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ABSTRACT

The Urban Mathematics Collaborative (UMC) project has the goal of contributing to the improvement of mathematics education in the inner-city schools by identifying models to enhance the professional lives of teachers and encouraging the entry of high school mathematics teachers into a larger mathematics community including mathematicians from higher education and industry. This document is a 5-year site report on the San Francisco Mathematics Collaborative from its inception in 1985 through June 1990. The intent is to reflect on the development of development of the collaborative, noting the changes that have taken place in regard to the context in the collaborative operated, the collaborative's management structure, and the focus of its activities. This final site report addresses the major influences exerted on the collaborative and the directions the collaborative has taken. Some conclusions are reached regarding both the collaborative's development and achievements in light of its specific goals as well as the goals of the total UMC project. (MDH)

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FIVE-YEAR SITE REPORT

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Report from the
Urban Mathematics Collaborative Documentation Project

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I. INTRODUCTION

This document is a five-year Site Report on the San Francisco Mathematics Collaborative from its inception in 1985 through June, 1990. The intent is to reflect on the development of the collaborative, noting the changes that have taken place in regard to the context in which the collaborative operated, the collaborative's management structure, and the focus of its activities. It is not the intent of this report to review the development of the collaborative; this has been done in the annual reports. This final Site Report addresses the major influences exerted on the collaborative and the directions the collaborative has taken. Some conclusions are reached regarding the collaborative's development and achievements in light of its specific goals as well as those of the total Urban Mathematics Collaborative project.

The Urban Mathematics Collaborative Project

In 1984, the Ford Foundation initiated the Urban Mathematics Collaborative (UMC) project to improve mathematics education in inner city schools and to identify new models for meeting the on-going professional needs of urban teachers. In February, 1985, the Foundation awarded five grants to establish urban mathematics collaboratives in Cleveland, Minneapolis-St. Paul, Los Angeles, Philadelphia, and San Francisco. In addition, the Ford Foundation established a Documentation Project at the University of Wisconsin-Madison to chronicle the development of the new collaboratives and a Technical Assistance Project (TAP) at the Education Development Center (EDC) in Newton, Massachusetts, to serve as a source of information for the collaborative projects (Romberg & Pitman, 1985). During the next 18 months, UMC projects were funded in Durham, Pittsburgh, San Diego, St. Louis, Memphis, and New Orleans, for a total of eleven collaboratives (Webb, Pittelman, Romberg, Pitman, Fadell, & Middleton, 1989). In August, 1987, an Outreach Project was funded at EDC to publicize and expand the UMC effort. In August of 1989, the Ford Foundation awarded replication grants to three additional sites: Dayton, Ohio; Columbus, Georgia; and Milwaukee, Wisconsin. In April, 1991, the fifteenth and final collaborative, the Greater Worcester Urban Mathematics Collaborative, was established in Massachusetts. A map indicating the location of UMC projects is presented in Figure 1.

The
Urban Mathematics Collaborative Project

Funded by The Ford Foundation

- **Cleveland Collaborative for Mathematics Education (C^2ME)**
  Cleveland, Ohio
- **Durham Collaborative: The Durham Mathematics Council**
  Durham, North Carolina
- **Los Angeles Urban Mathematics/Science/Technology Collaborative (LAUM/S/TC)**
  Los Angeles, California
- **Memphis Urban Mathematics Collaborative**
  Memphis, Tennessee
- **New Orleans Mathematics Collaborative (NOMC)**
  New Orleans, Louisiana
- **Philadelphia Math Science Collaborative**
  Philadelphia, Pennsylvania
- **Pittsburgh Mathematics Collaborative**
  Pittsburg, Pennsylvania
- **St. Louis Urban Mathematics Collaborative**
  St. Louis, Missouri
- **San Diego Urban Mathematics Collaborative**
  San Diego, California
- **San Francisco Mathematics Collaborative**
  San Francisco, California
- **Twin Cities Urban Mathematics Collaborative**
  Minneapolis-St. Paul, Minnesota

Replication Sites

- **Columbus Regional Mathematics Collaborative (CRMC)**
  Columbus, Georgia
- **Dayton-Montgomery County Public Education Fund Mathematics Collaborative**
  Dayton, Ohio
- **Greater Worcester Urban Mathematics Collaborative**
  Worcester, Massachusetts
- **Milwaukee Metropolitan Mathematics Collaborative (M^3C)**
  Milwaukee, Wisconsin

Figure 1. The National Network of Urban Mathematics Collaboratives.

During the five years covered in this Site Report, mathematics education in the United States has changed. When the Ford Foundation initiated the UMC project in 1984, a consolidated effort to reform mathematics had not yet begun, although the potential of the mathematics education community for achieving reform was envisioned. In this regard, the UMC project was innovative in mobilizing a group of inner city teachers to increase both their sense of professionalism and their connections with mathematicians in the business community and in higher education. Between 1985 and 1990, the landscape of mathematics education in this country began to change dramatically. In an effort to develop a new mandate based on such studies as *Renewing United States Mathematics: Critical Resource for the Future* (Commission on Physical Sciences, Mathematics, and Resources, 1984) and *A Nation At Risk: The Imperative for Educational Reform* (National Commission on Excellence in Education, 1983), the Mathematical Sciences Education Board in 1989 issued *Everybody Counts: A Report to the Nation on the Future of Mathematics Education* and the National Council of Teachers of Mathematics published *Curriculum and Evaluation Standards for School Mathematics*. As the collaboratives matured, the movement to change mathematics education in the country took on momentum, creating a new environment for the collaborative network. What began as a project designed to enhance the professional development of urban teachers evolved into a catalyst for the reform of mathematics education.

At each site, the UMC project supports collaboration among school mathematics teachers and between teachers and mathematicians from institutions of higher education and industry; it also encourages teacher membership and participation in a broad-based local mathematics community. Although the guiding principle behind the UMC effort has been that the teacher is and will remain at the hub of the educational process, it has become evident that many teachers--and especially those in inner-city schools--are overworked; lack support and material resources; and are isolated from their colleagues, from other professionals, and from the rapidly changing field of mathematics. Thus, the focus of the UMC project remains rooted in the premise that collegiality among professional mathematicians can reduce teachers' sense of isolation, enhance their professional enthusiasm, expose them to a vast array of new developments and trends in mathematics, and encourage innovation in classroom teaching.

Structure of the Five-Year Summary

The Five-Year Summary presented in the following chapter is comprised of six sections. The first section provides a brief overview of the collaborative. In the second section, the purpose of the collaborative is presented, as stated in its proposals to the Ford Foundation. The goals outlined in the collaborative's final request for funds to the Ford Foundation are contrasted with those specified in its initial proposal. The third section discusses the context within which the collaborative operated and the extent to which this has remained stable or has changed over the five-year period. Topics addressed in this section include demographic information on the surrounding community, changes in school district administration and enrollment and in the teacher population targeted by the collaborative, and significant changes occurring in mathematics and in the professional environment. The fourth section of the report describes the management structure adopted by the collaborative and changes that occurred in that structure over the five-year period. The fifth section covers the collaborative's activities in relation to four major themes that emerged as dominant in most collaboratives during the documentation process: socialization and networking, increased knowledge of mathematics content, teacher professionalism, and teacher leadership. These themes are used as a focus to organize ideas and to reflect on the collaborative's development with respect to some overriding expectations of the UMC project. The sixth and final section presents the reflections of Documentation Project staff on the approach the collaborative took to achieve its goals and the perceived outcomes in the areas of collaboration, professionalism, and mathematics focus.

