

Implementing Reform Methods of Teaching Mathematics In a Traditional and Conservative Department

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Abstract

The Mathematics Department at Westchester Community College is fairly conservative. Most members of the Department were skeptical and not very knowledgeable about mathematics reform and the American Mathematics Association of Two-Year College’s Crossroads in Mathematics, Standards for Introductory College Mathematics before Calculus. The Department is known for its excellent teaching and its strong and traditional mathematics courses. It is therefore difficult for most of the faculty to consider making dramatic changes in the curriculum or in teaching pedagogy.

The presenter will discuss the strategies used to overcome the Department’s initial resistance in developing a Reform College Algebra course, the challenges encountered in implementing the course and how these challenges were met. The presenter will also discuss her experiences in teaching such a course for several semesters and how she dealt with students’ resistance and eventually encouraged them to have a more thoughtful approach to their learning of mathematics. The Department has been more receptive now to introducing some reform in Precalculus and upper level courses.

The session participants will have the opportunity to work in groups with the TI-83 in solving problems that promote exploration, critical thinking, and modeling.

Introduction

At the 2000 Asian Technology Conference in Collegiate Mathematics presentation, I described the history of how I was able to overcome the initial resistance of a conservative and fairly traditional Mathematics Department at Westchester Community College to make some changes in teaching pedagogy and to implement the use of technology (Tan, 2000). It took seven years to convince our colleagues to use graphing calculators. Now all our Precalculus classes and beyond requires the TI 86. We also use the TI 83 in Statistics. I continue to assist members of the department in transforming our

teaching of mathematics and embracing the use of technology such as graphing calculators, various computer software, and the Internet.

This paper is based on the work that my colleagues Mel Bienenfeld, Rowan Lindley, Sheela Whelan and I collaborated on for four years. Most members of our department were skeptical about letting us do anything new and different. This is understandable since only a few of us attend conferences like the American Mathematical Association of Two-Year Colleges or the International Conference on Technology in Collegiate Mathematics. Fewer still are enthusiastic about mathematics reform and the AMATYC Crossroads initiative.

Catalyst for Change

We wanted our students to experience how mathematics can be taught and learned other than using the traditional methods and curriculum. It was the 1997 American Mathematical Association of Two-Year Colleges and the New York State Mathematical Association of Two-Year Colleges joint summer faculty institute held in Poughkeepsie, New York that provided the catalyst for us to reform our College Algebra course. We chose College Algebra because it is a course with a large enrollment as well as a terminal mathematics course for many of our students. Moreover, since College Algebra has high failure and withdrawal rates, we thought it would cause less resistance from the other members of the department if we were to make changes at this level. We organized a faculty conference and invited outside experts to talk about mathematics reform at WCC. After much discussion the department gave us permission to teach four pilot sections of Reform College Algebra, starting in the spring of 1998.

Preparation

We knew we had a lot to learn and started to prepare for the course during the fall 1997 semester. We held weekly meetings and continued to meet regularly for two more semesters. It was an invaluable experience to collaborate on everything from preparing the syllabus, selecting the textbook, preparing teaching notes and supplementary materials, and even common examinations. The mutual support we gave each other was helpful in learning new ways of teaching and in dealing with problems and frustrations. We gave each other feedback on how things did or did not work out as planned. It was fun to share our excitement and enthusiasm in our project.

We had to be flexible and realistic about time constraints since we expect students to work on extensive explorations in which they investigate algebraic concepts through use of a guided activity. We had to remind ourselves to keep to our resolution that depth is more important than breadth. We knew that students would need time and a lot of help both in using the TI 83 and in learning how to work in groups. We wanted our students to have time to absorb these new ways of learning and to do that we realized that we must help the students first overcome their initial resistance to doing something new.

We were fortunate to be able to arrange for two tutors to sit in on the class during the spring 1998 semester. We provided training for tutors at our Academic Support Center and provided additional tutorial help for our students through our Calculator Club (a student club I started in 1993). We encouraged students who have poor study skills and those with deficient pre-requisite skills to use the tutorial help. Many students complained and struggled with doing homework that have more than one possible solution and that involved writing. To enhance their effectiveness we kept the tutors informed of course developments such as upcoming exams, projects due dates, and shared our handouts and solution sets.

