CALCULUS AND COMMUNITY

A History of the Emerging Scholars Program

The College Board

Calculus and Community: A History of the Emerging Scholars Program

by Rose Asera

A Report of the National Task Force on Minority High Achievement

The College Board
May 2001

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Preface

This report was commissioned by the College Board's National Task Force on Minority High Achievement, which has been charged by the Board with developing recommendations for how the number of African American, Latino, and Native American students who are academically very successful can be increased substantially. These groups remain extremely underrepresented among individuals who earn bachelor's, master's, doctoral, and professional degrees in the United States. They also have a limited presence at all levels of the educational system among top students as measured by such traditional indicators as grades and standardized test scores. As a result, these groups continue to have much less access to selective institutions of higher education and, subsequently, to career tracks in various professions that offer promising avenues to leadership positions in many sectors.

Thus, until much higher percentages of students from underrepresented minority groups enjoy very high levels of educational success, it will be virtually impossible to integrate our society's institutions completely, especially at leadership levels. Without such progress, the United States also will continue to be unable to draw on the full range of talent in our population in an era in which the value of an educated citizenry has never been greater.

In *Calculus and Community*, Dr. Rose Asera presents a history of the Emerging Scholars Program, a proven strategy for increasing the number of underrepresented minority students who achieve at high levels in freshman calculus (and in initial freshman courses in several of the sciences, including chemistry, physics, and biology). She also discusses the lessons that have been learned over the years from efforts to disseminate the Emerging Scholars Program (in appropriately adapted forms) to a number of institutions. Dr. Asera is an experienced researcher and evaluator, who worked closely for 12 years with the creator of the Emerging Scholars Program, Dr. Uri Treisman, at both the University of California at Berkeley (where the program originated) and the University of Texas at Austin. As a result, she is singularly well positioned to tell the Emerging Scholars Program story in a way that can provide assistance to others who may be working at colleges and universities to increase the number of African American, Latino, and Native American students who achieve at very high levels in their majors.

Illuminating the history and capacities of the Emerging Scholars Program is valuable not only because the number of top African American, Latino, and Native American college-bound high school seniors is still relatively small. It also is important because there is extensive evidence that underrepresented minority students—including many academically well-prepared individuals—tend to earn lower grades, on average, at historically White colleges and universities than do majority students with similar academic backgrounds, such as similar college admission test scores. The Emerging Scholars Program has demonstrated a capacity to help overcome the overprediction problem.

Calculus and Community can be read as a companion piece to another report of the Task Force, *Priming the Pump*, by Dr. Patricia Gándara of the University of California at Davis. *Priming the Pump* examines several strategies that, when well implemented, have demonstrated a capacity to improve academic outcomes significantly for underrepresented minority students.

On behalf of the members of the National Task Force on Minority High Achievement, we would like to extend our deep appreciation and thanks to Dr. Asera. She has produced a report that should provide extremely valuable insights to higher education leaders and faculty members as they seek to improve academic outcomes for underrepresented minority students.

Eugene H. Cota-Robles and Edmund W. Gordon
Co-chairs
National Task Force on Minority High Achievement

Author's Acknowledgments

This report is based on intensive interviews with Uri Treisman, the creator of the Emerging Scholars Program and now a professor of mathematics and director of the Charles A. Dana Center, an organized research unit in the College of Natural Sciences at the University of Texas at Austin. I would like to extend my deep thanks to him for his time, reflection, and recollections. Thanks also to L. Scott Miller, who was the director of the National Task Force on Minority High Achievement at the College Board, for his support and encouragement, to Celeste Trinidad, also of the Task Force, for keeping track of the details during the process of working on this manuscript, to Leon Henkin for his historical perspective, to Robert Fullilove for his powerful reminder to include the students' perspective, and to Rachel Jenkins for her thoughtful and thorough editing. Only a very few of the hundreds of people who have played important roles in the national growth and development of the Emerging Scholars Program are named in this document. To have named everyone would have been impossible, but they are all—each and everyone—appreciated.

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Chapter 1

Introduction

At a time when higher education policies of access and affirmative action are shifting, and when the national data still tell a disheartening story about the academic trajectories of African American and Latino students, it is useful to examine the history of the Emerging Scholars Program. This multi-ethnic honors-level program originated in 1977 as the Mathematics Workshop of the Professional Development Program at the University of California at Berkeley. It is now widely disseminated across the United States as a part of freshman courses in academic departments (mathematics, physics, chemistry, etc.) and as an academic workshop component of numerous Minority Engineering Programs. In studies of Emerging Scholars Programs in public research universities—such as the University of Texas at Austin, the University of Wisconsin at Madison, the University of Kentucky (Lexington), Rutgers University, and others—not only do ESP participants score well above the general class average, but two-thirds or more regularly earn an A or B.

When it originated, ESP was in many ways anomalous among traditional access programs in higher education. For one thing, the program is not remedial; instead, it is emphatically focused on academic excellence. The program's goals are for students to succeed—defined as earning a grade of A or B—in the gateway freshman class, and to acquire the capacity to succeed in subsequent mathematics and science courses. ESP is also anomalous in that the academic curriculum itself—that is, mathematics—has shaped the program. This in contrast to many access programs that originate out of administrative offices and focus more on generic study skills. Specifically, ESP was originally designed to create a mathematically rich setting in which students could learn the major concepts of calculus. Thus, some of the program characteristics, such as the challenging calculus problem sets, were consciously crafted in response to the nature of mathematics as a discipline.

Moreover, ESP does not exclusively serve underrepresented minority students; instead, it intentionally serves a diverse and inclusive student population. While historically the department-based Emerging Scholars Programs have aggressively recruited African American and Latino students, the ESPs have always been open to all interested students, and thus have been able to serve other, less evidently underrepresented populations, such as students from small rural high schools. A second reason for ESP's intentional diversity is implicit in its name: the Emerging Scholars Program fosters a community of scholars focused on shared academic interests and common professional goals. ESP helps reduce student isolation and supports students in learning what it is to be part of an academic community. In this rich academic environment, diversity among students is regarded as an asset.

The intentional diversity of the ESP student population is rooted in the program's beginnings at Berkeley, as are many of the program's other characteristics. The Emerging Scholars Program, however, has developed beyond its initial creation as a direct solution for a local problem. ESP is, like many successful programs, the result of a series of careful observations, intentional experiments, pragmatic accommodations, and serendipitous accidents. The program has regularly reflected, retooled, and, when necessary, reconstructed itself. This essay outlines important lessons learned in the creation and dissemination of the Emerging Scholars Program over the last 20 years.

This essay will examine questions such as: What are the roots of the ideas that shaped the Emerging Scholars Program model? How has this model evolved? How have other institutions of higher education been able to implement ESP model? And what can the broader higher education community learn from the ESP model and its implementation? Of course, there are pitfalls in reconstructing this conversation between ideas and practice. In particular, events examined in retrospect can appear considerably more coherent and intentional than they actually were when they happened.

A note on program names: the original program at UC Berkeley was known as the Professional Development Program Mathematics Workshop. This name intentionally did not carry any connotations of being a program for minority students. The name *Emerging Scholars Program* was coined in the late 1980s and seemed to Uri Treisman, the originator of the Mathematics Workshop, and others to capture the spirit of the program. This name change also coincided with a shift in the program at UC Berkeley from a workshop that was conducted outside the academic department to a department-based discussion section. A number of programs established around the country in the late 1980s, including the UT Austin program, named their efforts Emerging Scholars Programs, and ESP has become the official name for the model and the work to disseminate it. It must be noted, however, that particularly in the process of dissemination that began in the early 1980s, campuses were encouraged to choose a program name that resonated with the local university culture. This was to foster a sense of local ownership of the program. Consequently, there are programs across the country that are based on and in the spirit of the ESP model, but that have completely disparate names, such as MathExcel (the University of Kentucky, Lexington), Excel (Rutgers State University of New Jersey), or Merit (the University of Illinois at Urbana-Champaign).

Chapter 2

History of the Ideas in Context

In 1973, the Special Scholarships Committee proposed to the Berkeley Faculty Senate that the SSC create a new Professional Development Program for high-achieving students from groups underrepresented in the professions for which Berkeley's outstanding graduate students were prepared. The aim was to enrich those professions, and in particular the university professoriate, creating thereby role models for minority students of later generations.

—Leon Henkin, Professor Emeritus, Mathematics,
University of California at Berkeley

The University of California at Berkeley: the Special Scholarships Committee and the Professional Development Program

The Emerging Scholars Program would not have come into existence without the fortuitous convergence of a number of forces. The first was a strong faculty commitment that established the Professional Development Program at the University of California at Berkeley. PDP, a student services program managed under the aegis of the academic faculty senate, provided a supportive environment for incubating programs that fostered student success. A second force was SESAME (Search for Excellence in Science and Mathematics Education), an interdisciplinary science and mathematics education graduate program at UC Berkeley that provided a fertile source of ideas about learning and cognitive science, as well as a pool of dedicated individuals who regarded teaching calculus as a creative challenge. A third force was Uri Treisman, then a graduate student in mathematics and a mathematics instructor for PDP. Treisman was able to creatively analyze the problem of minority student access and use existing resources to address it. Treisman brought to the situation an idiosyncratic set of skills and experiences. His interdisciplinary background—which had spanned landscape architecture, political activism, and mathematics—let him function as both an insider and an outsider to the mathematics community. In his outsider role, he was able to critically examine the conventional wisdom about learning mathematics. Moreover, his design background and sensibility helped him take the additional step of developing an elegantly conceived program based on his research findings.