The information presented in the Site Report is both a condensation and synthesis of information collected over the span of the UMC Documentation Project. Data were collected through monthly reports, the electronic network, four large-scale surveys, two demographic surveys, site visits, and case studies. These data-collection instruments and procedures are described in detail in the *UMC Guide to Documentation* (Pittelman, Webb, Fadell, Romberg, Pitman, & Sapienza, 1991). Detailed information about the Urban Mathematics Collaborative project is presented in six annual reports, four technical reports, and a set of case studies prepared by the Documentation Project. All of these reports are listed in the References. The Site Reports, which offer a retrospective summary of each collaborative's efforts over the grant period, have not been reviewed by

collaborative personnel and thus present the reflections solely of Documentation Project staff.

II. FIVE-YEAR SUMMARY: 1985 TO 1990

A. Overview

The San Francisco Mathematics Collaborative, one of the first five collaboratives established by the UMC project, expanded its initial target group over the five-year period from secondary mathematics teachers to all teachers of mathematics in Grades K-12 in the San Francisco Unified School District. Within the context of a school district that was experiencing a new administration at the beginning of the five-year period, a slight decline in student enrollment, and constant budget difficulties, the collaborative was operated jointly by the San Francisco Public Education Fund (FUND) and the San Francisco Unified School District. Over the five years, teachers assumed increasing responsibility for the governance of the collaborative. In 1988-89, after a review process of its structure and purpose, a full-time collaborative director was appointed and a collaborative council was formed with the membership specified to ensure that teachers would be in control. A variety of activities was made available to teachers that provided opportunities for networking and learning more about mathematical applications and mathematics education reform. Unique to the San Francisco Mathematics Collaborative were the Exploratorium Summer Institutes and a series of presentations by Nobel Laureates. Professors from higher education have been very supportive of the collaborative, serving on committees, providing meeting space, and presenting workshops. The collaborative has had greater difficulty in establishing a comparable relationship with the business community. At the end of the five years, the collaborative was working towards developing cross-grade teams of teachers, sponsoring an annual district mathematics conference, and clarifying its lasting relationship with the FUND.

B. Purpose

Since the organization of the San Francisco Mathematics Collaborative was first conceptualized late in 1984, the purpose of the collaborative has evolved from general statements to show teachers how mathematics is embedded in the world around them to six specific goals for structuring the environment so that motivated teachers become better mathematics educators. The collaborative's purpose, as specified in its 1984 proposal, focused on (1) encouraging teachers to remain in the field by enhancing their professional

development, (2) increased collegiality and network building, and (3) opportunities to enlarge their view of mathematics. This is in sharp contrast to the collaborative's purpose as stated in 1988, primarily by teachers, which acknowledges that teachers are motivated, knowledgeable, and accountable to their colleagues and students. The stated purpose of the collaborative is to provide opportunities for the teachers to reach their full potential for being the best mathematics educators possible. At the end of the 1988-89 school year, the purpose and functions of the collaborative were:

1. To create points of intersection for meaningful dialogue among K-12 teachers, representatives of higher education and local science museums, district administrators, the business community, and other organizations that would benefit from an improved education system in San Francisco;

2. To provide a "safehouse" where teachers can freely express their needs and concerns, share their creativity in open-ended exploratory activities, engage in reflection-oriented activities, take risks, and initiative activities;

3. To provide teachers with opportunities for professional development and collegiality based upon mathematics education.

4. To provide a structure in which teachers can take the lead in the improvement of mathematics teaching and learning;

5. To provide a means by which the community can invest in excellent mathematics education and support teacher ideas that advance quality mathematics education in San Francisco schools; and

6. To provide opportunities for teachers to discuss issues of equity as they relate to mathematics education for underrepresented minorities and girls, and to link the activities of the mathematics collaborative to equity issues.

The change in purpose reflects the deepening commitment of teachers to the collaborative and the collaborative's expansion to include all teachers of mathematics, K-12. The 1988 purpose statement makes particular reference to teachers taking risks,

teacher leadership advancing the quality of mathematics education in the district, and equity.

The initial target group of teachers were the approximately 250 mathematics teachers at the 8 comprehensive high schools and the 14 other magnet and small-necessary schools in the San Francisco Unified School District. Over the lifetime of the collaborative, an estimated 170 of the nearly 250 secondary mathematics teachers have participated in some collaborative activity. With the expansion of the collaborative in 1989 to include middle school mathematics teachers and elementary teachers, the potential target group expanded to nearly 1,500 K-12 teachers. Over 400 of these teachers have had some involvement in collaborative activities.

C. Context

The San Francisco Unified School District (SFUSD) serves the City of San Francisco and the County of San Francisco, a 49-square mile area. Between 1985 and 1990, the county experienced a decline in population of 10,000 resulting in a 1990 population of 590,000 residents. In the San Francisco Unified School District, student enrollment overall declined from 64,000 in 1985-86 to 62,700 in 1989-90. A decline in high school enrollment, however, was nearly balanced by a rising elementary school enrollment, which included a noted increase in immigrant populations. Over the five-year period, students from underrepresented groups accounted for 86 percent of the total K-12 school population. Of the 62,780 students enrolled in 1989-90, 24 percent were Chinese, 19 percent were Hispanic, 19 percent were black, 8 percent were Filipino, and 16 percent were of other non-white ethnic groups. Almost one third of the school population is classified as Limited English Proficient (LEP) or Not English Proficient (NEP). Approximately 40 percent of the K-12 students come from families who receive some form of public assistance or qualify for reduced cost lunches because of poverty-level family incomes. In 1989-90, the district had a student dropout rate of 16.4 percent.

A seven-member elected school board serves the San Francisco educational system. The district's budget has increased steadily over the years; in 1986, the district had a budget of $321.6 million while in 1990 the budget reached $415 million. A variety of factors has made the budgeting process for SFUSD extremely difficult. Of note is that

approximately 76 percent of the district's budget is provided by the State of California, which mandated severe annual cuts in available fund allocations during the 1985-90 period.

In 1985, Carlos Cornejo served a one-year interim appointment as the SFUSD superintendent of schools while a search was conducted for a permanent replacement. Dr. Ramon Cortines was appointed in April, 1986, and is under contract until 1993. Tania Madfes was the district mathematics supervisor during the 1985-86 school year; in 1987 Maria Santos was appointed team leader for Mathematics Curriculum. In February 1989, a second team leader, Bernard Farges was appointed. The 110 schools in the district include 22 high schools (Grades 9-12), 16 middle schools (Grades 6-8), and 72 elementary schools (70 Grades K-5 and 2 Grades K-8).

