Vision - Potential

Vision Within Every Instructor - Potential Within Every Student

Newsletter of the HBCU College Algebra Reform Consortium*
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[1] The Status and Purpose of College Algebra

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Each year, over 1,000,000 students [7] take College Algebra and related courses. Most of these courses were originally designed to prepare students for calculus, and most are still offered in that spirit to move as many students as possible up the "pipeline" to become math majors or to serve the traditional needs of the physical sciences.

But, STEM majors are only a small fraction of the students we face. In 2007, about 728,000 Associates degrees were awarded, 827 (under one-tenth of 1% of the total) in mathematics and 3404 (less than half of 1%) in the physical sciences and science technologies [8]. Similarly, about 1,524,000 Bachelor's degrees were awarded, 14,954 in mathematics and statistics (under 1% of the total) and 21,073 (less than one-and-a half percent) in the physical sciences.

Furthermore, most STEM programs expect that in-coming students are ready for mainstream calculus. However, very significant changes have taken place in calculus enrollment. Today, many more students take calculus in high school than in college [7, 2] and calculus is well on its way to becoming a developmental course.

Why then do students take College Algebra? How many are successful? What happens to those who pass? Herriott and Dunbar [6] found that only about 10-15% of the students taking College Algebra at about 15 universities are in majors that require calculus (usually applied calculus). Waller [9] reports that only 2-3% of more than 1000 students who start College Algebra at the University of Houston – Downtown each Fall ever go on to start Calculus I over the following 3-year period. Herriott and Dunbar [6] also report that only about 10% of the students at the University of Nebraska who successfully completed College Algebra over the past 20 years ever started Calculus I during the following four year period; almost none started Calculus III. Results at several two-year colleges are somewhat better. Both MacGowen and Agras report that perhaps 15% of the students who successfully complete College Algebra have subsequently started Calculus I at both William Harper Rainey College and at Miami-Dade College, respectively. This higher percentage can probably be attributed

* Supported by the U.S. Military Academy.

to the fact that the two-year students are older and more mature, and take their courses more seriously. Also, at two-year colleges, College Algebra tends to be taught by full-time and experienced part-time faculty compared to universities, where they are usually taught by TAs. Moreover, DFW rates on the order of 50%-75% appear to be the norm, nationwide.

It is increasingly evident that virtually none of the students we see in College Algebra will ever become STEM majors. We are guilty of providing the overwhelming majority of our students with mathematical experiences that are not useful to them.

What the Other Disciplines Need

There are two key questions that need to be addressed:

1. Why do all these students take college algebra?
2. What do these students really need from college algebra?

Many students are funneled into these courses using placement exams based on the traditional mathematics sequence. Many advisors tell students to take these courses because they also think of the traditional sequence. Many more take these courses to fulfill Gen Ed requirements, particularly at public universities. However, most students take these courses as prerequisites/co-requisites for introductory courses in other fields or as requirements for majors in those fields. This is especially true of almost all non-major courses in the laboratory sciences and in business and economics. It is also true for many majors in the softer sciences, including many biology, earth and space sciences, and even some chemistry programs.

But, what do these disciplines really need their students to learn in introductory mathematics? To find out, the MAA's committee on Curriculum Renewal Across the First Two Years (CRAFTY) conducted its Curriculum Foundations project. Leading educators from 25 fields participated in discipline-workshops where they discussed the current mathematical needs of their field and developed recommendations to the mathematics community. The recommendations from the first round of 17 Curriculum Foundations workshops are in [4]; the remainder will appear soon.

There is an amazing degree of convergence in the mathematical needs of students in almost every one of the quantitative disciplines, namely:

- Conceptual understanding is far more important than rote manipulation.
- Realistic applications and mathematical modeling that reflect the way mathematics is used in other disciplines and on the job
- Fitting functions to data
- Statistical reasoning
- The ability to use technology routinely and wisely.

These recommendations have some extremely important and significant implications for mathematics education, particularly at the College Algebra level. We will look into some of them in more detail in a follow-up article in the October issue of this Newsletter.

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3. CUPM Curriculum Guide 2004: A Report by the Committee on the Undergraduate Program in Mathematics, MAA, 2004.

4. Ganter, Susan and Bill Barker, The Curriculum Foundations Project: Voices of the Partner Disciplines, MAA Reports, 2004.

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6. Herriott, Scott and Steve Dunbar, Who Takes College Algebra?, PRIMUS, 2009.

7. Lutzer, David J., Stephen B. Rodi, et al., CBMS 2005: Statistical Abstract of Undergraduate Programs in the Mathematical Sciences in the United States, AMS, Providence, 2007.

