A Teacher Had a Question

Below is a summary of a rather famous experiment that turned into a national trend in teaching; the subject happens to be mathematics, but teachers from any field should notice that the teacher, Uri Treisman, started with a question: How can I get minority students to succeed more often in my course? This article originally was printed at the old FIPSE site, which has since be redesigned.

Lessons Learned from FIPSE Projects II - September 1993

University of California-Berkeley

The Professional Development Program

Purpose

In the late 1970's, Uri Treisman and colleagues at the University of California at Berkeley began a study to understand the dynamics of minority student performance in freshman calculus. A systematic review of Berkeley transcripts showed the magnitude of the problem: in a decade there was not a single year in which more than two ethnic minority students received grades of B- or better in first-term calculus. In his FIPSE proposal to remedy this situation, Treisman observed that freshman mathematics and science courses have all too often been burial grounds for the aspirations of minority students who enter college with the goal of majoring in engineering, or one of the sciences.

An eighteen-month ethnographic study helped Treisman understand the various obstacles to minority student success at Berkeley. In particular, he found that the widely held conventional explanations for failure--lack of student motivation, lack of academic preparation, lack of family support, and low average socio-economic status--did not, in fact, explain the phenomena he observed. He found, instead, a pattern of social and intellectual isolation which eventually led to students' demoralization, disorientation, and ultimately, their decision to leave the sciences. Many of these students, moreover, dropped out of the University.

Many of the African-American students Treisman observed studied alone, and maintained a rigid separation of their academic and social lives. This pattern was in marked contrast to that of Chinese students in Treisman's study, who typically created an academically-focused social group that served to support their aspirations for high achievement. In their informal groups, Chinese students discussed their academic work as well as such topics as interacting with faculty, the intricacies of getting a needed

answer from an administrative office, financial aid, and so on. Treisman believed that by creating a rich mathematical environment in which such collaboration among students was natural, African-American and Hispanic students would be drawn to mathematics and would thrive.

Treisman also observed the subtle and insidious ways in which special campus orientations and programs for minorities tended to marginalize the populations they served. In particular, he noted that for many minority students at Berkeley the locus of their campus identity was ethnicity rather than intellectual interests or professional goals. He came to believe that the resulting ethnic Balkanization of the Berkeley student body impeded minority students' progress in mathematics-intensive majors. Thus, to address the underrepresentation of minorities in mathematics, it would be necessary to create viable and robust multiethnic student communities drawn together by a shared interest in and affection for mathematics.

Innovative Features

In 1980, with support from FIPSE, Treisman established the Mathematics Workshop Program as a component of the Professional Development Program (PDP), an affirmative action effort of the University of California Academic Senate, Berkeley Division. The immediate and most visible goal of the project was the development of a cadre of minority students who would truly excel in calculus. The Workshop Program explicitly rejected remedial approaches to minority education.

Workshops of 20 to 25 participants worked together in small groups on problem sets specifically designed to deepen their understanding of concepts needed not only for their present course, but for later mathematics and science courses. These sessions were overseen by graduate instructors who did not lecture or repeat class material, but turned questions back on the group to help students understand the material for themselves. This approach was a substantial departure from the individualized tutoring, self-paced instruction, mentoring, and study skills courses which constituted the pedagogical armamentarium of institutionalized minority programs.

Evaluation of the Original Development of PDP

According to the evaluation of the first seven years of PDP, students did indeed excel. The results are unparalleled: 56% of the African-American workshop students earned a grade of B- or better in first-year calculus, compared to 21% of the non-workshop

African-American students. Beyond this, significantly fewer workshop students dropped out of calculus than non-workshop students (3% versus 25%) and four times more of these students graduated in math-based majors (44% versus 10%). These results persisted even when differences in pre-college preparation for mathematics were taken into account.

African-American students who attended the workshops and whose MSAT scores suggested they were at the greatest risk of failure outperformed the non-workshop African-American students at lowest risk of failure. In other words, weakly prepared students gained as much or more than students entering Berkeley with strong academic backgrounds. Further, African-American workshop students persisted to graduation at rates comparable to those of the campus as a whole, while African-American non-workshop students dropped out at substantially higher rates.

Project Impact

The Mathematics Workshop had a dramatic effect both on mathematics performance and on the persistence rates of participating students at Berkeley. Based on these successes, FIPSE again funded PDP in 1986 to assist 20 other campuses across the country to set up local adaptations of the project. PDP staff worked with faculty and administrators from colleges and universities to customize the project appropriately for each new setting. Many of the original twenty dissemination sites succeeded in creating effective programs: an evaluation of student performance at several of them showed the following results:

- At the University of Texas-Austin, where the program is known as the Emerging Scholars Program (ESP), the workshops are regular departmental offerings--effectively an alternative to traditional discussion sections. There are presently five
- At Rutgers, the State University of New Jersey, students enroll in a six-credit hour calculus class called EXCEL; the usual calculus course is four credit-hours. One section of EXCEL is housed in the College of Engineering, and another is housed at

section of EXCEL is housed in the College of Engineering, and another is housed at Douglass College for Women. Thus far, 75% of EXCEL calculus students have earned a grade of "A" or "B" as opposed to 41% of all students in the regular calculus classes.