In 1989-90, the district employed 2,392 classroom teachers. Of all certificated employees, approximately 62 percent are white, 12 percent are black, 10 percent are Chinese, 8 percent are Hispanic, and another 8 percent are from other non-white ethnic groups. Shifting enrollments accounted for a drop in the number of high school teachers from 1,300 in 1987-88 to 869 in 1990. Some teachers were given layoff status while others were reassigned to other schools. During the 1988-89 school year, there was a hiring freeze for all school personnel. The number of teacher layoffs and budget cuts have also created overcrowding in some classrooms.

In 1989-90, 235 teachers taught mathematics in high schools, approximately 250 to 300 teachers taught at least some mathematics in middle schools, and over 900 teachers taught in elementary classrooms. The high school mathematics teachers in SFUSD are on the average older and more experienced than teachers in most districts. The average high school mathematics teachers is 50 years old with 19 years of teaching experience, a statistic that has changed little over the five years.

The bargaining agent for SFUSD teachers changed over the five-year period; the San Francisco Classroom Teachers Association (SFCTA) was the bargaining representative for the teachers until 1989, when the majority of the teachers voted to have the San Francisco American Federation of Teachers (SFAFT) assume the role of bargaining agent. In October, 1989, SFCTA and SFAFT merged and became United Educators of San Francisco (UESF). In October, 1989, a new three-year contract was approved that provided a base

of $25,715 with a maximum of $44,960. The teaching contract is for 186 days annually and includes a half day of paid inservice for staff members. Approximately 43 percent of all teachers in the district have advanced degrees and 58.5 percent have some additional credentials. The 1988 state requirement that all teachers must be certified in their content area has made it necessary for teachers to become certified by passing the National Teachers Examination (NTE). In an effort to help teachers receive certification, an NTE preparation course was established in the spring of 1989 with funding from the SFUSD. Prior to 1990, fewer than 100 San Francisco high school mathematics teachers were certified to teach mathematics.

In 1986, SFUSD's curriculum department redesigned the mathematics curriculum to be consistent with the California *Mathematics Framework*. The shift in content and pedagogy necessitated retraining and the updating of methods for many district mathematics teachers. In 1987, the SFUSD adopted a single algebra textbook for all Algebra I classes. District inservice days and workshops were held throughout 1988 to help familiarize teachers with the new material. During 1988, the SFUSD Geometry Curriculum Development and Textbook Selection Committee met to select a text to be used in 1989. They selected two textbooks for regular geometry and another text for honors classes. The graduation requirement specified by state law, which mandates that all students must take two years of mathematics, has remained unchanged over the five-year period. In San Francisco, approximately 80 percent of the students who graduate from high school have taken more than two years of mathematics.

The San Francisco area has been and continues to be rich in resources, offering numerous opportunities for teachers to enhance their professional skills. Through the San Francisco Consortium for Higher Education, several universities provide programs and support for addressing urban problems. Another resource is the Exploratorium, a world-renowned science museum that offers "hands on" learning experiences and promotes problem solving for both teachers and students. San Francisco State University sponsored Saturday sessions on statistics, and teachers who completed the series received stipends and university credit. Colloquiums were offered by Industry Initiatives for Science and Mathematics Education (IISME). The California Mathematics Council sponsors a series of regional meetings for mathematics educators from all educational levels who come together to share and enhance their professional status as mathematics instructors.

A variety of other projects and organizations in the area provided mathematics teachers access to resources, experiences, and opportunities for professional growth. These include Project 2061, Students and Teachers Acquiring Mathematical Power (STAMP), the Interactive Mathematics Project (IMP), the San Francisco Mathematics Teachers' Association (SFMTA), the San Francisco Mathematics Teachers of Elementary and Middle Schools (T.E.A.M.), Science at the Core, the San Francisco Mathematics Teachers Resource Center, and the San Francisco Mathematics Leadership Project.

The strong focus on mathematics and on mathematics teachers in San Francisco United School District (SFUSD) is due in part to directives from the State of California over the past five years. Between 1985 and 1990, there was a demand on the state level for improved teacher credentials and training as well as for increased mathematics proficiency on the part of its students, resulting in certification-in-field laws imposed on the districts. Lack of funding created additional problems for the SFUSD, which was burdened with changing needs and requirements. In reflecting on the five-year period, however, it is apparent that the district, professional organizations, business leaders, and the teachers themselves met the challenges with a number of new programs and a concerted effort to provide quality mathematics education for the students in SFUSD.

D. Management Structure

The San Francisco Mathematics Collaborative is administered through the San Francisco Education Fund (FUND). The evolution of and changes in the San Francisco collaborative reflect and illuminate the relation between the FUND and the school district with respect to the collaborative. The executive director for the FUND, Ms. Gladys Thacher, also served as Executive Director for the collaborative until the end of the 1989-90 school year. She was the liaison between the collaborative, the SFUSD, the FUND's Board of Directors, the donor community and the Ford Foundation. Initially, the project director, a teacher released part-time from teaching to direct the collaborative, was not given much clerical support and was expected to guide the collaborative in addition to performing many other duties. After a little over a year, she resigned and was replaced by another teacher who was released by the district 60 percent of her time to coordinate the collaborative's programs. The FUND provided the support of a part-time director of Development and Community Outreach. The SFUSD provided office space, but no

clerical support. On occasion, the collaborative's teacher director was asked questions normally asked of the district mathematics supervisor, a position that was vacant at the time. While the FUND provided someone to do outreach, this person as well as the teacher who served as director were housed at the SFUSD Parkside center. The FUND, which did not assume much responsibility for the daily operation of the collaborative or for providing the kind of administrative support needed to develop a program, served primarily as a conduit of funds for the collaborative. During this time, the FUND was successful in raising funds for its collaborative projects and in increasing the number of collaboratives under its umbrella to four.

During the 1987-88 school year, there was a significant shift in thinking about the relationship of the collaborative to the FUND and to the school district. The shift was precipitated by the increase in the number of FUND collaboratives and in the amount of administrative attention they required. Furthermore, it became increasingly difficult for the coordinator to distinguish what she was doing for the collaborative from her responsibilities to the district. This arrangement placed her in a position of having to do collaborative business with administrators in the district who had supervision over her as a teacher. To correct this situation, a professor from San Francisco State University was appointed as a half-time collaborative coordinator. This coordinator, together with the director of Development and Outreach and with the support of a part-time administrative assistant, guided the operations of the collaborative. The FUND designated one of its staff members to be the director of Programs and Evaluation and oversee the administration of the four collaboratives being operated out of the FUND office. This restructuring symbolized the FUND's assumption of more administrative responsibility for the collaborative and the need for the coordinator to be able to work closely with the school district administrators. At about the same time, the district appointed a mathematics curriculum team leader who served as the major link between the collaborative and the district.