The Special Scholarships Committee

UC Berkeley's Mathematics Workshop was one of a family of programs organized by the Special Scholarships Committee of the Faculty Senate of the University of California at Berkeley. Leon Henkin, Treisman's advisor in the 1970s and now a UC Berkeley professor emeritus (Mathematics), recalls the faculty intent in establishing the Special Scholarships Committee:

> *In Fall 1963 Jerzy Neyman, one of the two great creators of modern statistical theory in this century, was invited by the MAA [Mathematical Association of America] to serve as Visiting Lecturer at colleges and universities in the South. He accepted on condition that his schedule include both Negro and white institutions (then separated by state laws). Upon returning to Berkeley, he invited a few friends, of which I was one, to hear about and discuss his experiences. He told us that he had met excellent students who did not have access to an excellent education. He proposed that the Berkeley faculty bring them to Berkeley and they could then return to the South and take leadership roles in the social revolution then just starting there.*
>
> *To implement his ideas, Neyman and his friends decided to propose, at the Faculty Senate meeting of January 1964, that the faculty create a committee to bring able but disadvantaged students to Berkely, who were unlikely to come without special effort. When our plans came to the attention of Clark Kerr, President of the statewide University of California, he invited us to meet with him. We told him that we proposed to raise funds for the operations of our committee's program by seeking annual contributions from individual faculty members, and Kerr replied that he would seek matching funds from the Regents of the University.*
>
> *The Faculty Senate accepted the proposed resolution. The new committee, not yet named but with Neyman designated as the Chair, was appointed (like all Senate committees), by the Committee on Committees which is elected by the faculty as a whole. At its first meeting Neyman proposed recruiting students from the civil*

> *rights movement of the South. However, some other committee members, noting that Berkeley's student body was "lily white" at the time, suggested that the committee first seek to recruit students from among the many blacks living in Bay Area communities near the campus. Neyman insisted the South, but after discussion a majority voted for a local program. The plan was to bring high school students to the Berkeley campus for special summer courses after their ninth, tenth, and eleventh grades at school, and then to help them apply for college or university admission. Those students who completed the program were promised special scholarships for the first two years of college work—whether they came to Berkeley or went elsewhere. Accordingly, we took the name "Special Scholarships Committee." Neyman, while a staunch supporter of its work, resigned from the SSC because it would not pursue his dream program. He was replaced by two co-chairs: Owen Chamberlain, Nobel laureate in Physics, and Mark Rosenzweig, a distinguished psychologist subsequently elected to the National Academy of Sciences.*

That this outreach and access effort at UC Berkeley was initiated by faculty and organized by the faculty senate was unusual in higher education at that time. In the early 1960s, at the height of the civil rights movement, many campuses had defined access as an administrative (as opposed to an academic) issue. Such a definition meant that the campus administrations took responsibility for recruiting and retaining minority students. Campus administrations typically perceived this work as a political obligation and consequently did not include faculty in the process. Campuses across the United States created a flurry of student support programs—focused on tutoring, mentoring, and advising—specifically for the newly recruited minority students. These programs were meant to address these students' perceived academic weaknesses and deficiencies. Moreover, these programs were usually housed in campuswide learning centers or student affairs programs, often located in the basement of the administration building and thus de facto separated from the academic life of the campus.

The Professional Development Program

The first effort of UC Berkeley's Special Scholarships Committee was a program for high school students who had completed ninth grade. The students took specially designed courses on the UC Berkeley campus for three successive summers, and then applied to UC Berkeley or another institution of higher education. Those whose applications were accepted were given scholarships. Henkin remembers the ensuing transition from the first SSC high school program to the Professional Development Program:

> *In 1973–1974, SSC co-chairs were Rodney Reed (Education) and myself (Mathematics). Taking note of the tenth anniversary [of the SSC high school program] the committee commissioned a study by the campus Office of Research to assess what it had accomplished to date, with the idea of deciding whether to dissolve, continue the program (which by then had merged with the federal Upward Bound), or create a new program. The study found that our SSC program had achieved retention rates equal to that of the whole campus, and graduated the same proportion as the campus. (This was in contrast to the [UC Berkeley] Administration's Educational Opportunity Program, which simply admitted an increased number of minority students by waiving regular admission requirements; many of these students did not complete their degrees.) However, graduates from the SSC program were clustered in a few traditional areas of study for minority students, like sociology and social welfare. Furthermore, their GPAs were almost all in the lower half.*
>
> *Based on this study, SSC proposed to the Berkeley Faculty Senate that the Upward Bound program be handed off to the administration, and that SSC create a new Professional Development Program for high-achieving students from groups underrepresented in the professions for which Berkeley's outstanding graduate students were prepared. The aim was to enrich those professions, and in particular the university professoriate, creating thereby role models for minority students of later generations. The SSC debated whether to limit the new program to students from low-income families (as federal laws required for Upward Bound), and rejected such a limitation.*

This broad mandate to increase the number of underrepresented students who could successfully complete a course of study in the technical fields in which they were historically underrepresented allowed for a broad array of pragmatic experiments and creative approaches to addressing issues of access. Although the Professional Development Program had a definite mission to increase minority participation in professional and technical fields, the program's name was deliberately broad, even vague, and the program was not specifically designated for minorities. The PDP staff knew that the high-achieving minority students entering that institution had seen the nature of most targeted minority programs in their high schools, and were not seeking the kinds of remediation that they typically associated with such programs.

UC Berkeley's Professional Development Program organized intensive summer programs in mathematics and science for high school students from populations underrepresented in the sciences; these included African Americans, Latinos, and women of all ethnic groups. The PDP high school summer program identified extremely talented minority students from local high schools; some were middle-class students, while others were from schools in poor neighborhoods. The PDP summer program was selective and competitive. In order to participate, students had to complete a written test and participate in a personal interview. A particular strength of the PDP summer program was in finding extraordinary teachers from different fields to work with these exceptional high school students. Virginia Thompson, subsequently a creator of EQUALS and Family Math at Lawrence Hall of Science, worked as the PDP summer program's first coordinator; she knew about shaping groups to enhance learning, and she infused professional teaching perspectives throughout the program. Thompson was one of the people responsible for creating a nurturing environment that complemented the challenging academics.

Another magnet for the PDP community was advisor Roy Thomas, a professor in the humanities at UC Berkeley (now retired). Thomas, a source of wisdom to the program community, encouraged students to explore different fields and different academic identities. The Professional Development Program was a place where race and ethnicity were recognized as assets, but where these characteristics were not immediately politicized. Thomas knew that many of the African American students who entered UC Berkeley were the children of professional parents, and had grown up and gone to school in diverse settings. As freshmen at Berkeley, a large, and at that time predominantly White, campus, many of these students would for the first time personally encounter racism, both institutional and personal.

Through all the PDP programs, participants were encouraged to explore political identities, but also intellectual identities, artistic identities, and other sources of self-knowledge. PDP recognized the importance of not forcing students to decide too early who they were. As a result, participants were encouraged to visit and become comfortable in different worlds inside and outside of the university. That conscious fostering of broad exploration was the source of Treisman's understanding that these students lived in many worlds. This idea became salient in the design of the workshop that was to become the Emerging Scholars Program.

PDP had a very strong commitment to ensuring that its programs be multi-racial and multi-ethnic, because the students who participated in them would become part of the mathematics and science professional communities. Although the Professional Development Program's commitment to keep its programs open to all students went against some of the political pressures of the times, its designers felt the settings needed to resemble the professional communities that these students would become part of in the future. Treisman recalls, "you could see it was the right idea; you could see the friendships forming among the students." Further, because the PDP's high school program shared a location with its graduate student program, the younger student participants heard about graduate school as soon as they entered PDP's summer program. This rich setting also encouraged a lot of tutoring and mentoring—both formal and informal—to happen across age groups.

The Mathematics Workshop

> *When I saw the kids I had worked with in our summer program, kids I knew were really smart—these were our kids, there was no doubt they could do anything we set before them—when they started having trouble in freshman calculus at Berkeley, it was disorienting. I knew we had to do something. I knew we could help get any individual student through calculus, but building a system, that was the challenge.*
>
> —Uri Treisman, Professor of Mathematics and Director, Charles A. Dana Center, the University of Texas at Austin

Although the faculty designers of PDP's high school program believed that intensive summer academic work could prepare students for university-level work, Treisman and others could already sense that social forces could interfere with these students' academic performance when they entered the university. This realization became acute when some of the summer PDP students foundered in freshman calculus at UC Berkeley.

The experience of these PDP summer students in freshman calculus led to a bigger question: what was the overall experience of African American and Latino students in calculus at UC Berkeley? Treisman and colleagues searched for the answer to that question through a quantitative review of student transcripts. The results were even worse than the researchers had imagined. In the decade leading up to the study (roughly the mid-1960s to the mid-1970s), more than 60 percent of the minority students who had enrolled in freshman calculus had failed. And there was not a single semester in which more than one African American or Latino student received a B or better in freshman calculus. This high failure rate included students who had entered college with strong mathematical preparation as measured by their SAT® scores, and was, in fact, most acute for African American males. This phenomenon of minority students who are well prepared (as measured by standardized test scores) not performing as well as their majority peers with similar scores is known as "overprediction." Overprediction subsequently has been documented by other researchers—including Bowen and Bok in *The Shape of the River* (1998)—at elite universities across the United States. But another way of looking at this phenomenon is as a measure, or a result of, the campus climate.