The syllabus included the following topics:

- Collecting, reading, interpreting and visualizing data
- Functions and fitting functions to data
- Average rates of change, slope
- Generating linear functions
- Systems of equations
- Exponents and logarithms
- Exponential functions, growth and decay
- Quadratic functions

Initial Results

Here are some of our observations, concerns, and the results after the first semester:

- We had hoped that the reform methodology would begin to address issues of poor attendance, low retention and low pass rates that are traditionally experienced in our College Algebra classes. At least in our first attempt, there was little to no improvement in these areas.
- We found that the students experienced great difficulty adjusting to new expectations regarding their performance (for example, answers in writing, non-mechanical modes of thinking, no cookbook procedures to follow).
- Although many students experienced difficulty learning to use their calculators they eventually grew to like them and find them helpful.
- Certain students, particularly the most mature, were very enthusiastic about a math course that was more real world based, but others were upset that they weren't getting the same old stuff. Some students just didn't understand the objectives of the course.
- Most students enjoyed the group work and it usually held their interest.
- Students needed careful guidance in the exploration activities, homework assignments, and preparation for exams. This is because they were used to math as learning a series of procedures and not used to open ended questions.
- We were (and still are) convinced that we were doing the right thing, mainly because of feedback from and the performance of those students who did assimilate the objectives of the course. (Bienenfeld et al., 1998)

Modifications

To address some of our concerns and improve success in subsequent semesters we made the following changes:

- We taught some sections at night. These sections meet only once a week instead of three times a week during the day classes. This helped improve the flow of the lessons. There were more mature students in the evening classes and they tend to work harder and appreciate the course.
- We wrote more supplements for the textbook, rewrote the solution sets, and prepared a customized version of the text for our students.
- We improve the balance between lecture, group work and other class activities.
- We were more flexible as regards the contents, eliminating certain sections when necessary to enable more time to be spent on essential concepts.
- We developed a technology lesson with homework for the second week of class to teach the students the fundamentals of calculator use. This encouraged the students to purchase their calculators earlier instead of waiting till several weeks into the semester. We have tried various calculator swap and loan programs to help students.

At the end of the first semester, we gave a half-day symposium to the rest of the math faculty. The highlight was a panel of students who spoke about their experiences and answered questions from faculty. The students were quite articulate and spoke with more enthusiasm than we expected since we chose students with varying abilities. They impressed everyone with their description of what they had gained from the course, particularly about the usefulness of math in the real world.

Continuing Concerns

In spite of their positive response to the student panel, our colleagues were still not interested in mathematics reform. We decided to continue to have dialogues with the department about implementing reform in our courses. A compromise was eventually agreed upon. As of the fall 2000 semester, the College Algebra classes used the same syllabus and required the TI 83. We were allowed to continue teaching our reformed College Algebra course while the rest of the department selected a textbook that they considered less radical.

As of June 2001, I have taught the course five times. My three colleagues have taught it every semester since 1998 and also during the summer sessions. We recently lost one colleague to the Computer Science Department when it became a separate department. Though serious problems remain, the four of us still believe that our students are getting a better mathematical experience. These have been our most troubling concerns:

- Students are aware that there are two different types of College Algebra being offered and some do not like being in a non-traditional class they feel requires more work. We

listen to their concerns and discuss the merits of the course. Whenever feasible we allow a few students who strongly wants a more traditional approach to transfer out.

- Students are not used to thinking and solving problems that are not just replicas of what they see in the classroom. We train and guide students through a number of exploration activities and model problem solving techniques and strategies. To reinforce these skills, we give full credit only when the solution is completed as required. Whenever possible we allowed some students to have additional time during tests.
- Most students do not like to have to write in complete sentences in a math class. Even at the end of the semester, some students continue to have great difficulty with answering open-ended questions with appropriate verbal expressions.
- Students fear the complexity of using the TI 83. We remind them to learn a few features of the calculator at a time and as needed. Those who take the time to learn to use it are delighted and appreciate its power in helping them understand and solve problems.
- Students have to be taught how to work collaboratively and this take time. We constantly had to pay attention to the pacing and in-class balance of the course.
- The retention and passing rates are about the same for the reform course compared with the more traditional course. We find that very few students go on from College Algebra to Precalculus. When we did a comparison, the reform students did better in Precalculus but the numbers were too small to be statistically significant.

Conclusion

We have made some progress in convincing our colleagues that the reform course would prepare students for Precalculus and beyond. Our colleagues main concern is that not enough time is spent in reinforcing algebraic skills. We continue to enjoy teaching our course and hope that we have set the stage for further reform in our departmental course offerings.

Among the students who remain at the end of the semester, more students in the evening sections have a generally positive attitude response when asked whether they thought the reform approach was better than the traditional. Although many of them complained early in the semester about how complicated it was to use the graphing calculator, they appreciated its power and found it very useful. Those students who understood the objectives of the course were most enthusiastic and excited about seeing how much math is used in real life. It is most gratifying to see students who struggled through the course and end up so amazed at how much they were able to accomplish and learn.

References

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