Another major change in the administration of the collaborative took place during the 1988-89 school year. This change was partially forced onto the collaborative by the Ford Foundation and the Technical Assistance Project at EDC, which required the FUND to rethink and resubmit its proposal for permanence. The FUND's initial proposal did not convey a specific plan regarding what the collaborative was to do, but instead described a process that could be employed to make decisions. Assisted by an outside facilitator who

was engaged by EDC, a series of meetings and conversations were conducted on the direction the collaborative should take. The meetings included a wide variety of people--teachers, business representatives, high education representatives, school district administrators, and FUND Board members. Through this process, the district established its expectation that for the collaborative to continue receiving SFUSD support, it had to address the needs of all teachers of mathematics in Grades K-12. In addition, the FUND's Board of Directors had to make a long-range commitment to administrating the collaborative. Out of these negotiations and discussions, a new structure for the collaborative was developed. The new structure created a full-time collaborative director and a Collaborative Council, and expanded the collaborative's target population from teachers of high school to teachers K-12. The new management structure was implemented in spring, 1989. The district's willingness to share the expense of financing a director and to continue to house the collaborative office was an indication of SFUSD's support. The FUND understood better the collaborative's potential and was committed to ensuring its survival over the coming years.

By the end of the 1989-90 school year, the collaborative was administered by a full-time director, supported by a part-time administrative assistant. The major decisions for the collaborative are made by the 29-member Collaborative Council. The membership of the Council is structured so that teachers are the majority, but representatives from business, higher education, the Exploratorium, the FUND, and the SFUSD are also included. The FUND employs a director of Program and Evaluation, who has responsibility for administrating the San Francisco Mathematics Collaborative and the FUND's three other collaboratives. This person serves as the liaison between the mathematics collaborative and the FUND. At the June 1990 Council meeting, Council operations were adjusted to have a teacher rotate as the chair and to establish by-laws. These changes were made so that teachers would have more control of the meetings.

At the end of five years, an administrative structure for the San Francisco Mathematics Collaborative had evolved that placed that collaborative on firmer ground than it had ever been. The links with the school district are solid, the procedure to acquire and replace Council members is established, and funding for the next two or three years is in place through the FUND.

E. Project Activities

Over the five-year period 1985-1990, the San Francisco Mathematics Collaborative sponsored a wide variety of activities for mathematics teachers in the San Francisco Unified School District. The range of activities encompassed all four themes that emerged from the documentation process as being dominant in the programming of the collaboratives: Socialization and Networking, Increased Knowledge of Mathematics Content, Teacher Professionalism, and Teacher Leadership. Socialization and Networking activities, especially prominent in the formative years of the collaborative, were designed primarily to initiate interaction among teachers and between teachers and mathematicians from business and higher education. These generally large-group activities were important to a collaborative's evolution by bringing people together, encouraging them to get to know each other, and promoting networking. The second theme, Increased Knowledge of Mathematics Content, encompassed activities designed to provide teachers with mathematics-directed experiences and to increase the knowledge of teachers and others regarding current trends in mathematics and mathematics education. Many of these activities helped to activate the agenda of the mathematics reform movement at the collaborative sites. The third theme, Teacher Professionalism, emerged in activities structured to enhance teachers' conceptions of teaching as a profession. Collaboratives provided opportunities and incentives for teachers to attend professional organization meetings and made mathematics teachers aware of grants and other opportunities. Some collaboratives paid teachers' membership dues to encourage them to join organizations and arranged for teachers to observe other teachers and reflect on their teaching. The fourth theme, Teacher Leadership, had not been identified at the beginning of the UMC project, but gained greater attention as collaboratives found that teachers lacked the skills needed to organize efforts, to plan, and to develop the power within their group to generate systemic change. This theme was advanced by the EDC through the UMC Teacher Leadership Workshops which, beginning in the summer of 1989, were attended by from one to four teachers from each of the collaboratives. However, since this training was initiated by EDC rather than by individual collaboratives, it is not discussed in the reports of the individual collaboratives. Near the latter part of the five-year period, some of the San Francisco Mathematics Collaborative's activities began to focus on developing teacher leadership--enabling teachers to take a lead role in their educational community.

In reflecting on a collaborative's activities as they related to the four themes, considerable overlap was noted, since most collaborative activities have multiple purposes. A single activity may therefore be mentioned under several themes.

Socialization and Networking

A primary focus of the San Francisco Mathematics Collaborative, especially during its initial years, was on fostering interaction among teachers as well as between teachers and members of the business and higher education communities. In 1985, and again in 1986 and 1987, the collaborative sponsored a fall reception to "kick-off" the school year, providing teachers with a chance to socialize with their colleagues and become better informed about the collaborative. One of the collaborative's first programs was the Dinner Lecture Series, which was initiated in 1985 and continued through the 1987-88 school year. The series, sponsored by Chevron U.S.A. Corporation, was designed to promote collegial relationships among mathematics teachers and representatives from business and industry. Selected science teachers, and later, elementary teachers were also invited. The series featured Nobel Laureates, as well as prominent mathematicians in industry and higher education from the San Francisco community and was attended by representatives from all sectors. The dinner lectures were extremely popular, and teachers expressed disappointment when the three-year series concluded. The teachers especially valued the opportunity to socialize and meet with other mathematics teachers.

The collaborative used newsletters as an important tool for communicating with teachers. The collaborative newsletter, *News by Degrees*, and the *Exponent*, the newsletter of the San Francisco Mathematics Teachers' Association, helped to increase teachers' attendance at events, heighten their awareness of collaborative events, and help teachers to feel more united. The collaborative discontinued publication of its own newsletter in the winter of 1988 but continued to publish articles in the *Exponent*. In 1989-90, the collaborative began to disseminate calendars of events several times during the school year. The one-page sheets described activities the collaborative was offering, with the expectation of encouraging teachers to participate.

A key factor in the development of a core of active collaborative teachers was the series of Exploratorium Summer Institutes and the follow-up seminars which were held during the academic year. While the institutes were designed primarily to expand teachers' perceptions of mathematics as well as their understanding of their own teaching practices, the bonding among the participants resulted in the formation of a close group of teachers who were committed to the collaborative, having themselves experienced "the value of the collaborative." The first Summer Institute for mathematics teachers was held in 1985, with 25 high school mathematics teachers participating in the four-week Institute. The 1986 Institute was expanded to include two four-week sessions, with an equal balance of new and returning participants. In the 1987 and 1988 Summer Institutes, only one four-week session was offered. At each of these sessions, there was significant representation by returning participants.

An important networking activity was the Annual Spring Mathematics Conference, held after school on March 7, 1990. The conference, targeted for teachers of mathematics of Grades K-12, was attended by over 450 participants, including 300 elementary teachers, 100 middle school teachers, 50 high school teachers, and 4 representatives from higher education, 3 school district representatives, and a representative from Citicorp Corporation. The conference was sponsored by all of the professional mathematics organizations in San Francisco, including the collaborative, the San Francisco Mathematics Teachers of Elementary and Middle Schools (T.E.A.M.), the San Francisco Teachers Association, and the San Francisco Mathematics Leadership (a part of the California Mathematics Project), marking the first time that all of the mathematics teacher organizations in the Bay area worked together to sponsor an event of such magnitude.