Treisman's personal observation about the potential impact of the campus climate on student performance, reinforced by the quantitative findings from his review of student transcripts, led him to design a longer-term qualitative study of the problem. Treisman spent a year and a half (1975–1976) studying the academic and social lives of selected African American and Chinese American student populations at UC Berkeley. The population of Chinese American students was chosen because faculty members and graduate student instructors had repeatedly noted that large numbers of Chinese American students excelled in calculus. Treisman's original study, now widely retold and published (Treisman, 1990 [several studies], 1992, 1995), found that the source of African American minority students' lack of success in calculus was not, as was widely assumed, poor motivation, poor academic preparation, or lack of family support.

Instead, what Treisman's study identified as a source of the problem was the social and academic isolation of African American students on a predominantly White campus. This isolation contrasted with the integration of social and academic lives that he observed among the Chinese American students. The African American students he observed tended to study alone. When they socialized, it was as a separate activity, and this socializing often engaged a different set of friends from those at college. In contrast, the Chinese American students studied first by themselves, then met in groups to go over their work together. Their group study setting had an informal feel, and often included food and music. In addition, older students (brothers, sisters, cousins, and friends) might drop by the study group. This tendency for Asian cultures to encourage their children to work and study collaboratively has also been noted by Steinberg, Dornbusch, and Brown (1992); they observe that in these cultures, this socialization to work collaboratively starts at an early age. Treisman was able to incorporate the strength of this group-study strategy into a PDP program in which a more diverse population could benefit from such community and collaboration.

Treisman's study provided a research base to support another strategy—or, more accurately, an emphasis—that runs through the Emerging Scholars Program: knowing who your students are and recognizing their strengths. Knowing who the students are, and in many cases, knowing their families as well, keeps a human face on the program. Treisman recalls, "The students' families, the black families, I could see they were like the families I grew up with. They were organized to support their children's education." The study also vividly illustrated the truism that the "minority community" was not homogenous. Some of the African American students observed in the study were the children of degreed professionals; others were the first in their family to attend college. Some of the students' family members had attended historically black colleges in the South, while others had not had that opportunity. John Ogbu's work (1978, 1991) provided insight as to why many black families had moved to California. They were, in Ogbu's terms, "immigrants by choice" from the South. They had come to California for an immediate reason, often moving there because of assignments with the military, but they stayed for the opportunities. These families invested a tremendous amount in their children, who were, in turn, hungry to succeed. Treisman and UC Berkeley's Mathematics Workshop took responsibility for nurturing those aspirations and providing the students with the resources to make them possible.

The challenge was to proceed from the study's observations of the students' social and academic lives and to create a program model that would recognize and build on the students' strengths, counter the debilitating isolation that many of them experienced, and foster their academic success.

Calculus: The Search for a Conceptual Model of Teaching and Learning

> *I recognized that mathematics is hard. I understood that math is highly condensed thought. But I liked math; I had personally spent hundreds of hours learning mathematics on my own, and I understood something about intensifying the experience, and about motivation. If students didn't have experience coming in, we could intensify their experience, but they needed a lot of time. People who did math on their own outside of class could outperform those who only did what was assigned in class.*
>
> —Uri Treisman, Professor of Mathematics and Director, Charles A. Dana Center, the University of Texas at Austin

Treisman himself had become a mathematician somewhat by accident. In junior high school, when his peers took algebra, he had been excluded from the class for arbitrary reasons. In self-defense against the other students' teasing, he went to the local public library and checked out books on algebra, then worked through them independently. Thus mathematics became a subject that Treisman explored extensively on his own. He had no way of knowing then that the algebra books that he borrowed were not secondary school texts, but college algebra books.

An uneven career path that included political activism, farming in Israel, and landscape architecture in Southern California, eventually led him to graduate school in mathematics at Berkeley in the early 1970s. In an act of creative procrastination while in graduate school, Treisman became interested in how students actually learned mathematics, and what practical implications their learning experiences might have for teaching. Thus Treisman, functioning both as a mathematician and as a self-described "dilettante social scientist," set out to construct a research-based conceptual model of mathematical teaching and learning. As part of this endeavor, he worked for two years training mathematics department teaching assistants. In this work, he was able to test a number of hypotheses. For example, he audio- and videotaped classes and attempted from those tapes to analyze how students actually learned mathematical concepts. As Treisman describes in retrospect, "I had this idea that I could track how students learned things. But I could see their ideas actually changed very quickly; they weren't static. So this sort of romantic idea in teaching—that you had to understand what students knew—was completely wrong. I'd observed students, and I could see that you could shape their behavior, but you couldn't know what they knew. There was humility in learning this: I could see the limits of what any teacher could know about student knowledge at any time."

This key realization shifted Treisman's view of the problem from how to teach a mathematical concept to how to create a setting in which students could learn mathematical concepts. In this new analysis, the instructor's responsibility was to create the environment that would allow students to learn and that would help move them towards a better understanding of the concepts. The instructor's role was to observe and facilitate this interaction.

But Treisman also knew that the phenomena of teaching and learning cannot be examined abstractly outside of the specific content area in which they occur. And what was taught in freshman calculus was, to a great extent, an accident of history. The relative significance of some mathematical concepts over others had become obscured by traditions in teaching and by the thickness of textbooks. Treisman's first step was to critically examine the freshman calculus curriculum so that he could identify the big ideas that are essential for understanding not only freshman calculus, but the content of subsequent mathematics courses as well. He knew that if he was dealing with students who had not had previous intensive exposure to mathematics, it would be important to make explicit which mathematical concepts they must comprehend in order to succeed.

The typical experience at UC Berkeley and other research universities was that students who became mathematics majors had either grown up in mathematical families, or had been enrolled since middle school in "fast-track" accelerated mathematics and science courses. Many had been on their high school mathematics team; many had worked recreationally on mathematical problems for entertainment. Their intensive experience and exposure had given them a fluency in mathematical language, and an insider's view of the field.

Treisman considered what kind of mathematically rich setting could provide students who had not had that kind of intensive background with the opportunity to examine and explore the mathematics intensively and in depth. Treisman knew from personal experience that mathematics was hard. Mathematics is, as he still describes it, "highly condensed thought." Even if students arrived at the university having completed all of their required high school mathematics courses, they might not have had the in-depth experiences that could transform them from good students in mathematics classes to *mathematicians*. These "outsider" mathematics students would need a great deal of time to gain computational intuition and number and function senses. This internalization of key skills could only come with intensive work and exploration.

In his search for ideas, Treisman looked not only inwardly to the mathematics content area, but also outwardly, to the fields of education, linguistics, and cognitive science. In particular, the UC Berkeley interdisciplinary mathematics and science education graduate program, SESAME, provided a source of ideas and people. This was a time of explosive growth in the development of new theories and possibilities in cognitive science. "In general," Treisman notes, "the teaching of mathematics in universities, especially in large lecture settings, was poor. And there were no incentives for doing it well. The new analytical tools of cognitive science were so powerful that it seemed if we *actually taught math*, the students could do well."

Especially through the influence of Leon Henkin, a prominent logician with a history of working on education issues, the idea emerged that well-crafted, beautiful calculus problems could drive the students' learning. These problems were conceptualized as "gravitational poles" that would pull students toward a more mature understanding of the key calculus concepts. Moreover, in the process of solving problems, students would learn to use the language of mathematics in ways that promoted conceptual understanding.

In 1977, Treisman and others launched a pilot PDP Mathematics Workshop based on these ideas. The initial core group of Mathematics Workshop students had participated in the PDP summer high school program. Participation in the new Mathematics Workshop was voluntary—students attended the Workshop for six hours a week on their own time to work together on challenging calculus problems.

Treisman and other early workshop leaders (such as mathematics and SESAME graduate students) devoted tremendous time and energy to crafting problems. Most of the problems were intentionally so challenging that they required more than one student to solve. Some of the problems were difficult because they incorporated within the same problem concepts from different chapters of the textbook. Some problems were designed specifically for particular students, to help them climb over obstacles in their learning. Others had no quick solution and forced students to wrestle with a particular problem for an extended period. For dramatic impact, some of the problems were taken directly from old midterm and final exams.

Other problems were crafted to make clear where gaps existed in the students' mathematical preparation. While the Mathematics Workshop was designed to identify and build on student strengths, it was clear that even excellent students arrived at the university with some gaps in their mathematical backgrounds. When these appeared during the process of working on problems, it was possible to address them in situ, that is, to fill in the background concepts in algebra or trigonometry within the context of working on hard calculus problems. This strategy proved more effective mathematically and psychologically than the alternative strategy of routing students to programs that were specifically structured as remedial. As a result, in the Mathematics Workshop, if "remediation" was called for, it was done in situ. This emphasis on addressing students' gaps in preparation as a natural part of the ongoing work of the course became a robust characteristic of the ESP model.

