An urgent call to improve traditional college algebra programs

An Urgent Call to Improve Traditional College Algebra Programs

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Traditional College Algebra is not working. That was the strong consensus of the participants in a recent Conference to Improve College Algebra, held at the U.S. Military Academy, February 7-10, 2002. The Conference, supported by the HBCU Consortium for College Algebra Reform, was organized by the MAA’s Task Force on the First College-Level Mathematics Course. The forty-five educators from twenty-seven states represented diverse educational experiences and positions. Seven invited speakers provided the background and challenges for breakout groups to define major issues, create visions, and develop recommendations to enhance college algebra programs. Scott Snook (U.S. Military Academy and Harvard Business School) opened the Conference by discussing why organizational change often fails. The keynote speaker, Arnold Packer (Senior Fellow and Chair of the SCANS 2000 Center at Johns Hopkins University’s, Institute for Policy Studies) presented a view of how revamped college algebra programs could address the quantitative needs of citizens, consumers, and producers. Mercedes McGowen (William Rainey Harper College) and Steve Dunbar (University of Nebraska) drew upon the 2000 CBMS survey and long-term studies at their individual institutions to examine demographic profiles of students in college algebra and precalculus. John Dossey (Illinois State University) traced the historical development of College Algebra and then discussed the Pacesetter math program. “Quantitative Literacy and College Algebra” was addressed by Bernie Madison (University of Arkansas and MAA) and Dennis Davenport (NSF) spoke on “Managing Change and Financial Support Opportunities.”

College Algebra, according to the 2000 CBMS survey, has the largest enrollment—approximately 400,000 students (Fall, 2000)—of any credit bearing mathematics course, being approximately equal to the combined enrollments in all calculus courses. In 1980 College Algebra enrollment was only 73% of the combined calculus enrollments. Although the enrollment in College Algebra is large and continues to grow, the role of College Algebra in the mathematics curriculum is very unclear. A traditional role for College Algebra along with Precalculus is to launch students into calculus; however less than 10% of College Algebra students enter Calculus I. Furthermore the combined enrollments in College Algebra and Precalculus have grown approximately 32% since 1980 while the Calculus I enrollments have remained relatively constant.

The pragmatic reason most students take College Algebra is to fulfill a college or state requirement. As such, the course is the terminal mathematics course for many students. What then should the content be? Participants in the Conference rejected the traditional content—factoring linear and quadratic polynomials, radicals, absolute value, determinants, Cramer’s rule, etc.? with its emphasis on algebraic manipulations as suitable for a last mathematics course. One participant commented, “Interpreting data has become more important than manipulation of algebraic skills that can be computerized.” Another, who is a Dean of Science and Mathematics, said, “Traditional College Algebra is a boring, archaic, torturous course that does not help students solve problems or become better citizens. It turns off students and discourages them from seeking more mathematics learning.”

The high FDW rate—percentage of students receiving grades of F or D or withdrawing—is a major reason for the claim that traditional College Algebra is not working. Several studies have reported FDW rates in the 40-60% range. Although no national studies have been conducted, these FDW rates are generally accepted as being typical. Thus, College Algebra blocks academic opportunities and plans for approximately 200,000 students per semester. Participants agreed that we should not accept this constraint of human potential or ambition.

Many factors contribute to the FDW rate—high school preparation, placement, content, attitude, pace, pedagogy, etc. Noteworthy, however, is the fact that several improved College Algebra programs have succeeded in lowering FDW rates by 15 to 25 percentage points while reversing the negative attitudes of students towards mathematics. Students in these programs were drawn from the same pool and were subject to the same placement as students in the traditional sections. The difference was the content and the pedagogical focus.

The vision espoused at the Conference is to create programs that empower all students to become confident problem solvers. These programs, motivated by real-world problems, address the quantitative needs of other disciplines as well as those for citizenship and the workplace. They incorporate strong communication components and employ technology to enhance conceptual understanding and computing. These programs should also prepare and encourage students to take additional quantitative courses.

The Conference participants recommend the following as major characteristics of a College Algebra program:

- Real-world problem based: a topic is introduced through a real-world problem and then the mathematics necessary to solve the problem is developed. Example problem: Schedule a multi-faceted process.
- Modeling (transforming a real-world problem into mathematics): - using power and exponential functions, systems of equations, graphing, and difference equations? primary emphasis is placed on creation of a model and interpretation of the results. Example: Model the stopping time versus speed data presented in a driver’s manual by plotting the data and fitting a curve to the plot. Interpret how well the resulting stopping time function models reality at small speeds. Revise the model, if necessary, to account for zero stopping time at zero speed. Use the (revised) function to predict stopping times for speeds not given by the data. Revise the model to account for different road surfaces.
- Emphasize communication skills: as needed in society as well as in academia? reading, writing, presenting, a
Colleges get ‘urgent call to innovate’. Community Colleges. August 20, 2018. college-level courses for credit. Some will be assigned to “concurrent support” services such as tutors in the classroom or attending extra study hours. One popular type of support is called the corequisite model, a separate class that students take to reinforce key concepts. The new law allows colleges to use high school performance rather than placement tests to evaluate whether students are ready for college-level math or English. College algebra students had a statistically significant change in their enjoyment of mathematics. Although the other attitudes, confidence, motivation, and value did not have a statistically significant change, the qualitative data indicates a change in these attitudes did occur. This study identified that cooperative learning, problem-solving, discourse, and graphing calculators increased student confidence in doing mathematics because they felt more competent in working problems on exams. Treisman calls college algebra “the most failed class in America”, and notes that it systematically culls a significant percentage of STEM students each year in the U.S. Developmental math presents the greatest challenge at the two-year college level. As mentioned above, 85% of the 2.1 million CCCS students are placed into developmental math classes upon entry. "mastery learning to scale," which he showed was a fundamental part of classroom practices that can improve student learning by two standard deviations (Bloom 1984). This blend, appropriately mediated by instructors, has been developed and proven effective at scale. Collaboration with faculty in other disciplines and with representatives from the workplace is important to the improvement of College Algebra and in on-going assessments of the program. This collaboration helps ensure that content will better align with student interests and needs which is often lacking in the traditional College Algebra program. This collaboration also establishes bridges to other disciplines that enhance embedding qualitative literacy throughout the academic program.

In the final analysis, curricula and syllabi are local in nature, as is the means for implementing change. Thus, the task of everyone involved with College Algebra is to engage colleagues, administrators, and local business people to improve the role of College Algebra in our educational system and in the effectiveness of the present programs.