Increased Knowledge of Mathematics Content

Many of the activities of the San Francisco Mathematics Collaborative were designed specifically to increase teachers' knowledge of mathematics content, provide mathematical experiences, or develop an awareness of the national movement for reform in mathematics education. In the early years of the collaborative, the activities were planned around the resources available in the area. As the collaborative matured, however, the activities were designed to meet specific mathematical needs, addressing issues related to the California

Mathematics Framework and the NCTM *Standards*. By 1990, it was clear that the collaborative's mathematics goals were driving the collaborative's programming, rather than that available resources were dictating the mathematics focus of the collaborative.

The focus of the lectures in the Dinner Lecture Series, which was initiated in 1985, was on mathematics as it modeled the real world and applied to other disciplines. While the presentations during the first two years of the series centered on helping teachers bridge the gap between theory and its application in the world of commerce, industry, and technology, the topics addressed were eclectic, based more on the interest and availability of local resource people than on a concerted effort to address any specific mathematical theme or subject. During the 1987-88 school year, however, the mathematical content of the series became more focused, addressing issues related to the mathematics education reform movement. Many of the speakers in this third and final series of dinner lectures spoke on topics derived from the California *Mathematics Framework*.

The Exploratorium Summer Institutes provided teachers with an opportunity to further their understanding of some important concepts of physics through the language of mathematics. The follow-up sessions that were offered during the academic year, following each Summer Institute, enabled teachers to pursue in greater depth topics that were introduced during the summer and to share classroom materials related to, and stemming from, their experiences at the Summer Institute. The sessions not only were very effective in helping teachers maintain the high level of interest and enthusiasm from the Summer Institute once they returned to their classrooms, but also provided teachers with an opportunity to participate in planning the Institute for the upcoming summer.

As a result of the enthusiasm generated by the follow-up sessions, nine teachers began an Independent Study program with Exploratorium Physics Professor Tom Humphrey in the summer of 1987. The focus of the independent study was to create lesson plans relating mathematics to the science exhibits in the Exploratorium. In the summer of 1989, four of these teachers participated in an independent study with Dr. Humphrey. In addition to their research, the teachers developed worksheets to demonstrate the applicability of their research to classroom projects. In 1990, the Exploratorium received funding from Hitachi for these teachers to refine, publish, and

distribute the worksheets developed as a result of their participation in the Exploratorium Institutes.

In addition to sponsoring Summer Institutes at the Exploratorium, the collaborative also supported teacher participants at the Woodrow Wilson Summer Institutes in 1986 (Statistics and Probability), 1987 (Geometry), 1988 (Functions 2), and 1990 (Mathematical Modeling). Other collaborative activities, such as the seminar at Wells Fargo Bank in 1985 and the tour of the Graphics Laboratory at the Medical Center in 1987, provided teachers with additional opportunities to build on resources within the community.

Between 1986 and 1990, the collaborative offered several workshops with a specific mathematics focus. Most of the workshops were presented by professors from local colleges and universities. During the 1986-87 and 1987-88 school years, the workshops addressed topics in discrete mathematics: "Linear Programming," "Geometry in Discrete Mathematics," "The Loading Problem," "Recursive Thinking," and "Matrices." During the 1988-89 school year, the collaborative sponsored three workshops addressing the connections between mathematical theory and application in the areas of industry and technology. Two of the workshops, "The SCI-MATH Program" and "Applied Mathematics: Simulation of a Biological System," were co-sponsored with the San Francisco Unified School District. The third workshop, "Geometry in Architecture," was presented by a collaborative teacher who had received a grant from the Education Fund's Small Grants to Teachers Program to conduct the workshop.

During the 1989-90 school year, the collaborative sponsored three workshop series. The first, a series of four programs on the Hewlett Packard 28S graphing calculator and symbol manipulator, was for high school teachers. The collaborative sponsored this workshop series in order to instruct teachers on the use of the HP28S calculator, since it was felt that the advanced technology employed in the calculations will have an impact on how mathematics is taught. Teachers who were teaching advanced mathematics courses were selected for the workshop, because the new technology would first be applied in their classrooms.

The second series of workshops offered during the 1989-90 school year focused on topics that are emphasized in the NCTM *Standards*. Each of the three workshops was

targeted for a specific grade level. All three workshops were offered on Saturday mornings. The first workshop, "Topics in Discrete Mathematics for Middle School," was targeted for teachers of Grades 5-9. The second workshop, "Probing the Primes and Counting Probability, and Pascal's Triangle," was targeted for teachers of Grades 4-6. The third workshop, "Developing Number Sense in Upper Elementary Students," was a two-part workshop that met on two consecutive Saturdays. The workshop was targeted for teachers of Grades 3-5. The third workshop series sponsored by the collaborative during the 1989-90 school year addressed important issues and ideas associated with the national mathematics education reform movement. The three after-school workshops, which were open to all K-12 teachers of mathematics, are discussed under the theme Teacher Professionalism.

The Spring Mathematics Conference, held in March, 1990, provided another opportunity for collaborative teachers to increase their knowledge of mathematics and to become better informed about the reform movement in mathematics education. The conference featured 31 workshops, highlighting themes from the NCTM *Standards*, and all participants were given copies of the *Executive Summary of the Standards* (1989). A Mathematics Fair, with dozens of booths displaying curriculum ideas and videos, ran concurrently with the workshops. The keynote speaker was Ruth Cossey of the EQUALS Project at the Lawrence Hall of Science and co-author of *Family Math*.

Both the Spring Mathematics Conference and the third workshop series conducted during the 1989-90 school year marked a change in collaborative programming from activities that focused on the content area of mathematics and mathematics reform to activities that addressed professional aspects of teaching and provided professional growth opportunities for teachers.

Teacher Professionalism

As the San Francisco Mathematics Collaborative matured, it began to provide programming that gave teachers an opportunity to become more familiar with pedagogical issues such as assessment and tracking. The third 1989-90 workshop series was designed to address issues and ideas coming out of the national mathematics education reform

movement. Each of the three after-school workshops featured a noted leader of the reform movement: Sherry Fraser of the EQUALS Project addressed the topic, "Untracking the Curriculum Allows You to Untrack Students"; Philip Daro, Director of the California Mathematics Project, spoke on new types of assessment techniques for mathematics; and Alan Schoenfeld of the School of Education at the University of California-Berkeley discussed the changing expectations educators have of students' mathematical thinking and how the state's *Mathematics Framework for California Public Schools* reflects that desire. As a result of having expanded its target population, the collaborative opened the workshops to all K-12 teachers of mathematics.

The collaborative also promoted the professional development of teachers by playing an instrumental role in helping teachers receive funding for special projects. In the fall of 1988 and again in fall, 1990, the collaborative sponsored three proposal-writing workshops and offered on-going assistance to teachers interested in writing proposals. Between 1986 and 1990, 64 proposals for mathematics projects were submitted to the San Francisco Education Fund, of which 36 were funded.

