About the Author

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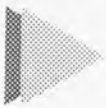
The BETA Project: A Mathematical Perspective



Gary S. Itzkowitz

I. Introduction and Background

Last year, quite by accident, I picked up a newspaper and spotted an article about a U. C. Berkeley math professor named Uri Treisman. The idea that a newspaper would feel that a math professor was newsworthy intrigued me so much that I read the article. It pointed out that brilliant Black students at Berkeley flunked Calculus while White students didn't, and told how Treisman investigated this situation, discovered the reasons, and devised a solution—so that now those Blacks that go through his program have a lower flunk rate than White students.

This article is about Treisman's solution and our attempts to apply it at Glassboro State College. A number of synchronous events made our BETA project (Better Efforts Towards Achievement) a reality. First, our Dean, Minna Doskow, also read about and was inspired by Treisman. She then urged me to start a project right here at GSC. Next, the New Jersey Institute for Collegiate Teaching and Learning (NJICTL) sent me an invitation to hear Treisman speak. At the same moment that I was getting interested in Treisman's work, so was Martin Finkelstein, Director of the

NJICTL. He brought Treisman in as a Scholar in Residence for New Jersey colleges for a whole year. Going to hear Treisman was inspiring for me. A charismatic speaker, he convinced me that there was something positive that I could do right here in the wilds of Glassboro.

What Treisman had discovered is that most Blacks and Hispanics came from a culture that was anti-academic. Students in this milieu could not speak to their friends about school or their problems in class. They had to do their school work in complete isolation. While this technique worked in high school, it was a formula for disaster in college. Treisman designed workshops to help these students learn how to study properly. His ideas came from watching the very successful Chinese group study habits and from Treisman's own Jewish background with traditional Talmudic group study techniques used in Yeshivas. He chose to integrate his workshop ideas into the calculus course because calculus was the gateway into all mathematics, science, and engineering programs. It was also the course that tended to be the great killer course for people going into the technical professions.

The fact that calculus was the killer stemmed from a peculiarity of the late 1950s. Historically, only about three-tenths of one percent of our high school graduates want to be mathematicians. Also historically, this small number of mathematicians was all that our society needed. Then, two things happened: Sputnik and the dawn of the computer age. All of a sudden, the number of math majors jumped to about four-and-a-half percent of the high school graduating class. The colleges were not prepared for this. The response was to use calculus to weed students out of the major. In the course, huge amounts of material were presented in a very uninteresting manner for the simple purpose of discouraging as many students as possible. Well, it worked. We are now back to our historical small numbers of budding mathematicians. Unfortunately, in this new technological age, we need great numbers of mathematicians. Treisman's

workshop was designed not only to help students survive a killer course like calculus, but to get them excited about mathematics.

At Treisman's Rutgers talk, he not only mentioned the success of these workshops but also the need to revise and decompress the syllabi of both the Calculus sequence and Pre-Calculus Math. As I thought about his talk, I realized that any successful program at GSC must have both elements: workshops and curriculum revision. I then set out to create such a program. I realized this ambitious project was going to take a great deal of effort, time, and money—and I didn't have any money. Again, synchronous events brought this project into existence.

Finkelstein called me shortly after Treisman's talk and asked if I would be willing to develop a workshop project at GSC. When I agreed, he immediately said that he could give me a few thousand dollars for seed money, provided my Dean would match his money. I knew Dean Doskow was enthusiastic about this idea, and it wasn't hard to get her financial commitment. She matched his money with six credits of released time, and Finkelstein formally gave me a grant of $2500. This got the ball rolling, but the amount of money was not enough to do what I contemplated. The next synchronous event occurred when I bumped into Jane Sullivan, who told me she was writing a grant proposal to the Department of Higher Education to use state monies to create a writing workshop using Treisman's ideas. As soon as I told her what I was trying to do, she invited me to join her in writing the proposal. She wrote most of the narrative, I contributed the math ideas, and Dolores Harris worked out the budget. In mid-August, DHE granted us $50,000 for our project. Now we had to scramble. We only had two weeks before school began, and everything had to be in place before then: the students, the faculty, the student mentors, and a place to meet!

The easiest part of the project was recruiting the faculty team. With a minimum of persuasion, Tom Osler and Evelyn

Weinstock agreed to head the curriculum revision. Ron Czochor and Marcus Wright agreed to run the workshop. Getting student mentors was a matter of approaching a few of our top majors; they were almost instantly excited. Finding a place to meet was a real headache. We needed a large room with small tables so that small groups of two to four students could work undisturbed. No such room existed. We needed to build this room by tearing out the wall between two offices, a delay that hurt us. We were not able to begin the workshops until the fourth week of the semester. For the math workshop, this meant losing sixty percent of our hastily recruited students.