Numerous educational researchers have described mathematics as a key educational filter. In particular, algebra (in high school) and calculus (in higher education) have served as critical gateway courses. Historically, mathematics has filtered some students into, and others out of, the high-status technical and professional fields. And by the 1970s it had become clear that African American and Latino students were far too frequently filtered out. Leon Henkin and other mathematicians felt strongly that the discipline they loved should not be used as such a filtering mechanism. This was not only because of the negative effect such filtering had on the students, but also because these mathematicians felt it would be better for the future of the profession if its practitioners were as diverse a group as the American populace. Thus, creating a setting in which it was possible for a diverse group of students not just to pass—but to excel in—calculus became a compelling academic need. The PDP Mathematics Workshop was ultimately fostered equally by the supportive PDP environment, Treisman's research findings about the isolation of minority students on campus, and a deep commitment to mathematics as a discipline.

Collaboration and Community

One of the most widely recognized characteristics of the Emerging Scholars Program model is the emphasis on students working together in small groups. Over the life of the program, it has become evident that this group work does more than just help students learn the mathematics: it helps them learn what it is to be part of an academic community. The intent of student interaction in the workshops, however, was not originally to create social support. Nor was it pedagogical, as is true of many collaborative learning theories, which have those students who understand an idea teach it to those who don't. Rather, the intent of the group work was academic: it was to foster conversations in which the students had to articulate their own mathematical ideas and listen to the mathematical ideas of others. The instructor, in the role of facilitator, could proceed from those conversations to pose questions, to challenge students' ideas, and to prompt them to think harder about the mathematics.

The group setting served a number of other mathematics-focused purposes as well. Workshop students arrived at the university with varying levels of mathematical preparation. Because the workshop interactions ensured that the students made their work public, each student got to see how his or her peers interacted with various mathematical ideas. Some of the students who had always done well in mathematics had often succeeded without a great deal of effort. The mathematical concepts had seemed clear to them, and, if blessed with a good memory, many of these students could excel in high school mathematics without ever really running into hard challenges. These students often thought of their ability to do well in mathematics in terms of "talent." When these students ran into their first really hard problems in college, they tended to become discouraged and decide they were not as talented as they had thought. The Mathematics Workshop group provided a setting where they could see that others struggled with the material as well. Some of the calculus problems were designed to help students shift from the assumption that doing well meant being able to solve problems quickly and easily to the idea that doing well meant working very hard and persevering.

In contrast, those workshop students who had not found mathematics easy, but who had learned in high school how to work hard on problems, got to see that others also struggled with the material and made mistakes. Further, for those students who were accustomed to working alone, the group provided the model for how to approach a calculus problem from different points of view. Over time, students became skilled at, and internalized, this conversation—this process of incorporating various perspectives into solving a problem.

Because the process of doing mathematics in the workshop is public and shared, this setting may have the capacity to allay what social psychologist Claude Steele has described as "stereotype threat." Steele and Aronson's work (1995) describes how African American students' scores in mathematics can decrease when they are aware that others may judge their performance in terms of their racial background, rather than their individual background. A setting where it is evident that everyone must work hard to succeed in mathematics may diminish this stereotype threat.

The workshop setting also created an opportunity to make explicit some of the implicit expectations of the university environment. One focus of the Mathematics Workshop was to make explicit the amount of work it actually takes to excel in calculus, and by association, in the university. The rules by which higher education actually works are often obscured by history, by tradition, and sometimes even by conventional practice. For example, many mathematics professors will articulate it as a common standard that their students should put in at least two hours of study time for every class contact hour. By this standard, for a four-hour calculus class, a conscientious student should put in eight hours a week in homework and study. In Treisman's research on freshman calculus students, he found that the African American students—who had been excellent students in high school—regularly put in the commonly understood requisite six to eight study hours a week on calculus. In contrast, however, the students getting A's in calculus did not follow this minimum standard for outside work. From the advice of their older siblings and friends, they had learned not to pay attention to it, and they put in as much time as was needed, which on average turned out to be 14-plus hours a week. The workshop setting let students triangulate where their work stood in relation to that of their peers; that is, the group setting made it easier for them to check with each other about critical details such as how much time they spent studying and how well they were doing on quizzes and exams. This talk among peers helped students normalize their view of what was really required to succeed.

Community, like many other ESP principles, can be a deceptively easy concept. Human relations and caring were at the heart of the community. PDP was a place on a big campus where, as students frequently said, "Someone knows who I am." "They know me by name," and "Someone listens to me." The workshop was a place where the faculty and staff took the students' intellectual aspirations seriously. It was also a place where students could meet peers. Students could take part in conversations with mathematicians, and also have people to talk about music, sports, or news. PDP was a place where students could find things familiar and comfortable, but was also a place safe enough to explore new and unfamiliar ideas.

The social environment nurtured the students and helped give them the support and resources to avoid the nonacademic pitfalls (such as financial aid, housing problems, or even homesickness) that might draw their attention from academics. The pedagogical theory of collaboration fit together perfectly with the Professional Development

Program's spirit of community and its commitment to ending the isolation of minority students on campus.

Commitment to Academic Excellence

> *The kids I worked with convinced me that the remedial idea wouldn't work. And excellence is what the university is about. Aiming for excellence respects the mathematics, and I was a math guy; the remedial programs didn't respect the math. If you're aiming for an A or B, and you fail—well, the student still passes. If you're just aiming for students to pass the course, then if you fail, they fail.*
>
> —Uri Treisman, Professor of Mathematics and Director, Charles A. Dana Center, the University of Texas at Austin

As a mathematician, Treisman respected mathematics and knew that the mathematics faculty cared deeply about their subject. Thus, he knew that if a program was designed only to help its students attain a minimum level of content knowledge, the students would never experience the real mathematics; that is, they would not have the opportunity to deal with the content that the faculty valued. Moreover, if a program aimed only to help students pass (i.e., to get a C) and the program wasn't successful, the students could receive a D or F.

In addition, the Special Scholarships Committee had clearly mandated that the Professional Development Program produce students who were prepared to go through graduate school and become the next generation of faculty and scholars. The SSC's vision fostered a program that reflected the real mission of the university: academic excellence, scholarship, and service. For a program to be at home in the university, and not marginalized on campus, that program had to have rhetoric and goals that resonated with the university goals. This idea of program-university congruence became important in the later dissemination of the Emerging Scholars Program.

The program's staunch belief in excellence was also a reaction against a political trend of the time. Minority programs tended to be housed in centralized learning centers and to be focused on generic study skills. Many remedial programs at UC Berkeley and other campuses were designed to address the putative deficits of the students, without ever checking to see if those assumptions of deficits were accurate. The main learning center practice at that time was to provide self-paced, individualized, remedial instruction, which translated to a tendency to isolate the student as he or she went through this self-paced process. Thus, the learning center remediation tended to reinforce the very academic isolation that Treisman had noted as a key cause of minority student failure.

For example, at UC Berkeley the relationships between PDP and the learning center were complicated. Learning center personnel cared deeply about their students, and they had seen a lot of unexpected failure among students who came in with good preparation.

The staff understood how devastating such failure was to the students and their families. Often, in reaction, they would steer students away from rigorous courses such as calculus. The challenge for PDP, then, was to convince the learning center staff that the Mathematics Workshop was not just falsely raising student hopes, but that it would support the students academically.

Within the Mathematics Workshop, excellence prevailed both as a philosophy and as an outcome. The results of the pilot (1977), which were replicated in subsequent workshops, were dramatic: two-thirds of the students who participated in the Mathematics Workshop at UC Berkeley earned grades of A or B. And virtually no Workshop students failed (Fullilove and Treisman, 1990). Treisman recalls that "It was exhilarating!" Eliminating failure was a by-product of the focus on excellence, and it became a watchword of the Mathematics Workshop that it was "easier to help a student get an A than a C."

Chapter 3

Structure: What Does an Emerging Scholars Program Look Like?

The lessons learned from the evolution of the Emerging Scholars Program at the University of California at Berkeley and the University of Texas at Austin provide insight for anyone who wants to construct a similar intervention for a gateway course in a particular academic discipline. The philosophical stance that informs all the essential elements of the ESP model is that its purpose is not to "fix the students," but rather to change at least a small part of the university environment, by making it more welcoming, both socially and academically.

The original intent of the Mathematics Workshop was to create a mathematically rich setting in which students could learn calculus. Therefore, the first elements of the program stressed intensified academic instruction: increased student interaction, well-crafted calculus problems, and increased time spent on these problems. This aspect of the Mathematics Workshop is presented in detail in an earlier work by the author (Asera, 1990). The article is a description of an active Workshop, as if the reader is sitting and observing. It also captures the students' perspective and student presence that has been at the heart of the program. Over time, it became clear that other things had to happen "backstage" to help ensure the effectiveness of the program's intensive academic setting. Some of these backstage activities were related to students' nonacademic needs. Others were political and administrative arrangements that had to be established on campus to facilitate the continued existence of the intensive setting.

For the first 10 years (1977–1987), the original PDP Mathematics Workshop was an adjunct program, meaning that students attended the Workshop on their own time, and that workshop leaders were mathematics or science education graduate students who were employed by PDP (rather than by their departments). Several workshop leaders first apprenticed with an experienced leader, and then continued to work at PDP for a number of years, honing their craft. Though overseen by Special Scholarships Committee faculty members, the Mathematics Workshop was for this initial period separate from the UC Berkeley Department of Mathematics.