Beginning in the fall of 1986, the Education Fund targeted $11,000 in grants specifically for mathematics teachers for projects or materials that would enrich students' mathematics education. An individual teacher could receive a grant of up to $1,000 and two teachers submitting proposals jointly could receive up to $2,000 in funding. Twenty teachers submitted proposals. Twelve of the teachers, representing eight high schools, received grants ranging from $250 to $1,000. During the 1987-88 school year, the Education Fund expanded its grant program, offering awards of up to $2,500 for individuals and $5,000 for departments. The collaborative offered two proposal-writing workshops and encouraged teachers to develop proposals, review each other's proposals, and offer suggestions for improvement. Twenty-three proposals were submitted in 1987-88. In 1988-89, mathematics teachers received eleven mini-grants of $1,000 each, and nine small grants of $2,000 each. In 1989-90, six grants were awarded. Two of the grants were awarded to elementary school teachers, one to a middle school teacher, and three to high school teachers.

In 1988-89, the collaborative, through the San Francisco Education Fund, initiated a trial program for awarding School Team grants of $5,000 to mathematics departments for

projects designed to identify and address high priority needs throughout the department or the entire school. In spring 1989, two schools were awarded Team Grants, but only one accepted. During the 1989-90 school year, the School Team Grants Award Program was expanded to encompass Cluster Teams comprised of teachers from more than one school, with special funding of up to $3,500 also available to elementary school teachers in the areas of art and science.

In addition to assisting teachers with grant applications through the San Francisco Education Fund, the collaborative offered travel grants to provide funds for teachers to attend regional and national mathematics conferences. Teachers who received travel grants were expected either to informally share their experiences and knowledge with the Mathematics Collaborative Council, or to participate in a follow-up workshop to share ideas from the conference with their colleagues. The Spring Mathematics Conference, for example, provided many of these teachers with the opportunity to share their expertise with their peers and to be recognized for their professional knowledge. Between 1986 and 1990, the collaborative awarded 64 travel grants to teachers to attend professional meetings and conferences, including national and regional meetings of the National Council of Teachers of Mathematics and the Mathematics Reform and Teacher Professionalism Conference in Durham, North Carolina.

In 1986-87, another opportunity for professional growth in the teaching profession came as a result of visits to four schools by Professor Uri Treisman of the Mathematics Department at the University of California-Berkeley. These visits led to the development of a curriculum project at Mission High School by former project director Theresa Hernandez-Heinz, and Professor Treisman successfully wrote a proposal to the National Science Foundation for a project to address the mathematics needs of minority children. The proposal was funded in the spring of 1989 and, as a result, three district high schools are participating in the STAMP (Students and Teachers Acquiring Mathematics Power) Project. STAMP, which is designed to help students of under-represented ethnic backgrounds pursue the college preparatory sequence in mathematics, focuses on students during the transition from middle school to senior high school.

The Cross-Grade Visitation Program initiated in 1989-90 also provided teachers with a valuable opportunity to participate in still another type of professional experience. In

the first year of the program, four teams participated; in future years, the collaborative will encourage the formation of a greater number of teams and classroom visits.

Teacher Leadership

The development of teacher leadership was an important issue in the San Francisco collaborative. In addition to the management operations of the collaborative, some of the collaborative's programming was structured to enable teachers to assume a leadership role. The March 1990 Annual Spring Mathematics Conference, for example, was planned and implemented by teachers for teachers. Nearly 80 volunteers worked to plan the conference and present workshops. Seventeen different subcommittees were formed to handle various aspects of the event. In preparation for the conference, a special dinner meeting was held for session leaders at which they were given a copy of the Overview of the NCTM *Standards* and asked to incorporate ideas from the *Standards* in their presentations. A mathematics fair that offered a multitude of problem-solving activities representing the different strands of mathematics described in the California *Mathematics Framework* was presented at the conference. The fair was a project undertaken by 20 elementary, middle, and high school teachers. The Spring Conference provided the members of the San Francisco collaborative with an important opportunity for teachers to assume responsibility and to demonstrate leadership.

F. Reflections

The main intent of the San Francisco Mathematics Collaborative has shifted since the collaborative was first conceptualized in 1984. The initial proposal submitted in December, 1984, was prepared by representatives of the San Francisco Unified School District, the San Francisco Education Fund, and the San Francisco Consortium for Higher Education, with little input from teachers. The goal of the collaborative was phrased in terms of the need to provide teachers with increased knowledge of the field of mathematics with a greater appreciation of their profession. The overriding purpose was to show teachers "how mathematics is embedded in the world around us while being sensitive to the needs and interests of the teachers involved in the program." In support of

this purpose, the collaborative's intent was to make the teaching of mathematics more attractive and to encourage teachers to remain in that field. This was to be accomplished by building on local initiatives. By 1989, the purpose of the collaborative, as expressed in the permanence proposal, had changed dramatically. The value and attractiveness of teaching were inherent in the statement of purpose, which this time was formulated primarily by teachers. It stressed the importance of teachers growing through interaction among themselves; having freedom to explore, take risks and reflect; participating in opportunities for professional development; assuming the lead in improving mathematics teaching; and providing a means for the community to invest in mathematics education. Along with the change in purpose, the permanence proposal also included the expansion of the target group of the collaborative from mainly high school mathematics teachers to all teachers of mathematics, Grades K-12. This change in the target group, which has been stipulated by the SFUSD as a condition of its continuing financial support, indicated that the collaborative was to become more important to the district's mathematics program. For the district to continue its support, the collaborative would be required to benefit all teachers of mathematics--not just those in the high school. This change in purpose generated a new administrative structure and the development of programs based less on other initiatives than on what teachers themselves initiated and developed.

The general approach to collaboration taken by the San Francisco Mathematics Collaborative was to provide experiences that helped teachers increase their knowledge of how mathematics is used in real-world situations. The Exploratorium Summer Institutes and the Nobel Laureate Dinner Series, for example, both related mathematics to practical applications. The approach to collaboration was based more on process and less on a visionary focus on what mathematics education could become, what structure was needed, and what steps needed to be taken to achieve identified goals. This process approach to collaboration worked to bring teachers and other mathematics professionals together. It provided the colleges and universities in the area access to teachers and a means by which professors could give workshops to teachers. The approach gave the SFUSD and the FUND an opportunity to gain a better understanding of each other and for the FUND to reconsider how it could be more proactive in working with the district. The process approach, without a strong vision challenging the collaborative, made the collaborative less controlling of teachers. This was important, since many of the teachers felt the district to be very dominating, as reflected in the revised purpose for the collaborative to create a "safehouse" for teachers.

