when trying to meet these objectives. Therefore we try to focus our questions on conceptual understanding of topics, and not so much on procedural skills.

Mathematics is typically not thought of as a course taught from a discussion perspective. Through the use of clickers we have been able to generate more discussion from our students and have them work on their ability to explain their reasoning. We have found that by using the clickers early in the semester, students begin to expand on their ability to reason through why it is they chose the answer they did. Clickers allow students an initial anonymity when first answering the question, thus everyone is encouraged to participate and each student is required to make a decision about the posed question.

Typically we ask students to begin by voting individually, without any discussion with a classmate. Once the initial vote is completed, we ask the students to discuss their vote with someone sitting next to them. We then open up the process for a revote. Depending on the distribution of the votes, this is where a full classroom discussion can ensue. By encouraging discussion amongst group members, students become more confident in their ability to explain their thinking and reasoning. We try to emphasize to students the importance of not only choosing the correct answer, but that they can also explain the reasoning behind their choice to their peers. Through the incorporation of clickers into the classroom, we feel it allows us to reach the fourth mode of the "Rule of Four," verbal communication.

We conclude this article with three examples of clicker questions that could be used in a course below calculus. Correct solutions are in bold print.

1. Based on the table of data below, decide what type of model would best fit the situation.

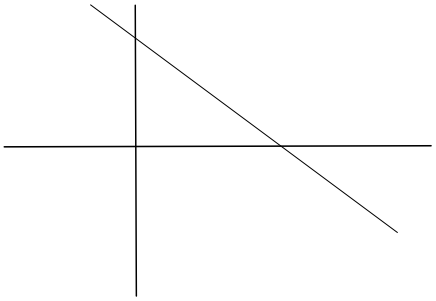
x	0	1	2	3	4
m(x)	3	6	12	24	48

a. Linear
b. Quadratic
c. Exponential
d. Trigonometric
e. None of these

2. By changing the sign on the a parameter in the function, $f(x) = ax^2 + bx + c$, the function's graph will:

a. shift vertically
b. change concavity
c. change the location of its vertex
d. more than one of these is correct
e. none of these are correct

3. Based on the graph below, which of the following are true about the parameters of the function $r(t) = mt + b$?



a. m > 0, b < 0
b. m < 0, b > 0
c. m < 0, b < 0
d. m > 0, b > 0
e. None of these

[2] Parallel Lines Falling in Love

Bernadette Turner
Lincoln University

(Bernadette Turner was inspired to write the following poem by seeing the poetry reading session, led by Editors Sarah Glaz, and

JoAnne Growney, on the schedule of the Joint Meetings in January 2009. The theme of the session was "love and mathematics.")

We started out as just two parallel lines in the plane of life.
I noticed your good points from afar, but always at the same distance.
I assumed that you had not noticed me at all.

But one day, you changed.
You began to transform,
Rotating about one of your incredible points,
I could see it all happening.
You were headed straight for me,
There would be an intersection,
A sharing of a single point...
And we, no longer parallel,
Would have something in common.

As you continued to rotate about our shared point,
I began to observe the symmetry we could make together.
The rotations formed different symmetric spaces between our sides.
As we continued to relish our joining in a single point,
With you rotating about me,
We affectionately named those spaces, "angles".
After a time, we began to wonder,
Exactly what would occur if we further closed the space between us,
Could we possibly intersect in every point?

And then one day my wonderful rotating line
Decided that we could intersect in every point.
What would happen if we did?
Would one of us be lost forever?
Would my awesome rotating line ever want to rotate again?
But, as my gallant line observed, our sharing could be more complete this way.
So I said 'yes'.
And so we became one line.
What bliss!
We were everything together, although,
We were one line—Intersecting itself in every point.
No more rotating—this joining went on to infinity.

[3] Municipal Solid Waste (MSW) - Generation and Recycling

The emphasis on recycling has increased as our country has become more environmental and energy conscious.
a. Using the following data, taken from the United States Environmental Protection web site, determine the pounds of recycled waste per person per year and then plot the results.

Year	MSW Waste (million tons)	% Waste Recycled
1960	88.1	5.6
1970	121.1	8.0
1980	151.6	14.5
1990	205.2	16.2
2000	239.1	29.0
2007	254.1	33.4

b. The amount (lbs) of waste recycled has increased, but so has the country's population. Determine how the daily, per-capita generation of waste (lbs/person/day) from 1960 to 2007 has changed and plot the results.

Year	Population Millions
1960	179.98
1970	203.98
1980	227.26
1990	249.91
2000	281.42
2007	301.62

c. Determine the average daily amount (lbs) of waste recycled per capita from 1960 to 2007 and plot the results.

[4] Fly or Drive?

Over the past year several airlines have raised rates and reduced service to many of the smaller airports. This often creates the question for the person traveling to a city served by a small airport: Should I pay the higher fare and fly directly to my destination or should I fly to a larger airport (at a lower fare) and then drive to my destination? For example, Don wanted to travel to Corpus Christi, TX from New York, NY. The airfare to fly into Corpus Christi was considerably higher than it was to fly into San Antonio, TX, 150 miles away from Corpus Christi. Develop a list of considerations that Don should take into account in deciding whether to fly to San Antonio, rent a car, and drive to Corpus Christi or fly directly to Corpus Christi. Clarify each consideration with a sentence or two of explanation.

[5] Queries

a. If $f(x) = ab^x$ with $a > 0$, for what values of b is f increasing (decreasing)? Explain.

b. How much would each person in the United States have to pay if the cost of the government's proposed $850 billion stimulus package was charged to each person equally?

c. Consider the multigraph of the two functions $f(x) = 3x$ and $g(x) = \frac{1}{2}x$ for $x \geq 0$. Does the graph of the average of these two functions bisect the angle formed by the graphs of f and g?

[6] Wake-up Exercises

These are individual or small group exercises for the beginning of class to help students mentally transfer from their previous activity to your mathematics class.

a. Let f(x) = 1.1 $(1.2)^x$. If f(x) = 10, what is the value of x?

b. Graphically determine the zeros of the function $f(x) = 3x^4 - 3x^3 - 18x^2 + 12x + 24$.

[7] Notices

1. The sixth edition of *Contemporary College Algebra: Data, Functions, Modeling* by Don Small is now available. Contact Kathy Kilburg (563-584-6322, Kathyj_Kilburg@mcgraw-hill.com) for an examination copy.

2. http://usmasvdzdeanext/departments/math/HBCU/ is a resource website for the seventeen HBCUs in the U.S. Military Academy's program to assist HBCUs in refocusing their college algebra courses, as well as for anyone else interested in refocusing college algebra.

3. MAA PREP Workshop: REFOCUSING AND REMODELING COLLEGE ALGEBRA, will be held June 1-5, 2009 at the University of Wisconsin-River Falls. Facilitators are: Don Small, Erick Hofacker, Kathy Ernie. To register or learn more, visit www.maa.org/PREP.

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

5. Deadline for contributions to the March Newsletter is March 1, 2009. Opinion articles, suggestions for writing assignments, small group in-class activities, small group out-of-class projects, Queries, announcements, etc. are welcomed.

6. 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.