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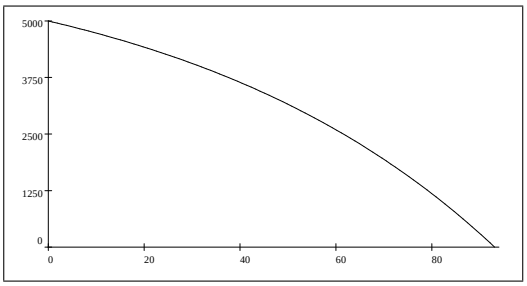
9. Waller, William, Tracking Students from College Algebra, (unpublished manuscript).

[2] Jessica's Credit Card Debt

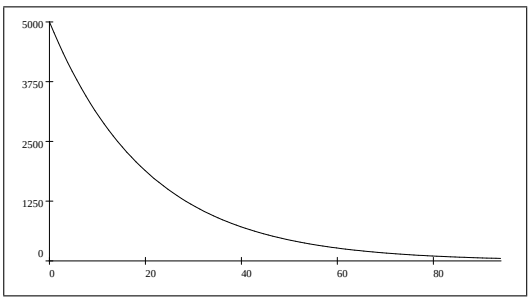
Jessica has decided to tear up her credit card and to pay off her \$5,000 debt by paying \$100 per month (the minimum required payment). The credit card company charges her 1.5% interest per month. In order to gain a sense of how her debt will decrease with her monthly payments, she asks two friends to sketch a graph showing the amount of her debt over time. They draw the following two graphs, but cannot agree which is the correct one. They turn to you for help. Which, if either, of the two graphs is correct? Explain your reasoning.

(The horizontal axis displays the number of months and the vertical axis displays the amount of Jessica's debt.)

Friend A's Sketch



Friend B's Sketch



Create a recursive sequence modeling Jessica's debt and then determine how many months it will take to pay off her debt? How long would it take if she paid \$150 per month?

[3] Driving the Maine Turnpike

Two brothers, Mike and Jonny, drive toward each other from opposite ends of the 100 mile long Maine Turnpike. Mike drives with an average speed of 64 miles per hour and Jonny, leaving 15 minutes after Mike left, averages 72 miles per hour. When they pass each other, which brother has driven the greater distance? What was his distance and how long did it take him?

[4] Graduation Rates

President Obama, foundation spokes persons, Governors, State and National Education officials are sounding the alarm bells over our decreasing graduation rates. Last summer in his education speech at the University of Texas, the President noted that over the past decade the United States had fallen from first

place to 12th among the 36 countries in the College Board's study on the percentage of the population with an associates or higher degree. He highlighted three reasons for this slippage.
1. Rising costs - college costs increased approximately 439% from 1982 to 2008 compared to a 147% increase in the median family income.
2. A disconnect between skills learned and skills needed.
3. Dropout rates - more than a third of US college students fail to complete their degrees within six years.

Although we may not be able to affect the rising costs issue, we can and should address the second and third reasons. In particular, we need to take a serious look at our courses below calculus. There are thousands of students in these courses that will never earn a degree. We need to understand the student population for each of these courses - their background, their circumstances, and their goals. We need to reevaluate each of the courses - their goals, pedagogue, and content. Most importantly, we need to focus on creating positive student attitudes towards mathematics and building student self-confidence.

I encourage you to send me your comments and ideas so that we can carry on a discussion through our Newsletter on refocusing courses below calculus, Don Small, Editor.

[5] Notices

1. Joint Mathematics Meetings, New Orleans, LA, January 6-9, 2011

2. **Reunion for Those Interested in Refocusing College Algebra**

   Joint Mathematics Meetings, New Orleans, LA

   Friday, January 7, 5:30 p.m. – 7:30 p.m., Grand Chateau, Sheraton Hotel

   Organizer: Don Small, US Military Academy

   Sponsor: CRAFTY

   Abstract: A national movement to refocus college algebra has developed over the past ten years. Refocus courses emphasize modeling in the problem-solving sense, elementary data analysis, and interpreting graphs. A familiar exercise is to plot given data, fit a curve to the scatterplot, and use the resulting function for predictive purposes. Pedagogically, refocused courses are student-centered and emphasize group work. Developing communication skills and self-confidence are important characteristics of these courses.

   The reunion will consist of a two-hour discussion/presentation of refocusing college algebra. Several people who are active in the movement will describe their activities.

   In order to ensure adequate space, persons planning on attending are encouraged to contact Don Small at donsmall@usma.edu.

3. Deadline for contributions to the October Newsletter is Friday, October 1, 2010. Opinion articles, suggestions for writing assignments, small group in-class activities, small group out-of-class projects, Queries, announcements, etc. are welcomed.

4. 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.