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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 4-year site report on the San Diego UMC from its entry into the program in 1984 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 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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SAN DIEGO URBAN MATHEMATICS COLLABORATIVE

FOUR-YEAR SITE REPORT

A Final Report to the Ford Foundation on the Urban Mathematics Collaborative (UMC) Project

Norman L. Webb, Susan D. Pittelman, Thomas A. Romberg, Allan J. Pitman, Edel M. Reilly, and James A. Middleton

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Report from the
Urban Mathematics Collaborative Documentation Project

Wisconsin Center for Education Research
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Madison, Wisconsin

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I. INTRODUCTION

This document is a four-year Site Report on the San Diego Urban Mathematics Collaborative from its inception in 1986 through June, 1990. The intent is to reflect on the development of the collaborative, noting the changes that have taken place over time in regard to the context in which the collaborative operated, the collaborative 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 period 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, 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 Four-Year Summary

The Four-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 four-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 four-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 goal 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. FOUR-YEAR SUMMARY: 1986-1990

A. Overview

The San Diego Urban Mathematics Collaborative was formed in April, 1986, as part of the second phase in the establishment of the eleven original mathematics collaboratives. With the San Diego State University (SDSU) Foundation as the host agency, the collaborative has from its beginning been administrated by the Center for Research in Mathematics and Science Education (CRMSE). The collaborative was structured to be closely linked to the strong, established group of university mathematics educators and faculty members of the Department of Mathematics at SDSU. This strong link with the mathematics education research community was evident in the number of collaborative activities that were directed toward advances in mathematics education, technology, and mathematics. During the four-year period reported in this Summary, the administrative structure of the collaborative changed dramatically, evolving from a small executive committee to a bicameral organization--a 25-member Board of Directors and a Council of Mathematics Educators. In the beginning, the collaborative's director, Alma Marosz, provided the primary impetus--making decisions and guiding the development of the organization. After two years, a small group of teachers assumed more responsibility for long-range planning and leadership. Motivated by the pressure to develop a plan for permanence, and through the help of a facilitator, members of the larger community--business people, parents, school board members--became more involved in the governance of the collaborative.

The collaborative, employing a phase-in strategy, began by targeting the mathematics teachers from six schools--two high schools and the two feeder junior high schools for each. Three of the schools were from the San Diego Unified School District (SDUSD) and three from the Sweetwater Union High School District (SUHSD). After two years, mathematics teachers from three additional high schools became part of the collaborative. One reason for using a phase-in approach was to afford the collaborative staff an opportunity to work with each mathematics department as it was brought into the process. The number of mathematics teachers served by the collaborative increased from approximately 70 teachers in 1986 to 150 by 1990 including teachers at the nine target schools as well as others who participated in some of the collaborative's activities.

From this group, a core of approximately 20 to 30 teachers emerged to assume the leadership responsibilities of the collaborative.

Over the four years of its operation, teachers have increasingly assumed a greater responsibility for the leadership of the collaborative. An organization that began as a means of providing professional opportunities for teachers evolved into one that encouraged teachers to give workshops to other teachers and then into one that led teachers to assume the leadership of its major governance committees. The focus of the collaborative's goals shifted during this time from providing professional experiences for teachers to the more global issues of equity, mathematics education reform, and teacher empowerment. Representatives from higher education have been active in the collaborative and involved in its formation from the beginning. This was not the case with the business community, which participated very little in collaborative activity until planning for the permanence proposal began. The restructuring of the collaborative to build a permanent organization engaged more business and community representatives.

By the end of four years, the collaborative had developed a governing structure that provided a balance of power between a group of mathematics educators dominated by teachers and a group of community representatives. A core group of teachers had risen to positions of leadership and activity. Teachers in this first echelon were reaching a limit in the time and energy they were able to devote to operating the collaborative and were looking for other teachers to assume greater responsibility. The two participating school districts, San Diego Unified School District and Sweetwater Unified School District, were looking to collaborative teachers for examples of innovative changes that could be made. One school principal observed that teachers in the mathematics department were trying new ideas and working toward innovation and improvement much more effectively than teachers in other departments. Collaborative teachers became more knowledgeable of teaching methods for content recommended in the California *Mathematics Framework for California Public Schools: Kindergarten through Grade Twelve* and the NCTM's *Curriculum and Evaluation Standards for School Mathematics*. The collaborative gave a number of teachers financial support and encouragement to attend professional conferences for the first time for some and for the first time in a number of years for others. By the end of the 1989-90 school year, the collaborative had advanced into a new phase of development. A different relationship was being forged between the

collaborative and the school districts, with a mathematics resource teacher for SDUSD serving as the half-time collaborative director/coordinator.

B. Purpose

The purpose of the San Diego Urban Mathematics Collaborative has changed with the evolution of the collaborative. When its first grant was issued, the collaborative's purpose statement, which had been developed primarily by those from the university with the involvement of very few teachers, focused on improving the lives of teachers. The objective was to achieve this by reducing teachers' isolation and by increasing their contacts in the larger professional mathematical community. The collaborative began to sponsor activities, and an Executive Committee that included teacher representatives became active. The collaborative's coordinators began to work with the mathematics departments in the target schools. Along with these activities, the collaborative's purpose was expanded to address the school districts' responsibilities. After the first year, a long-term goal was added: that the school districts provide teachers with professional development experiences. At this time, fostering active participation of teachers in the Greater San Diego Mathematics Council was added to the collaborative's statement of purpose.