In 1988, the PDP Mathematics Workshop moved to the mathematics department. While the essential pedagogy did not shift, the program structures did. The workshop became a two-credit department elective that consisted of an extended discussion section with significantly more time than the regular calculus discussion sections. Making the workshop a two-credit elective enabled students to take a lighter freshman load, and, in keeping with PDP advice, "to excel in a few courses first." These discussion sections were led by graduate teaching assistants. The University of Texas ESP, also piloted in 1988, began in the UT Austin Department of Mathematics with direct faculty involvement of John Dollard, Gary Hamrick, and Efraim Armendariz, among others, and the support of the Office of the Dean, College of Natural Sciences.

Below are described the essential elements of an Emerging Scholars Program. Such a program description has been attempted before and has always proven more difficult than it seems. This is because the essential elements of the ESP model tend to recombine in highly distinctive ways, depending on the demands made by the local environment. The structure of any given program must be determined by a combination of at least the following variables:

- A particular local intent or student need to be addressed;
- the resources that are available locally; and
- the creativity and job description of the individual or individuals responsible for developing the program.

The descriptions below are based on observations of the Mathematics Workshop at the University of California at Berkeley and of the Emerging Scholars Program at the University of Texas at Austin. Descriptions of variations on the ESP model as they play out in other settings are included in Section IV of this essay, which covers dissemination of the model.

These are the three overlapping levels at which work must be carried out to sustain the program:

1) The section or workshop setting,
2) program administration, and
3) campus negotiations.

Different skills, and often, different individuals, are needed at each level. Faculty members play important roles in designing and maintaining the curricular integrity of the workshop setting and in campus negotiations. Faculty may also play a role at the workshop level in visiting ESP sections and in direct conversations with students. The efforts of the program within a specific campus become more powerful when the faculty who lead the program are linked to national networks and professional organizations.

1) The Section or Workshop Setting: Intensified Instruction

At the heart of any program based on the Mathematics Workshop/ Emerging Scholars Program principles are groups of students working on challenging mathematical problems. The following bullets, adapted from an article on the UT Austin ESP (Moreno et al., 1999), summarize the special characteristics of an ESP section. It should be noted that to date, the University of Texas ESP has been a joint project of three UT Austin entities: the Department of Mathematics; the Office of the Dean, College of Natural Sciences; and the Charles A. Dana Center, an education-oriented organized research unit in the College.

In contrast to the regular calculus discussion sections, which focus on homework problems, ESP sections:

- **Increase structured time spent on calculus:** At the University of Texas at Austin, ESP students enroll in a regular calculus lecture (three hours a week) and in an ESP elective. The elective incorporates and extends the regular lecture's discussion section time of two hours and adds four more hours, for a total of six hours a week of intensive discussion section over and above time spent in lecture. Emerging Scholars discussion sections meet three times a week for two hours at a time in contrast to non-ESP discussion sections that meet twice a week for one hour at a time. It is important to note that during the ESP section or workshop, the participating students work on designed problem sets—not on homework. Students are regularly reminded that they are each responsible for homework on their own. The UT ESP program does provide resources to support the students' work on homework, through graduate teaching assistant office hours, and evening sessions with undergraduate student assistants, during which time students can tackle questions about homework.

- **Explore more challenging aspects of the mathematics:** Students work individually and in small groups on worksheets of carefully crafted, challenging problems that help develop a deeper conceptual understanding of calculus. The problems are not just hard for the sake of being hard. The teaching assistants construct the problem sets for each ESP section, based on the material covered in class lectures and on individual student needs. The UT Austin and UC Berkeley programs have developed a substantial and growing database of calculus problems.

- **Provide more personal interaction with peers, graduate students, and faculty:** Non-ESP discussion sections typically include up to 40 students, and ESP sections are limited to 24. A graduate student teaching assistant leads the ESP discussion sections, with help from one or two student assistants—undergraduates who have been through

ESP. The undergraduate student assistants serve as peer mentors for the freshmen and help transmit the culture of the program. (In addition to the knowledge they gain about teaching and learning, the student assistants get the benefit of reviewing the entire calculus curriculum over the course of the year.)

- **Foster a student community:** ESP organizes activities that encourage students to connect their academic and social lives. These can include picnics, volleyball games (often on the same day as a midterm review), and, sometimes, community service activities. In addition, wherever possible, students are scheduled together in other academic courses besides mathematics. This provides a sense of familiarity and continuity that stretches across the broader campus. The program also encourages informal student interactions outside of class.
- **Provide academic advising:** The program coordinator advises students so that they can make informed choices about their academic program, not only for freshman courses but also to prepare for mathematics-based majors. As at UC Berkeley, UT Austin students receive two elective credits for ESP participation and can therefore take a lighter academic load their freshman year. This allows students to concentrate on and excel in a smaller number of challenging classes their first year.

The way the ESP student groups are organized shifts over the course of the semester, from assigned and formally structured to more self-chosen and informal. Typically, early in the semester, workshop leaders will make an organized attempt to ensure that each student works with all the other students in the workshop. After that initial introductory period, the student groups start to become self-forming and fluid. Even within one session, students might move from group to group with comfort. Since some students need more time working alone, these students may within one session shift from working alone, to working with a group, and back to working alone. In the early days of the Mathematics Workshop program, Treisman, in his role as workshop leader, would sometimes note two students grappling alone at the same point in a problem and gently suggest that they work together. The intent was to get students to work with others who were at about their same level of knowledge. Over the course of the semester, the amount of formal structure and directed interaction decreases as students became more skilled in working together.

2) Program Administration: Building a Nurturing Environment

The next level of implementation is the program's administrative aspect: its overarching structure that creates the nurturing environment in which students feel comfortable. The ESP model reflects a fact that has been widely recognized in the higher education research literature on student retention: the more complex and the higher the number of relationships that students have in the university environment—the more people they care about and who care about them—the more likely they are to remain and succeed at the university (see, for example, Astin, 1993; Tinto, 1993).

An ESP program coordinator has primary responsibility for building community and for student advising. Ideally, the program coordinator should really understand students, because a program based in a mathematics department needs a designated (and dedicated) coordinator who can function as an advisor or counselor who is knowledgeable about and connected to the broader campus community. The program coordinator has formal responsibility for recruiting, advising, and registering students—and informal responsibility for checking in with students and making sure they are not derailed by issues such as financial aid or housing. The coordinator, the graduate teaching assistants, and the undergraduate student assistants together serve as a safety net that can either prevent problems, or identify and provide resources to students having academic or nonacademic difficulties.

Recruitment

The task of identifying and recruiting potential workshop students requires knowing the general profile of the students who are able to use the program effectively, as well as knowing when to bend the program's admission guidelines. The program has been shown to be effective for students who, in ESP parlance, "live in the same town as the ballpark." This means students who are ready, or close to ready, for calculus. The program is not designed for students who do not have a background in high school algebra and geometry to get through calculus.

The program coordinator is responsible for keeping the boundaries of the program permeable, so that any student who likes mathematics and is willing to work hard can find his or her way in. Thus, the program outreach documents tend to underscore the fact that any interested student is welcome.

Recruitment is a personnel-intensive activity. One of the first steps is to share information about the program with a wide network of educators, advisors, and counselors, on higher education campuses and in high schools. These professional networks are among the most effective ways to locate potential students. This initial identification is followed with a great deal of personal attention, letters, phone calls, and conversations with students and parents. The first contact and conversations about ESP set the expectations on both sides. At UC Berkeley the recruitment process was by no means uniform, particularly in the early years. In those days, it sometimes took an act of creativity just to acquire the list of minority students accepted to the university. Each student received a letter and a personal phone call. The letter began with congratulations to the student on their acceptance to the university and to the Mathematics Workshop, and went on to highlight the honors nature of the program.

The Mathematics Workshop and ESP have often had to respond to the accusation that its positive outcomes are the result of student self-selection rather than of an actual program effect. That is to say, the students who choose to participate are well prepared and highly motivated and would succeed even without a program. Although Treisman's research illustrated that students who had in earlier years entered the university with equally strong academic preparation had not succeeded in calculus, the issue of self-selection was still a concern. One year at UC Berkeley, in a negotiated compromise with the learning center about who could recruit which students, PDP was limited to recruiting only students from a limited geographic area. It was significant that the student results that year reflected the same pattern of success.

The challenge of recruitment is first to identify the pool of potential students and then to create the right level of invitation and "theater"—the drama of pursuing an extraordinary standard of excellence in studying calculus. This powerful invitation lets students, some of whom would not usually join special programs, see themselves as a part of the Emerging Scholars Program.

Advising

Advising includes the formal task of helping students get scheduled into the right courses, and when possible, helping them get placed with the strongest instructors. One of the most important advising tasks for incoming freshmen is to help them avoid the pattern of scheduling a courseload that resembles that of a high school senior, that is, five "solid" courses. This means working with students so that they sign up for fewer courses initially and are therefore able to focus on them more intensively. Ensuring that students get additional academic credit for participating in ESP helps this happen more easily and can generate revenue for the department as well. At the informal level, advising entails checking in periodically with students throughout the academic year. It also means connecting students to opportunities that might benefit their academic careers. The ESP coordinator, faculty members, and graduate students all share information about summer programs, graduate school, and future career opportunities.