II. Description of the Workshop

After being notified in mid-August that we had our grant, we immediately set to work finding students. Ollievita Williams in the EOF office helped us find qualified minority freshmen. We found one minority student ready for Calculus and twelve ready for Pre-Calculus Math. Since our grant was for developing methods for retention of minority students, it was obvious that we couldn't start the workshop with Calculus. We decided to begin where the students were—with Pre-Calculus Math in the fall and Calculus I in the spring.

We were constructing an elite program. This workshop was not for the purpose of tutoring the weakest students. In the workshop the students were going to be doing problems much harder than they would get for homework in the basic course. These students were required to sign up for regular sections of Pre-Calculus Math in addition to this non-credit workshop. We hoped that the work the students did in the workshop would help them to soar in their classwork. With this in mind, we created a letter of invitation to send to our possible recruits, telling them of this achievement program. Before sending the letter, we needed to find some qualified non-minority students, too. Experience at other schools had shown that an all-minority program, no matter how well

meaning, is automatically presumed to be a remedial program, which is precisely what these minority students did *not* need. After we found our qualified students (about thirty-five people), the letters went out. About seventeen accepted our invitation, even though no credit was involved. Unfortunately, the delay until the fourth week to begin the workshop caused many of our recruits to drop out. When we began, there were only about ten students left, of whom about six attended regularly. This small group became a tightly knit group that really worked hard and succeeded.

Getting student mentors was easy. Many of our math majors jumped at the chance to work with us. We wanted these student mentors to be a liaison between faculty and students. Since the mentors were closer in age to the students, we felt the students would be more willing to speak to the mentors and to ask them for help. Also, since we could not force the students to attend, we needed a mechanism to encourage them to come to the workshop sessions. If necessary, the mentors could call the students to remind them. They could even bring the problem sheets to their dorm rooms if students were ill. This system worked well, especially when combined with the free food we provided.

But we were offering a great deal more than free snacks. At each session the students were presented with both elementary and advanced problems—problems, in many cases, that they could not solve alone. Each would have to pool ideas with others to get a solution.

The food helped, too. In one instance, the students were working unsuccessfully, and individually, trying to solve a problem, when suddenly the pizza arrived. All work stopped and eating began. While eating and socializing, the students began to talk about the problem each was trying to solve. The next thing you knew, they figured out the solution—by working together!

The kinds of problems presented were determined by the course. Since Pre-Calculus Math deals with functions and their properties, graphics calculators turned out to be the

perfect tools to aid in the learning process. We managed to borrow enough TI-81 graphics calculators for all. The students loved this calculator and quickly became adept in its use. In several instances, with the aid of the calculator, they were able to pose questions to the faculty that couldn't be answered immediately. It became a learning experience for the faculty as well as the students.

By the time the fall semester had ended, Ron and Marcus felt the program was a relative success. The only thing they were unhappy about was the size of the group. They were determined to get additional recruits for the spring semester. Of the core group, all but one did extremely well in Pre-Calculus Math. One of the minority students even declared that he was going to change his major to mathematics.

Unfortunately, things did not go quite so smoothly in the spring. When we opened the workshop to additional students, we destroyed the close-knit fellowship of the original group. The addition of ten new students overwhelmed the old group identity. Most of the students in the spring never developed the group study techniques. Part of this problem was also due to the difficulty of scheduling. Many students just couldn't attend both meetings each week. Hence, they attempted each problem alone, without help. As a result, the faculty were disappointed, but for some strange reason the students weren't. They were still telling their friends about this "wonderful" math workshop they were attending.

I guess the conclusion is mixed. On the one hand, the students loved solving advanced problems, especially with graphics calculators. On the other hand, the faculty learned that if we are to teach students the group study techniques, we must strictly limit the number of additional students admitted in the middle of the year and get the students to arrange their schedules so that they can attend all sessions of the workshop. It would probably be a good idea to keep the number of additional students to less than half the original group.

III. The Curriculum Revision

As I have mentioned, the calculus course developed in response to a very rapid growth in demand. Now that the demand has fallen back to its historic low, we have a new problem. Half a century ago, our nation only needed a fraction of a percent of its population trained in mathematics, but in today's high-tech world we need many, many more. Our challenge now is to develop a mathematics program that will attract people instead of turning them away. This challenge has been accepted by the mathematics profession. Many suggestions for attracting students have been put forward, but so far none has proved viable.