- City College of New York (CCNY) is an urban commuter college; two-thirds of the entire student population is African-American or Hispanic. Students in the CCNY workshop program participate in six hours of intensive mathematics laboratories as a supplement to their basic calculus class; four hours of this lab time is overseen by advanced undergraduate students. 88% of participating students have received grades of "B" or better in calculus.
- At the California Polytechnic State University at San Luis Obispo, the Emerging Scholars Program (ESP) offers workshop laboratory sections in precalculus and calculus. These labs are attached to particular lectures and are led by advanced undergraduates who have expressed an interest in teaching. Consistently over the four years of the program, 90% of the students have achieved grades of "C" or better in calculus; typically, two-thirds of non-ESP students make such grades. In 1988, the year of the pilot, 85% of ESP students earned grades of "A" or "B," while 18% of students not participating in ESP labs earned similar grades.
- The California State Polytechnic University at Pomona runs a workshop program for minority students enrolled in the College of Engineering and the College of Science. The program serves more than 100 minority freshmen a year. A recent retrospective longitudinal study (conducted by Marty Bonsangue and supported by the National Science Foundation) of minority workshop participants from 1986 to 1991 found that workshop students scored, on average, six-tenths of a grade point above their classmates in calculus. Bonsangue found that participation in the workshops had a powerful effect on students' performance and persistence in subsequent mathematics and science coursework, as well as on graduation in a technical major.
- The Medical Scholars Program (MSP), an adaptation of the workshop was established with FIPSE support at the University of California at San Francisco School of Medicine (described on page 69). Minority student failures in physiology and other first year courses declined significantly, the school's overall pass rate on the National Boards improved, and pre-medical school achievement ceased to be a significant predictor of minority and non-minority students' actual exam scores.

Evaluation of the PDP Dissemination

An extensive summative evaluation was conducted of each of the campus pilot programs and student performance, using appropriate comparison groups. Specifically, it examined the relationship between background characteristics (e.g., race, sex, SAT scores, high school rank in class, etc.) and achievement in math and science. A qualitative observer's report was also completed to provide faculty at other sites with a

description of key features of the program, how it operates internally, how it may be adapted, and how it appears to its participants.

Project Continuation

There are currently over 100 mathematics departments offering students a "Workshop/Emerging Scholars" Program. In 1991, Treisman received a grant from the National Science Foundation (NSF) to create the Alliance for Minority Participation in Mathematics (AMPM) which will expand to at least 200 the number of mathematics departments offering such programs.

The program has expanded both to the upper-division and pre-collegiate levels. The Summer Mathematics Institute (SMI) variously funded by the Sloan Foundation, the Dana Foundation, and the National Science Foundation is an immersive six-week residential summer school, principally for ESP alumni, designed to enable them to make an informed choice about graduate work and careers in the mathematical sciences. In Fall 1993, approximately 20 SMI alumni will begin work in mathematics at elite graduate programs.

At least ten mathematics departments have created versions of ESP for high school students and teachers. These initiatives, most often called "C-cubed" programs, have received generous support from the National Science Foundation and from local school districts.

Several successful sites have emerged as secondary dissemination sites helping institutions in their region to learn from their work. Moreover, the process of dissemination has led to substantial improvements in the model, some of which have influenced the shape and direction of the original Berkeley program.

The Workshop Program itself has undergone many transformations. Most important is the shift from adjunct status, i.e., as a voluntary add-on program, to becoming an integral part of a math department's offerings. In some institutions, the Workshop Program has been a catalyst and model for the reorganization of departmental courses. Currently, there are many departments seeking to utilize the Workshop model as a vehicle for bringing about curricular change. The increased class time and the focus on student community make it a natural environment for curricular experimentation. Finally, the Workshop approach has become a highly visible example of faculty leadership in such problematical areas as multiculturalism, academic culture change (i.e., resetting the balance among research, teaching, and service), and quality management.

Recognition

PDP's project director, Uri Treisman, was honored with the Charles A. Dana Award for outstanding achievement in American higher education. The Dana Foundation then awarded Berkeley approximately $1 million for the creation of the Charles A. Dana Center for Mathematics and Science Education to continue to disseminate Workshop Programs. In 1989, *Newsweek* selected Treisman as one of 25 Americans on the leading edge of innovation, one of three in education. In 1992, he won the MacArthur Fellowship Award for his pioneering work in increasing minority participation in mathematics.

The California State Legislature awarded $500,000 to create PDP workshops on each of the nine campuses of the University of California. The National Science Foundation sponsored a Chautauqua short course for math and science faculty on increasing minority participation in math-based disciplines. A minority student and alumna of PDP at Berkeley was named a Rhodes Scholar--the first woman, first African-American and first engineering student on campus so honored.

Available Information

A FIPSE-sponsored lecture that describes the project, *Academic Perestroika: Teaching, Learning and the Faculty's Role in Turbulent Times,* is available upon request from:

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