Creating a sense of community

The ESP coordinator is also usually the person who organizes the program-sponsored picnics, pizza parties, and other social events that bring together present and former ESP students, graduate students, and faculty. Such events foster a sense of belonging and also further widen the network for the ESP participants. Another strategy that has been used to foster this community is a conscious focus on outreach activities and service to the broader community. For example, at UC Berkeley, Mathematics Workshop participants would sometimes tutor at an Oakland high school, bringing to local students their mathematics knowledge and firsthand information about college. Other programs around the country have experimented with organizing environmental projects, collecting food for homeless shelters, or participating in campus outreach activities to middle schools. This added service role gives students the status and responsibility of representing the university in the community.

One of the powerful resources for community-building at UC Berkeley was a room dedicated for the Workshop's use. This designated space (and reserved space is a highly valued commodity on any campus), provided a home base for students—a place they could drop by, any hour of the day or night, to hang out and work on mathematics.

Although it is the coordinator's responsibility to "foster" the sense of community, community itself grows from the human relations and interactions among all the participants: students, former students, graduate students, faculty, and staff. The community is most vital when the students take a active role in shaping their own environment.

3) Campus Negotiations: Advocating for the Program

The third level of program implementation is negotiating with the department and with the campus administration. This entails advocating for the program, advertising its successes, and searching for allies and resources on campus. A number of well-tested strategies are available to guide this level of activity. For faculty members beginning a program, the general strategy is to start small and build a local tradition of success. In other words, a pilot program should provide an existence proof: a visible example of success. To achieve such a success, it is critically important to identify those students who are most likely to succeed with intensified instruction. Too often in education, viable theories are first tested on the most difficult cases. By instead starting with more achievable goals, the program can build a local history of success that in turn changes expectations and generates support.

Senior faculty with stature in their academic field should be at the center of the advocacy effort; such involvement reinforces the academic integrity of the endeavor. Junior faculty who may be interested in playing such a leadership role may jeopardize their own research and tenure by taking on such a role. Further, they are often not as likely to know their way around the campus politics. Former department chairs, former deans who have returned to the classroom, or other faculty members who have been active in campus politics and understand the forces on campus can be powerful leaders or allies in this process. Such individuals will be able to identify departmental resources and structure departmental incentives, and will know the best ways to approach deans or provosts. This complex advocacy and negotiation work is strengthened when the active faculty members are connected to national and professional networks, and they can present the campus efforts in terms of national priorities and concerns.

Chapter 4

Dissemination

> *We tried to have a dissemination theory that reflected our pedagogy, so we framed it as a set of problems to be solved. Some of these problems were about students: how to identify students, for example—recruitment. Some of the problems were about instruction: how to construct the worksheets so they don't kill the students. And some of the problems were administrative: how to fund and support the program.*
>
> —Uri Treisman, Professor of Mathematics and Director,
> Charles A. Dana Center, the University of Texas at Austin

Overview

ESP's dissemination, much like its development, was shaped by experimentation and observation. Attempting to disseminate ESP has been a process of pragmatically inventing, trying, discarding, or refining strategies. It is important to note that over the years since dissemination began, the volume of inquiries about the program has served as a measure of the severity of the problem and of the relative scarcity of effective solutions. Over the years, the dissemination effort has been supported by a number of sources, both public (the Fund for the Improvement of Post-Secondary Education and the National Science Foundation) and private (the Charles A. Dana Foundation).

From 1980 onward, it is possible to trace dissemination through professional networks and waves of geographic expansion. Since a time very early in the program's existence, its dissemination has included some consciously crafted efforts and successes, as well as some ideas that sounded wonderful in theory but that simply did not work in practice. Dissemination has benefited from advantageous accidents as well. The greatest challenge to dissemination has continued to be the fact that the Emerging Scholars Program is not a singular or monolithic model, but rather, as described above, a set of principles and heuristics. Although it is true that one predominant department-based model has emerged for research universities (as described for UC Berkeley and UT Austin, above), other institutions of higher education have creatively configured and adapted ESP principles to a wide range of settings.

Many of the lessons learned from ESP's dissemination have also been noted by other innovative educational programs through their dissemination efforts. Perhaps the most important lesson has been just how much ongoing technical assistance is required after a potential site's initial inspiration and decision to implement the program. The ESP dissemination effort was shaped by, and responsive to, the resources and opportunities available. In retrospect, it is clear that the PDP and Dana Center staff who worked on the dissemination effort had substantially underestimated the energy and personnel that would have been required for the project to maintain ongoing technical support.

Early Days: First Dissemination Efforts

A 1978 grant from the Fund for the Improvement of Post-Secondary Education (FIPSE) supported the growth of the workshop at UC Berkeley and included an initially small component for dissemination. This support was very significant in the initial growth and expansion of the Mathematics Workshop. For more than a decade, FIPSE supported the Mathematics Workshop as their flagship project in educational access. Later FIPSE grants directly supported dissemination of the Workshop to other campuses.

In 1980, the Ford Foundation increased national recognition by sending a small team to the UC Berkeley site and following up with a national meeting. With increased national attention, the number of requests for technical assistance began to grow. At the same time, the program was gaining attention through a second avenue as well: word of mouth. In the late 1970s and early 1980s, nearby campuses started to inquire about the Mathematics Workshop model. In fact, some of the project's first dissemination efforts were responses to requests from nearby colleges, even before the program was formally organized for dissemination. At the time, Treisman began to be invited to give talks at state universities and colleges throughout California. By 1983, some 15 campuses in California had programs based on the Mathematics Workshop—some in learning centers, some in Minority Engineering Programs, and some as freestanding workshop programs.

Early interactions with other campuses rapidly exposed the shortcomings of the project's original simplistic idea that it would be possible for other campuses to copy the program structure and achieve the same results. Such easy replication was not possible, in part due to the complexity of American higher education. Campuses with very different missions and student populations tried literally to photocopy the program—i.e., its invitation letters, attendance forms, problem sets, and so on. If, for example, students at a neighboring community college, many of whom were returning adults, received an (exactly replicated) invitation letter that noted it was issued "under the aegis of the faculty senate to foster faculty members of the future," these students knew that this program was not about them. Consequently, the outcomes of attempts to simply copy the program were, at least in retrospect, predictably ineffective.

Local community colleges, however, did find creative ways to adapt the model to their distinctive environments. Laney Community College in Oakland, California, for example, was one of the first campuses that was able to take the core ideas of the Mathematics Workshop and construct implementation strategies that were compatible with its campus. Laney Community College's environment was markedly different from that of UC Berkeley, but Laney's entrepreneurial leadership could see how the Mathematics Workshop could be useful. Thus, Laney set up a series of workshops linked to different classes, not just calculus, that met the needs of their students.

Expansion of Dissemination Efforts

By the mid-1980s, the Mathematics Workshop was receiving attention from national professional organizations, such as the Mathematics Association of America and the Mathematicians and Education Reform Network. Two landmarks of this period were a second implementation grant from FIPSE (1986) and Treisman's receipt (1987) of the Charles A. Dana Foundation's Dana Award for Pioneering Achievement in American Higher Education. The Dana Award brought increased national attention and was followed by a 1988 grant from the Dana Foundation to establish the Charles A. Dana Center for Innovation in Mathematics and Science Education at UC Berkeley, with responsibility for disseminating the successful Mathematics Workshop model. It was also at approximately this time (1988) that the name Emerging Scholars Program became commonly used as a local name of a number of programs, and as a generic name for the process and dissemination.

Over the years, various Dana Center and Professional Development Program staff tried to develop a guidebook that would lay out not only the program structure, but its heuristics and essential elements. But development of such a guidebook always faced obstacles. One critical obstacle was that the Mathematics Workshop itself was constantly changing. When its staff described the program in comprehensive detail, other campuses tended to reproduce those details as exactly as possible, which was usually inappropriate. But when the staff resorted to describing instead the program's driving principles, that strategy, too, proved problematic, since the principles without the weight of specific examples were far too easily misunderstood.

Treisman remembers, "We started identifying what we saw as the central elements, and we could see how they confused people. People misunderstood; they would pick out features, often something that we had designed specifically to match the Berkeley environment, and confuse that with the heart of the program." A particularly important example of this kind of misunderstanding centered on the programmatic principle of congruence. Congruence is the idea that the implementation of the program in any given institution must be congruent with the culture of that institution. Put another way, the goals of a workshop must match the goals of its home institution.

Given the limitations of describing the program in comprehensive detail (faithful replication) and of describing its driving principles (essential elements), the Dana Center at UC Berkeley, which in the late 1980s had a staff of only three or four people, chose to focus on two linked strategies: "shotgun" dissemination and developing a set of existence proofs in different settings.

Shotgun dissemination

The intent behind what came to be known in ESP parlance as shotgun dissemination was to disperse the ideas broadly into the public domain, with little or no attempt to control them. As part of this dissemination effort, Treisman and other Dana Center staff spoke at a large number of national and regional conferences, professional meetings, and symposiums. The main target audiences were higher education mathematics and science faculty, and campus administrators, particularly deans and provosts. Treisman used these presentations to recount his study of African American and Chinese American freshmen, and how he had come to understand the critical importance of addressing the isolation of black students on campus. He continually adapted the story for different audiences. His detailed retelling allowed each audience to vicariously experience Treisman's dilemmas and conclusions about the nature of the problem.

The program's dissemination mirrored its pedagogy: when Treisman described the issue in terms of an intriguing problem to be solved, he hooked many of the mathematicians in his audience. Many faculty who cared about both mathematics and students had seen minority students in their classes fail. These faculty often could not resolve the tension between their professional commitment to the standards of their discipline and their personal and political sympathies for these students. Hearing Treisman's narrative of his experience allowed them to realize their own—often unexamined—assumptions about the students who did not pass their classes. These faculty could then shift to a different perspective on the problem, a perspective in which their skills as mathematicians came to be viewed as a valuable resource for solving the problem.