After two years, during which the collaborative had been providing workshops for teachers, sending them to conferences, and encouraging their interaction with one another and with other teachers in the UMC network, the vision articulated for the collaborative shifted. Rather than making teachers the recipients of collaborative services--stressing the effort to reduce their isolation and to provide professional development experiences for them--the focus changed to the teachers themselves as agents of change. In 1987-88, the purpose of the collaborative was to promote the development of leadership skills among teachers and to encourage teachers to take greater initiative in their classrooms and at their school sites.

At the end of the documentation period, teachers had assumed increased responsibility for leadership and representatives from the broader community had become involved in planning for the collaborative. The purpose shifted once more to center not only on teachers, but on the larger issues of reform in mathematics education and equity

along with the empowerment of teachers. This progression of purposes reflected the commitment of teachers and their immersion in collaborative activity. It also reflected an awareness of the potential that existed when teachers worked with those from business, science, academia, and the school district administration. Thus, the collaborative saw its role as forcing equity on the agenda of mathematics education reform. As such, the collaborative became less an end in itself and more a mechanism for promoting equity in mathematics education.

C. Context

The San Diego Urban Mathematics Collaborative serves mathematics teachers in both the San Diego Unified School and Sweetwater Union High School districts. Although these two districts are in relatively close geographic proximity to each other, each is unique in terms of the social and demographic context in which the collaborative operated.

The San Diego Unified School District

Over the decade of the 1980's, the population in San Diego City increased 27 percent to over 1,110,000 in 1990. In 1990, the metropolitan area of San Diego County had a population of nearly 2.5 million. The San Diego Unified School District enrollment draws from the city population. In the 1989-90 school year, the district enrolled 118,134 students, over a 2 percent increase from the point at which the collaborative was established in April, 1986. A decline in the percentage of white students enrolled, from 46 percent in 1986-87 to 39 percent in 1989-90, was accompanied by an increase in the percentage of Hispanic students (20% to 25%) and Asian/Pacific Islanders/Filipino students (17% to 19%). The number of black students remained constant at 16 percent over the four years the collaborative has been in existence. In 1989-90, 43 percent of the students received government-funded lunches, 21 percent were from families receiving some form of public assistance, and 18 percent were considered ESL (English as a Second Language) students. The district reported an annual dropout rate of about 8 percent. This has been consistent over the period of the study. Approximately 8 percent of the students who are eligible to attend SDUSD schools attended private or parochial schools, a percentage that remained the same over the four years.

In 1989-90, the final year of data collection, Dr. Thomas W. Payzant was serving his seventh year as the superintendent for SDUSD. The district's five-member school board made decisions for the district, which had a total expenditures of over $543 million for 1989-90. This represented an increase of 11 percent over the 1986-87 expenditures of $490 million. Of the 1989-90 expenditures, 64 percent were from state revenue limit sources and 27 percent from other state funds. Only 6 percent of the district's funding was directly from federal funds and 3 percent from local funds. In 1989-90, the district had 18 senior high schools (Grades 9-12), 12 junior high schools (Grades 7-9), 8 middle schools (Grades (6-8), 106 elementary schools (Grades K-6) and 14 special education or magnet schools. The five schools participating in the collaborative from the SDUSD were: Samuel F. B. Morse High School (18 mathematics teachers) and its two feeder schools, Alexander Graham Bell Junior High School (16 mathematics teachers), and Kieller Middle School (8 mathematics teachers); Lincoln Preparatory High School (18 mathematics teachers); and San Diego High School (14 mathematics teachers).

The total number of teachers in SDUSD, approximately 5,300, has remained nearly the same from October, 1986, through the 1989-90 school year. There are nearly 200 high school mathematics teachers--82 percent white, 7 percent Asian, 4 percent Spanish-Hispanic, 3 percent black, and 2 percent American Indian--and 173 junior high and middle school mathematics teachers--76 percent white, 9 percent black, 8 percent Asian/Pacific Islander/Filipino, 4 percent Spanish-Hispanic, and 3 percent American Indian. The actual number of district high school teachers, including the mathematics teachers, had declined by about 6 percent over the four years being documented. This decline corresponded to a decline in high school student enrollment of nearly 19 percent.

The teachers in SDUSD are represented by the San Diego Teachers' Association to which about 65 percent of the teachers belong. A three year contract, beginning in July 1989, was approved between the district and the union in November, 1988. The salary range in 1989-90 was $23,832 for a beginning teacher with a B. A. degree to $46,521 for a teacher with a master's degree and 90 graduate credits. The average teacher salary was $39,904.