The process approach, however, did not create a viable structure for operating the collaborative and for ensuring its future. Even after five years, members of the FUND's Board of Directors were questioning their role in operating a collaborative and becoming involved in a long-term commitment. One reason for this is that the responsibility for the collaborative was shared between the school district and FUND. For the first three years of the project, the coordinator was paid by the district and taught part time, yet was responsible for performing the directives of a program funded through the Education Fund. This prevented the coordinator from going beyond providing administrative support for existing programs. Increased initiative was exerted when a part-time coordinator from a university was appointed. When the full-time director was appointed, a move supported by the Collaborative Council, the collaborative became more directed and new forms of programming were instituted.

The process approach also did not generate a strong sense of ownership among the teachers. Initially, greater effort was given to planning activities *for* teachers rather than planning activities *with* teachers. While some teacher leaders did emerge among those who attended the Exploratorium Summer Institutes, a viable group with teachers participating in major decision-making did not evolve until the permanence proposal intervention and the creation of the Collaborative Council. The process approach, which included higher education professionalism, gave them a means of fulfilling one of their missions of providing inservice experiences for teachers. This approach did not offer a strong reason for those from business and industry to become actively engaged. Representatives from business served as resources, providing funding and meeting locations. But they never found their niche in the collaborative, even though when asked they said they supported the concept. One reason for the lack of significant involvement by businesses was that representatives from the business community were not directly represented in the preparation of the initial proposal establishing the collaborative. As the collaborative focused more on activities, business people were called upon to give presentations without being involved interactively in creating the structure for the collaborative.

From hindsight, a few changes prior to the establishment of the collaborative perhaps would have created a stronger foundation. One would be to have involved representatives from the business sector from the beginning, using their expertise to develop a structure that could serve the different entities--the teachers, the district, and the FUND. Another

focus might have been on creating a core of teacher leaders early in the development of the collaborative. This would have required working with a group of teachers over a period of time who would be trained to make decisions for the organization. Finally, stronger communication was needed with the FUND's Board of Directors as to what the collaborative was doing and its purpose. The Board of Directors should have been educated and systematically updated regarding the needs of the collaborative, so that it would have become an advocate of the collaborative rather than another group that had to be convinced of its worth. Even with the administrative struggles that the collaborative encountered, clear outcomes were achieved.

Collaboration Outcomes

The San Francisco Mathematics Collaborative succeeded in bringing together a significant proportion of the district's secondary mathematics teachers and helping them get to know one another better. New links were made that helped to create a stronger support network among teachers. More opportunities were made available to and were taken advantage of by mathematics teachers. The participants in the Exploratorium Summer Institutes achieved a better understanding of how mathematics applies to the physical sciences. Some of these teachers experienced a greater sense of worth through contributing to exhibits at the Exploratorium and to the workbooks that supported exhibits. Through the efforts and support of the collaborative, the chasm between the two professional organizations for mathematics teachers, SFMTA and T.E.A.M., was reduced and teachers from across grade levels began interacting more with each other.

Professionalism Outcomes

Initially, the active participants in the collaborative, drawn from the high schools in the district, reflected a bias toward teachers who already possessed an interest in events beyond the confines of their own school buildings. The collaborative was successful in establishing a network among them, but it was questionable at that time as to the degree to which individual teachers were able to act as catalysts for change in their own schools. Although a realignment was forced upon the collaborative in order to maintain the financial support of the district, the expansion provided, for the first time in several years,

a vehicle whereby teachers across the span of K-12 grade levels could in[illegible]on a professional basis.

The image teachers have of themselves, as reported in interviews and in response to surveys, indicates they feel they enjoy autonomy in making decisions and are active participants in professional organizations. While being committed to teaching, the teachers do not give a strong message that they feel recognized for the contributions they make to society. These teachers are only mildly interested in assuring quality within their own group. In 1987-88, a sense of professionalism was expressed as intellectual creativity, through efforts to explore new mathematical concepts and ideas. Individual efforts to bring enthusiasm and innovation into classrooms were linked to a strength and prominence of the development of collegial networking.

The major achievement of the collaborative in its effect on the professional lives of teachers has been in reducing their isolation, particularly in establishing contact between teachers in different schools. In the early years, the Dinner Lecture Series did much to provide the opportunity for teachers to socialize with one another as well as with others in a setting with a mathematical focus. The groundwork was thus laid for the development of a district-wide network. The Exploratorium experience also contributed significantly to this framework. Trips to conferences have enhanced two elements of teachers' professional lives: First, their participation has, of itself indicated an interest in expanding their occupational knowledge; and, second, their individual knowledge bases have been extended, regarding developments both in content and pedagogy and also in the awareness of an extended professional community.

One of the first activities of the collaborative, the Summer Institute at the Exploratorium, was planned originally to help teachers, yet it resulted in a relationship that was mutually beneficial to the teachers and to the Exploratorium staff. Participating teachers' input on exhibits was well received by the Exploratorium staff and incorporated into the development of mathematical exhibits. Further, teachers were heavily involved in the development of printed lesson materials for the Exploratorium. These experiences provided an opportunity for teachers to be treated as experts in their own right in an environment in which their knowledge and skills were being enhanced. The expansion of the Institute in the second summer permitted more teachers to take part and also permitted the further development of the professional relationship between teachers and

Exploratorium staff as veteran participants undertook independent projects and had input into the planning and program execution of the second Institute.

The Mini-Grant Program of the San Francisco Education Fund provides insight into one of the barriers teachers face as proactive participants in changing their professional practice. Because of inexperience in seeking funds for their own projects, the first call for grant applications brought forth a small number of responses, the quality of which was disappointing with regard to presentation and, to a degree, content. This led to recognition of the need to provide support in enabling teachers to develop skill in grant writing--a skill previously not a part of their experience. The 1987-88 school year saw an increased application rate for the mini-grants. Board members noted an accompanying improvement in their quality, although few were subsequently funded. In the first four years, 36 of 64 applications had been funded.

Teachers have built upon the opportunities provided by the collaborative. For example, some have given workshops based on their NCTM conference experiences; others have worked on developing mathematics/science instructional materials. A long-time active collaborative teacher has written a successful grant application with a university professor. The outcome, STAMP, is a three-year project that focuses on the transition from middle to high school. The project, which involved three schools and several teachers, was partially supported by the collaborative with the approval of the Collaborative Council.

Teachers have begun to break down barriers with district personnel, as noted by one administrator. Teacher participation in the district's committees and in professional development programs has increased, with more teachers prepared to invest their time and energy. It has been observed that teachers have begun to initiate their own involvement by approaching administrators in order to volunteer, whereas previously the department heads had appointed teachers to serve. There was, concurrently, a greater awareness among teachers of mathematically-related activities throughout the district.

These improvements must be set against a backdrop of antipathy between the teacher unions and the administration. By the end of the collaborative's second year, teachers were looking to it as an organization that recognized them as professionals at a time of when they were under stress locally in their profession. One of the stated functions of the

collaborative in 1988-89 was to "provide a 'safehouse' where teachers can freely express their needs . . ." The historical unease and distrust between mathematics teachers and the central administration has persisted with long-term substitute teachers in mathematics being laid off and with one third of the mathematics classes being taught by teachers lacking even a minor in mathematics. Striving for a common curriculum within a course and the cutting of funding for the development of a Mathematics B course has led to skepticism regarding the administration's view of teacher professionalism.