The large conferences and symposiums at which Treisman and other Dana Center staff presented had the advantage that ideas could be described to large groups of practitioners at one time. But a second, smaller kind of venue also proved invaluable because of the higher level of interaction it made possible with participating campus teams. This was the professional short course: everything from Chautauquas to Mathematical Association of America minicourses to Mathematics and Education Reform Network conferences. These short courses tended to run for two or three days at a time, and they gave Dana Center staff a chance to discuss the program in much more detail with the faculty and administrator teams. But even then, the small number of Dana Center staff meant that it was impossible to have the subsequent extensive contact with the campuses that would help the Dana Center and the campuses implementing the program to learn from the experience. In short, the Dana Center developed effective vehicles for making program information widely available, but it did not have the resources to work in depth with more than a small handful of campuses. The Dana Center also did not have the resources at that time to build an ongoing support structure to connect faculty members from various campuses who were developing and running Emerging Scholars Programs.

This is not to say, however, that this shotgun strategy was not effective. Its major achievement was to change the nature of the conversation about access in the professional community. In part, it was able to do this because the timing was auspicious. In the late 1980s, the higher education mathematics community was grappling with the issue of "calculus reform," a movement to modernize the calculus curriculum. Although ESP was not directly connected to calculus reform, it was connected to the general zeitgeist that calculus education must be strengthened. The mathematics community was able to look at the visible example of ESP's successes and embrace the concept that students from diverse backgrounds could achieve in collegiate mathematics. As a result, a notable segment of the higher education mathematics community came to view it as the university's responsibility to develop structures that would support such achievement.

Developing a set of existence proofs in different settings

> *We had to learn about the different worlds of higher education. We could see the connections between ideas and locations and between the general and the specific. We could see what needed to be managed in different ways depending on setting. In some cases, we made it too problematic: for example, it turned out that the ESP model could be directly adopted at other research universities. But in other places, the more missions an institution has, the greater the number of ESP variations that are possible.*
>
> —Uri Treisman, Professor of Mathematics and Director, Charles A. Dana Center, the University of Texas at Austin

As part of the dissemination effort, the Dana Center at UC Berkeley proposed to create a set of existence proofs that illustrated how ESP principles played out in different higher education settings. These settings, described in more detail below, included Minority Engineering Programs, research universities, and comprehensive colleges and community colleges. The clearest, most developed examples are within Minority Engineering Programs and in mathematics departments at public research universities. There are an abundance of program designs that have flourished at comprehensive and community colleges. These designs include laboratory sessions, computer labs, and electives linked to specific courses. With the exception of a few programs developed by committed faculty members, the ESP model has not taken hold at private universities or colleges, despite a number of attempts to launch programs. The reasons are not entirely clear.

Minority Engineering Programs

Minority Engineering Programs, which tend to be based mostly in state universities and colleges, were among the first enthusiastic adopters of the Workshop model. MEPs began incorporating Workshop components into their programs in the early 1980s. At that time MEPs had strong community-building and support structures. The academic support they provided, however, tended to rely on the traditional strategies of tutoring and study skills. Ray Landis (then of California State University, Northridge, and now Dean of Engineering and Technology at California State University, Los Angeles), a major force in the development of MEPs, recognized the potential academic value of the Mathematics Workshop. In particular, the idea of a nonremedial approach to curriculum resonated for him, and he immediately understood the subtle idea that the Mathematics Workshop was significantly different from group tutoring. Landis advocated for the inclusion of Mathematics Workshop principles in MEPs.

In coordination with UC Berkeley's Professional Development Program, Minority Engineering Program directors (including those at UC Berkeley, UCLA, and California State Polytechnic University at Pomona) worked out the details of the MEP workshop component. These MEP directors constructed a hybrid workshop model that could be incorporated into the Minority Engineering Program model. Frequently, these MEP workshops are facilitated by an undergraduate mathematics or engineering major. There are now workshops for freshman calculus and for other critical courses in mathematics, the sciences, and engineering.

The new MEP workshop model was disseminated throughout the networks of the National Association of Minority Engineering Program Administrators (NAMEPA) and the Minority Engineering Program (MEP), first in California, then nationally. Interestingly, today at least a quarter of all MEP directors have gone through or led a MEP workshop based on the original Mathematics Workshop ideas.

Research universities

Based on the Mathematics Workshop's experience at UC Berkeley, both its successes and its constraints, it became clear that the model could function more effectively when based within the academic department (rather than in administrative offices or as an informal adjunct program). This was in part because as the number of minority students entering UC Berkeley increased significantly, they could no longer be served as effectively by an auxiliary program. Further, the Faculty Senate–mandated Professional Development Program was an anomaly that most other research university campuses would not have.

Research universities—including the University of Texas at Austin, whose Emerging Scholars Program is described in more detail above—built their programs based on Treisman's developing vision of what a large research university's departmental program should look like. This model was configured for departments with large lectures (100 students or more) and discussion sections led by graduate students. It was Mike Freeman, a professor of mathematics at the University of Kentucky, who, after visiting the UC Berkeley and UT Austin programs, pointed out that large public research universities are very similar. He noted that he would not have to alter the ESP model very much to implement it at the University of Kentucky.

Major research university mathematics workshop programs that began in the late 1980s, such as those of the University of Kentucky, Rutgers University, and the Universities of Illinois at Chicago and at Urbana-Champaign, created and institutionalized programs that 10 years later are still running. Moreover, some of those campuses, such as the University of Kentucky and the University of Illinois at Urbana-Champaign, have further disseminated the program internally, so that these campuses now also have workshop programs in chemistry and other sciences.

The Dana Center at UC Berkeley convened the faculty from these and other campuses informally once or twice a year at the major mathematics professional organization meetings. Each of these major research campuses had a primary faculty advocate who led the effort to develop a program, and a team of faculty and staff who then brought the program to life. Although the Dana Center stressed the importance of departmental involvement, successful implementation usually came down to an individual faculty member who functioned as the "torchbearer." For some campuses, the Dana Center at UC Berkeley (and at UT Austin, where the Dana Center moved in 1991) was able to use its growing national prominence to build support on the campus and to lend authority to that torchbearer.

Comprehensive colleges and community colleges

Dissemination of the ESP model to comprehensive colleges and community colleges was less clear-cut. These institutions have a larger number of missions and serve a wider range of students. It was problematic to use the same department-based model as adopted by large research universities, because of a number of key differences. For example, although research universities have many large lectures of a hundred-plus students, which are supplemented with smaller discussion sections, comprehensive colleges tend to have a wider range of class sizes, and fewer small discussion sections. Thus, building the workshop on an existing discussion section is less viable at many comprehensive colleges. In addition, comprehensive and community colleges do not usually have a ready supply of graduate students to serve as workshop leaders. Some comprehensive college programs have found creative ways for upper-level undergraduates to serve as workshop leaders, by providing these students with intensive training and mentoring so that the work also serves as student development for a small group of majors.

On comprehensive and community college campuses, there are more diverse interpretations of ESP principles. Faculty tend to take the ESP ideas and find ways to develop creative local implementation structures, sometimes within a department and sometimes at the level of a course within the department. At some community colleges, including Glendale Community College and Santa Barbara Community College (both of California), the faculty organized structures, such as voluntary laboratories or designated sections of the class that have increased time, which allowed the faculty to increase the time students could spend on difficult material and to add a problem-solving dimension to work that might otherwise have remained theoretical and textbook-driven. Over the years, a number of community colleges around the country have developed programs not only in mathematics, but in sciences as well. Sometimes these programs were established with very few resources other than faculty creativity and commitment. It is interesting that some community college programs tended to choose names, such as "the Berkeley Program," or the "Treisman Program," that lent authority via affiliation.

Instructive Mistakes

Dana Center staff have always learned from their work—not only from its successes, but from its limitations and mistakes. One of the ongoing Dana Center staff conversations grew into a collection of "instructive mistakes," a description of the predictable pitfalls that practitioners might encounter when attempting to establish an ESP. These stories grew out of real examples and were part of the oral tradition of the ESP dissemination effort. This instructive mistakes list served as a learning tool for Dana Center staff in their dissemination work—and as a warning for practitioners interested in starting a program.

1. **Transplant dementia.** A program model that is designed in a particular location cannot be simply uprooted and transplanted to another setting. This is particularly true when attempting a transplant across different sectors of higher education, such as from a research university to a community college. There must be congruence between the goals, language, and character of the program and of its home institution. Consequently, in the early days of dissemination, it became necessary to differentiate between what was an essential element of the ESP model, and what was an accidental artifact of the program's creation at UC Berkeley. Each campus that implemented the program had to construct local definitions of success that were congruent with the campus mission and the strengths of their students. Over time it became clear, particularly with feedback from faculty, that the ESP department-based model could be implemented at large research universities with only minor local alterations, but that much more customization was required to adapt the model to a comprehensive college, a community college, or a private liberal arts college.
2. **Soft money as a virus.** When programs are started with external funding, such as "soft money" from a foundation or corporate grant, the education system develops antibod-

ies to it. In other words, in many instances, innovative programs supported by outside dollars—despite extensive attention in proposals to planning for continuation and raising additional funds—disappeared as soon as the funding ended. For a program to successfully take root, campuses need to invest institutional resources, and not just rely on seed money from a start-up grant. Institutional resources might include faculty time, graduate student allocations to the department, and tutoring funds to support student assistants. Institutional resources were most likely to be forthcoming when the administration was actively committed to equity and access.

