Response to position papers by William Fox and Scott Herriott

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Both of these papers clearly outline what I believe to be some of the most important difficulties with traditional college algebra. Some of the most striking are as follows.

- The content of college algebra has traditionally been driven by the perception that students are preparing for a main stream calculus course when in fact few college algebra students go on to calculus.
- The DFW rate is extraordinarily high.
- Many students enter the course with a strong fear of and dislike for mathematics, and many exit with these fears and dislikes reinforced.
- College algebra is often used as ”the math requirement” which must be fulfilled by all students. As such it is attempting to serve a truly diverse audience.

The idea that college algebra students are preparing for calculus is widely held in the mathematics community. The statistics at OSU agree with those I have heard quoted elsewhere and flatly contradict the widely held view. In fact, at OSU, the vast majority of college algebra students never enroll in any further mathematics courses. Many students put off taking college algebra until (what they hope to be) their final semester in college. This says a great deal about just how important a knowledge of traditional college algebra is to those students' majors.

At OSU a study was made to determine why departments across campus which require college algebra but not calculus send their students to the mathematics department. What knowledge or skills are they expecting their students to gain from the course? We talked formally with people from departments all over campus. We heard any number of things including the following.

Understand the relationships between formulas, graphs, data tables, and verbal descriptions.

Understand what a mathematical model is and, at least in elementary situations, know how to go about constructing one.

Be able to use a computer or calculator to perform linear and exponential regression and to interpret the meaning of the formula produced.

Have a qualitative understanding of rates of change.

Absolutely no one even referred to such things as factoring, simplifying complicated expressions, the quadratic formula, radicals, etc. This is by no means an exhaustive study, but perhaps it points to the need for one. I would really like to see a study that includes state universities, state colleges, liberal arts colleges, and community colleges from around the country. A definitive statement of what various disciplines are expecting their students to learn in college algebra would be most helpful to anyone seeking solutions to the college algebra problem.

Exiting student's attitudes about mathematics is quite important. For many, experience in college algebra will shape their life time impression of mathematics and its value. Aside from the natural desire to have people appreciate the discipline we love, the practical consequences of influential people such as public policy makers believing that mathematics is stupid and worthless are obvious. It is my position that most humans could benefit from some basic mathematical skills, and that a curriculum which truly addresses their needs should be developed.

The audience served by college algebra is perhaps the most diverse of any on campus. Students enter the course with a myriad of expectations and needs. I am somewhat skeptical that any single course can appropriately serve the needs of all beginning students. I think students who want to take calculus but are not prepared should take a course called precalculus. That still leaves a large collection of students needing an entry level mathematics course. About five years ago we at OSU instituted (in addition to precalculus) a three track entry level mathematics program. We have traditional college algebra, a "math appreciation" course using the COMAP book, and a math modeling course (using the *Functions and Change* text by Crauder, Evans, and Noell) which has many features in common with the Francis Marion course. Today, among students who would traditionally take college algebra, about 40% take college algebra, 40% take the modeling course, and 20% take the math appreciation course. Some of the key features of the modeling course are listed below.

- Course content is completely driven by real applications, and new ideas are introduced in the context of problems drawn from other disciplines and from scientific literature.
- Nonlinear symbol manipulation is largely supplanted by use of the graphing calculator.
- Data handling including linear, quadratic, and power regression is a prominent part of the course.
- A qualitative idea of rates of change pervades the course.

- Group projects and hands-on experiments are an optional (but much encouraged) part of the course.

This three track system has produced dramatic results. The DWF rate is much improved (from 40 to 50% in the past down to a current rate of around 30% or less), the university retention rate has improved, and students are much happier with their entry level mathematics experience. I personally think it is the most successful educational innovation ever implemented by the OSU mathematics department. And I can shed some light on how the upper administration feels about tangible improvements made in college algebra. In the 30 years I have been at OSU, the mathematics department has, sadly, received exactly one new faculty position. We got it two years ago as a result of what we had done with entry level mathematics.

I believe the current state of college algebra gives the mathematics community some serious problems to deal with. Of course, the first step in solving it is recognizing that it exists. We need to spread the word as well as make people aware of a number of projects in various stages of development which are designed to confront the college algebra issue.