If we limit ourselves to Calculus, we can get an idea of what is involved. One suggestion is for a "lean" Calculus course. We have been throwing so much at the students so fast that we have lost sight of the fantastic beauty of the concepts. One proposal is to reduce both the complex Calculus syllabus and the size of the standard Calculus text. There is no agreement about what is to be removed. Another suggestion is to incorporate high-tech tools into the course, either graphics calculators or high powered math programs for computers like Mathematica, Derive, or MathCad. As Tom, Evelyn, and I were looking at these issues, we saw firsthand how much the workshop students loved the graphics calculator.

While checking the available experimental lean Calculus texts, we found nothing that seemed to suit our students. All the lean texts we saw were aimed at Princeton or M.I.T. students. These texts were also radical in their approach, while we were more oriented towards an evolutionary approach. For the present, we are not opting for radical change in the syllabus. Instead, we are moving to implement the use of graphics calculators. We looked at math software for computers but rejected this approach because of cost. There is no doubt that computer software is more sophisticated than the programming built into a graphics calculator, but a calculator can be carried easily into class

and can be just as easily taken home. This gives tremendous flexibility, and even though it may not be as sophisticated a solution, we discovered in the workshop that it can serve adequately. We have found that the use of graphics calculators actually "increases student participation, enthusiasm and ability to grasp concepts by a quantum leap," according to a proposal submitted to the department by Tom Osler and Evelyn Weinstock.

The department has been talking about these ideas all year, and at our last official meeting on May 6, 1991, decided to make the momentous change of requiring the use of the TI-81 graphics calculator in all applicable courses. This will be implemented sequentially. In fall 1991 this calculator will be required in Pre-Calculus Math; in spring, it will be required in Calculus I and Calculus/Techniques and Applications (our business calculus course). In subsequent semesters other courses will begin using these nifty little tools.

This change means that all our faculty must now learn how to use these machines effectively in class. One of the lessons learned this year is that the traditional lecture approach in mathematics is no longer viable!

IV. Results of the BETA Project

We have already talked about the results of the curriculum revision portion of this project, namely, of not opting for a lean Calculus at present, of adopting the use of the graphics calculator in many courses, and of the necessity of retraining the faculty in this new approach. This by no means concludes our efforts. We must now figure out how best to integrate the use of appropriate technology in all our courses. Therefore, our curriculum revision efforts will continue into the foreseeable future. The department thought this was so important that it decided to use some of its released time for this purpose.

As far as the workshop is concerned, our question is: Have we accomplished our goals?

1. Did we show students how to study in groups?
2. Did we convince students they can enjoy and be excited by mathematics?
3. Did we attract a few good math majors, particularly minority students?
4. Did we get our faculty involved in these activities?

For goal number 1, our results were mixed. We definitely got the first group involved in group work but failed with the second group. We are encouraged enough by what happened that we intend to run this workshop again next year. Goal number 2 we feel was accomplished, just from the comments we've heard from the students. Goal number 3 was accomplished because one of the minority students decided at the end of the fall to declare as a math major. Goal number 4 was accomplished since not only did we get 5 people in a department of 16 directly involved, but several others on their own started exploring the use of software or calculators in their advanced math courses.

All in all, we had a very challenging and exciting year and are looking forward to the same in the future. The department now feels it has enough resources to keep this project going next year. Dr. Finkelstein at the NJICTL has promised us another $2500 if the Dean will match it again, and she has indicated her continuing willingness to support us. We will again apply for a DHE retention grant, but getting this grant will no longer be the sole determiner of whether or not this project continues. When we write our proposal to the DHE this year, we will be including several more departments in it.

About This Book

We composed this book on a Macintosh II with Connectix's Virtual 2.0, A Mac LC, and several Mac SEs and Pluses.

We used Claris MacWrite, Microsoft Word, Adobe TypeAlign and TypeManager, and Aldus PageMaker. The text faces are Janson Text and Janson Text Italic. The cover face is ITC Garamond. The arrowheads are Zapf Dingbats. All the faces are from Adobe.

We printed proofs and page-readies on a Hewlett-Packard DeskWriter and an Apple Laserwriter IINT.

Denby Graphics of Laurel Springs, New Jersey, printed and bound the finished copies.