A core group of teachers has developed a sense of being part of an extended educational community and participants in a discourse that extends beyond their school buildings and, in a significant number of cases, beyond the district to the national level. There also appears to be evidence that the role of professional organizations such as the San Francisco Mathematics Teachers' Association (SFMTA) is increasingly valued. This observation must be tempered to some extent by the tendency of many teachers to polarize commitments between the collaborative and that organization. Attempts to establish a formal relationship between the two organizations have contributed to a reduction in this bifurcation.

The lack of flexibility in the allocation of teacher time during the school day is an institutional barrier to the involvement of teachers in a range of professional activities. Contributing to this situation are the institutional organization of schools, high pupil-to-staff ratios, lack of availability of substitute teachers, and lack of funds to pay substitutes. An anomalous barrier is the teachers' commitment to teaching their classes: professionally a fundamental necessity, it precludes participation of many teachers in conferences, committees, and other activities that require absence from their teaching responsibilities.

Mathematics Focus Outcomes

The collaborative has expanded teachers' perceptions of mathematics, their attitude toward teaching mathematics as a profession, and their understanding of their own teaching practice. For example, as a result of the Exploratorium Institute experience, a teacher reported that she saw the world differently. Another high school teacher credits the collaborative with helping him to see that mathematics should not be taught in isolation, but should be taught in conjunction with other student experiences. For him, his

teaching is more student-driven than curriculum-driven. This has raised his expectations for students, "I'm a little more open to trying different things . . . to pushing the kids a little harder. . . ." The change in mathematics teachers' approach to their teaching because of the collaborative is apparent to others. One high school principal, a former mathematics teacher, was very proud of what the mathematics teachers were doing in their classrooms and attributed it, at least in part, to the collaborative. She observed that the students were so engaged in learning mathematics that their classes looked more like what would be expected of a science class than a mathematics class. When asked if she had any indication of how the collaborative was becoming institutionalized within the district, the principal cited the two grants that the mathematics teachers had received and noted what mathematics teachers were doing.

Over the period of five years that the collaborative has been in existence, the mathematics program in the San Francisco Unified School District has gone from the point of not having a mathematics supervisor and struggling to change the mathematics curriculum to having a mathematics team coordinator and a program linked to state and national projects. The interaction between teachers in elementary schools and mathematics teachers in high schools is as favorable as it has been for some time, providing teachers with an opportunity to learn more about what is being taught at other grade levels. This is due, at least in part, to the K-12 expansion of the collaborative. Teachers have attended inservices, workshops, and presentations on the most current trends--including graphing calculators, discrete mathematics, geometry, curriculum reform, problem solving, and alternative forms of assessment. In 1988, when the chair of a high school mathematics department offered a draft of the NCTM Curriculum and Evaluation Standards at a department meeting, it was pushed to one side with no show of interest on the part of department members, whereas in 1990 the collaborative sponsored a conference on the *Standards* that was attended by over 400 district teachers. The collaborative has been instrumental in drawing mathematics teachers' attention to developments in mathematics and mathematics education. The collaborative also has been able to build links among the different mathematics teachers' professional organizations, the California Mathematics Project, and the Exploratorium. The district's mathematics program and individual teachers are taking much more advantage of local and national resources to further the teaching of mathematics.

The major impact of the collaborative has been experienced to the greatest extent by a core group of from 50 to 100 teachers who have attended summer institutes, served on the Collaborative Council, or actively participated in some way to build programs for the collaborative. Teachers among this group report they are more willing to try new ideas and are more energetic toward their teaching. There are some indications that their teaching has changed: they have raised their expectations for their students, and led students to be more actively engaged in learning and in relating mathematics to science and the real world. Efforts to expand the number of teachers reached by the collaborative through large-scale activities have been successful. By the end of the 1989-90 school year, the district had developed an invigorated mathematics program and, although all of the issues had not been resolved, the district was trying to institute new ideas and make substantive efforts at change.

Conclusion

The evolution of the San Francisco Mathematics Collaborative has been equated with the topography of the terrain upon which the city is built, hilly. In the absence of a strong, dominating administrative personality, the collaborative sometimes lacked a clear focus or the concentrated resources needed for the tasks at hand. What kept the collaborative going through the valleys was interest in the value of the concept and what it could provide for San Francisco. People associated with the collaborative in San Francisco seemed always to be able to respond constructively to observations and reactions from the Ford Foundation. Such responses resulted in the appointment of a FUND staff member to oversee the FUND's collaboratives and the convening of a mathematics collaborative review group that generated major changes in the organization of the collaborative. The collaborative also was affected by changes within the internal organization of the FUND that centralized the separate fund-raising efforts for each of the FUND's collaboratives to a department of development for the collaboratives as a group. Even though the executive director of the collaborative remained the same during the five years, the coordinator or director changed three times. What was important was that amidst these many changes, FUND officials accepted responsibility and always saw that the work was covered.

What came out of this loosely knit organization, which lacked a strong sense of direction but demonstrated a strong sense of commitment, were outcomes that perhaps

would have been missed in a different environment. One was that the two key institutions, the school district and the San Francisco Public Education Fund, began to rethink their own structures and their relationship with each other. Going through the process of collaboration caused the district administration and the FUND's directorship to interact about how they were going to work together to support the organization they shared. The FUND became more cognizant of the details of program management and what that entails--a shift from its role of issuing small grants. The district began to see that with modest resources teachers could be energized to work toward improvements by themselves. Through the collaborative, the district administration saw teachers take the initiative, develop ideas, write proposals, and receive money without direction from the district. The lack of a strong collaborative structure with a clearly defined purpose afforded the collaborative administration the opportunity to begin meeting with the SFMTA and T.E.A.M., which helped to bring members from these two organizations into collaborative activities. A true asset of the San Francisco Mathematics Collaborative turned out to be the district's strong interest and involvement from the beginning. This fostered a close working relationship between the district's mathematics program and the collaborative, which has not be the case for all of the collaboratives. Another strength has been the excellent support the collaborative has received from those in higher education and the Exploratorium, also both there from the beginning. What the San Francisco model of collaboration has not been successful at doing over the course of its development is forming alliances, such as with the business community--if these were not in place during the beginnings of the collaborative.

The collaborative is visible to those who teach mathematics in the district. An estimated two thirds of the secondary mathematics teachers have participated in collaborative programs in some way. The collaborative has provided a program that has done well to reach its target group. There is strong indication that a number of teachers of mathematics now view their teaching differently and are approaching their profession differently compared to their experience prior to the collaborative. The collaborative and the district's mathematics programs have done well to build on the momentum created by the mathematics education reform movement. How the collaborative will survive will depend on the importance that the FUND places on it as being essential to its program and how willing the FUND's Board is to raise the needed funds. At the end of the five-year period, the collaborative was on its way upward. It remains to be seen what awaits it when it reaches the next ledge--a downward slide, a plateau, or another climb.

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