3. **The search for the magic bullet…and the resultant foot wound.** ESP is a multifaceted program. Different people tend to see different facets of the program, depending on their background; these selective views reflect the perception, and often the position, of the observer. For example, faculty tend to grasp the importance of a challenging curriculum and of increased time spent on hard problems, but they tend less often to recognize the importance of the personal support for students. Conversely, academic support personnel tend to see the supportive environment and emphasis on collaborative learning, but might miss the essential feature of the rigorous mathematics. The challenge for dissemination was to help all those involved with implementing a specific program to see the program in all its complexity, and to recognize that constructing a successful program would require a clear and comprehensive vision that incorporated all the essential program elements.
4. **Turf wars…the sequel.** One of the unique qualities of the ESP model is that it incorporates student-support services directly into department-based courses. Yet in the early days of dissemination, campuses rarely had structures that enabled active collaboration between student-support units and academic departments. In one potential interpretation of ESP, some academic departments would negotiate with the offices that supported minority students and find ways to actually blend resources. Unfortunately, this blending rarely came to pass because campus history and unequal access to resources were often insurmountable obstacles. Counselors tried to protect their resources and their students, occasionally demonizing the faculty members in the process. Faculty in turn would often discount the value of student services. Successful negotiations and blending of resources can only take place when it is clear that everyone is concerned about students' well-being and success and when all the active participants don't blame each other for the problems that are the result of system design.
5. **Recrudescence—a fresh outbreak of something, especially something unpleasant.** The higher education culture tends to have deeply embedded assumptions about minority students and the need for remediation. These assumptions crop up if a program is not vigilant about maintaining standards of academic excellence. If faculty and graduate students cease actively addressing student strengths, the specter of remedial work arises anew. Over the years, Dana Center staff saw pro-

grams that had been established in the spirit of excellence, but that without ongoing curricular input from faculty, devolved into tutorial homework sessions. In a few cases, such programs had to be reconstructed from the ground up with a renewed commitment to academic excellence.

6. **Structural impediments—excellent pedagogy does not compensate for an inadequate *curriculum*.** A transcript review at UT Austin (which turned into a UT Austin doctoral dissertation, Ruddock, 1996) revealed that students who started their college mathematics in precalculus—rather than in calculus—were unlikely to persist and graduate in mathematics-based majors. What was surprising was that even those students who earned excellent grades in precalculus were unlikely to graduate in technical majors. The problem with precalculus seemed to be either that the curriculum, despite its name, did not prepare students to succeed in calculus, or that the timing (taking precalculus in the fall, calculus I in the spring, and calculus II the following fall) threw students off track. Either way, precalculus, the study showed, was not functioning as an effective entry to the technical majors. Thus, even designing an ESP that would support student excellence in a course such as precalculus would not necessarily increase student chances of majoring in technical fields, because of problems with the course itself.
7. **Don't import a solution until you understand the problem.** Sometimes faculty attempting to establish a workshop program would call the Dana Center staff and say something like, "I have a great workshop program, but I have a problem: I only have five students." Such incidents often indicated that the campus had probably not examined their own department's resources and needs. The Mathematics Workshop at UC Berkeley was based on a quantitative review of transcripts and a qualitative observation of Berkeley students. Although other campuses did not need to replicate the entire multifaceted study, each campus was encouraged to do some local research to understand their own students' needs. Campuses that did this often were surprised by what they found. One campus found that the majority of their freshmen entered either having taken Advanced Placement Program® calculus, or needing precalculus—but they had very few entering freshmen ready for college-level calculus. Thus, at that campus a calculus workshop would be difficult to fill. It became clear that there were some requisite conditions for establishing an ESP: a sufficient number of target students at the right threshold of mathematical preparation, and a critical mass of expertise in the subject area—for example, an adequate supply of calculus instructors.

Chapter 5

Conclusion

The Emerging Scholars Program began more than 20 years ago as a response to a locally recognized problem at the University of California at Berkeley. Academically prepared minority students—who by all indicators were predicted to do well at the university—were not succeeding. Treisman's research into this phenomenon found that the cause of this failure was the social and academic isolation of these students on a predominantly White university campus. The solution—the Emerging Scholars Program—drew on a number of resources and strategies to create a mathematically rich environment in which it became possible for a diverse group of students to excel in the freshman mathematics courses. The essential alchemy of ESP integrates curriculum (reinforcing the strongest conceptual understanding of the subject), and community (building an environment where students work together and merge their academic and social lives). This complex alchemy has been re-created in various programs on campuses across the United States. Numerous studies have demonstrated the efficacy of ESP and sister programs across the country (see for example, Moreno et al., 1999; Kosciuk, 1997; and Bonsangue & Drew, 1995).

Now, 20-odd years later, the problem is still common in institutions of higher education: the numbers of African American and Latino students excelling in all undergraduate areas are still disproportionately low. And due to the work of Bowen and Bok (1998), the higher education community is even more aware of how pervasive the phenomenon of overprediction is for underrepresented minority students. The strongest African American and Latino students (from all economic backgrounds) coming out of high school are not always able to capitalize on the strength of their academic preparation as they enter college. This problem becomes even more acute with the decreasing support for affirmative action in institutions of higher education.

The Emerging Scholars Program has served as proof that it is possible to create an environment in which a diverse group of students can excel in courses that constituted nearly insurmountable obstacles for their predecessors. The responsibility for addressing this problem belongs to the institution, and faculty members have a vital role to play in ensuring that the next generation of scholars in their fields reflects the full diversity of the American populace.

References

Asera, R., "The Math Workshop: A Description.," *Issues in Mathematics Education*, Conference Board of the Mathematical Sciences, published by the American Mathematical Society in cooperation with the Mathematical Association of America, edited by N. Fisher, H. Keynes, and P. Wagreich. Vol. 1, January 1990.

Astin, A.W., *What Matters in College? Four Critical Years Revisited.* San Francisco: Jossey-Bass, 1993.

Bonsangue, M. and Drew, D., "Increasing Minority Students' Success in Calculus," *New Directions for Teaching and Learning*, No. 51, 1995.

Bowen, W. G., and Bok, D., *The Shape of the River: Long Term Consequences of Considering Race in College and University Admissions*. Princeton University Press, 1998.

Fullilove, R. E., and Treisman, P. U., "Mathematics Achievement Among African American Undergraduates at the University of California, Berkeley: An Evaluation of the Mathematics Workshop Program," *Journal of Negro Education*, Vol. 59, Summer 1990.

Kosciuk, S., I*mpact of the Wisconsin Emerging Scholars First–Semester Calculus Program on Grades and Retention from Fall* '93–96. Madison, Wisconsin: University of Wisconsin, LEAD Center, 1997.

Moreno, S.; Muller, C.; Asera, R.; Wyatt, L.; Epperson, J.; "Supporting Minority Mathematics Achievement: The Emerging Scholars Program at the University of Texas at Austin," *Journal of Women and Minorities in Science and Engineering*, Vol. 5, No. 1, 1999.

Ogbu, J., *Minority Education and Caste:The American System in Cross-Cultural Perspective*. New York: Academic Press, 1978.

Ogbu, J., *Minority Status and Schooling: A Comparative Study of Immigrant and Involuntary Minorities*. New York: Garland, 1991.

Ruddock, M. S., *The Efficacy of Prerequisite Courses in Mathematics for Minority and White College Students* (Ph.D. Dissertation). University of Texas at Austin, 1996.

Steele, C. M., and Aronson, J., "Stereotype Threat and the Intellectual Test Performance of African Americans," *Journal of Personality and Social Psychology*, Vol. 69, No. 5, 1995.

Steinberg, L., Dornbusch, S., and Brown, B., "Ethnic Differences in Adolescent Achievement: An Ecological Perspective," *American Psychologist*, Vol. 47, 1992.

Tinto, V., *Leaving College: Rethinking the Causes and Cures of Student Attrition* (second edition). Chicago: University of Chicago Press, 1993.

Treisman, P. U., "Teaching Mathematics to a Changing Population: The Professional Development Program at the University of California, Berkeley. Part I: A Study of the Mathematics Performance of Black Students at the University of California, Berkeley," *Issues in Mathematics Education*, Conference Board of the Mathematical Sciences, published by the American Mathematical Society in cooperation with the Mathematical Association of America, edited by N. Fisher, H. Keynes, and P. Wagreich. Vol. 1, January 1990.

Treisman, U. "Studying Students Studying Calculus: A Look at the Lives of Minority Mathematics Students in College," A Mary P. Dolciani Lecture, *College Mathematics Journal*, Vol. 23, No. 5, November 1992.

Treisman, U., and Asera, R., "Routes to Mathematics for African-American, Latino and Native American Students in the 1990s: The Educational Trajectories of Summer Mathematics Institute Participants," in *Changing the Culture: Mathematics in the Research Community*, edited by N. Fisher, H. Keynes, and P. Wagreich; *Issues in Mathematics Education*, Conference Board of Mathematical Sciences, published by the American Mathematical Society with the Mathematical Association of America, 1995.

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