The graduation requirements for students enrolled in SDUSD include six semester units of mathematics, as well as demonstrated proficiency on a series of examinations. Vance Mills remained the district mathematics supervisor during the four years of the

collaborative. In 1988, SDUSD began phasing in a new core curriculum that requires all secondary students to take college preparatory courses in basic subject areas including algebra.

Sweetwater Union High School District

In addition to serving teachers in the San Diego Unified School District, the collaborative drew teachers from four schools in the Sweetwater Union High School District. This district, located between the city of San Diego and the Mexican border, draws from a population area of 147,000 residents. The district enrolled 27,200 students in 1989-90, a 9 percent increase from the student enrollment in October, 1986. Over the four years of the collaborative, there has been some shift in the ethnic population. In 1989-90, appropriately 75 percent of the population was from underrepresented groups, an increase from 69 percent in 1986. Of the students enrolled in the district in 1989-90, 57 percent were Hispanic (an increase from 50 percent in 1986), 25 percent were white (a decrease from 31 percent), 10 percent were Filipino (a decrease from 11 percent), 4 percent were black (no change), and 4 percent were from other minorities (no change). Nearly 13 percent of the SUHSD students are considered ESL students and 30 percent are eligible for federally-funded lunch programs.

Anthony J. Trujillo, appointed in 1985, continued to serve as the superintendent of SUHSD over the four years covered by this report. The mathematics collaborative's efforts have been viewed as consistent with his priorities for the district. The district elects a five-member school board. In 1989-90, the total expenditure for the district was approximately $120 million, an increase from $102 million in 1986-87. State of California funds provided about 75 percent of the budget, federal funds provide 6 percent, and local funds were used to finance the remainder. The district has a director of curriculum but does not have a mathematics supervisor or coordinator.

The 20 schools in the district include 2 middle schools (Grades 7-8), 3 junior high magnet schools (Grades 7-9), 4 junior high schools; 9 senior high schools (two Grades 9-12 and six Grades 10-12), and 2 learning centers. In 1986, when the collaborative was formed, Sweetwater High School (11 mathematics teachers) and its two feeder schools National City Junior High School (7 mathematics teachers) and Granger Junior High

School (7 mathematics teachers) were targeted as collaborative schools. At the time, these schools had a total of 25 mathematics teachers among them. In 1987, the collaborative was expanded to include the 11 mathematics teachers at Mar Vista High School.

The number of teachers employed by the SUHSD has remained approximately 1,100 over the duration of the collaborative. Seventy-eight percent of the teachers are white, 16 percent are Hispanic, 2 percent are black, 1 percent are Filipino, 1 percent are Asian, and 2 percent are from other ethnic backgrounds. All Sweetwater teachers belong to a teachers' union and receive four paid release days for inservice and other training annually. The salaries for teachers in 1989-90 ranged from $22,316 for beginning teachers with a BS/BA to $48,400 for those with a doctorate, or a master's degree plus 45 semester units.

In 1987-88, the SUHSD initiated a major staff development program entitled "Writing Across the Curriculum/Writing to Learn in Math." Mathematics teachers in half of the district's schools received at least seven days of training on implementing the writing component of the *Mathematics Framework for California Public Schools*. In the spring of 1988, the SUHSD Board established a policy to restrict teacher release time on the assumption that teacher absences impacted on student absences. This policy restricted mathematics teachers' participation in the collaborative until it was rescinded in the middle of the 1988-89 school year. In June, 1989, two of the Sweetwater schools, Sweetwater High School and National City Junior High School, converted to a year-round schedule that includes four nine-week sessions with intersession classes offered during the breaks. In 1989-90, some of the elementary school districts that feed students to the Sweetwater Union High School district were studying ways to consolidate some secondary and junior high schools with their elementary schools.

Professional Opportunities for Teachers

The San Diego area provides a variety of opportunities for mathematics teachers to become more active professionally. The Greater San Diego Mathematics Council, with 800 members, holds an annual conference each February. The mathematics educators at the Center for Research in Mathematics and Science Education have administered and

developed a number of programs during the existence of the collaborative, including the San Diego State University Mathematics Project. The University of California-San Diego has sponsored an annual Mathematics Teacher Institute consisting of both a summer program and a one-year academic program. The Partnership in Education program was initiated by the Greater San Diego Industry-Education Council about the same time the collaborative was created. SDUSD has a public education fund, the San Diego Compact, that has conducted a few conferences during the past five years, including one in 1988 on the problem of dropout rate. The regional Teacher Education and Computing (TEC) Center was closed in 1988 after state funding was withdrawn. In 1988, Frank Holmes, a member of the collaborative's governing board, former collaborative coordinator, and director of the minority engineering program at San Diego State University, was awarded an NSF grant to develop a minority mathematics enrichment program for second and third graders.

D. Management Structure

The grant from the Ford Foundation to support the San Diego Urban Mathematics Collaborative was awarded to the San Diego State University Foundation. The actual administration of the grant was through the Center for Research in Mathematics and Science Education (CRMSE) and the Department of Mathematics. CRMSE provided the collaborative office space and clerical support. The San Diego Urban Mathematics Collaborative was administered with the active involvement of the director and co-coordinators. Unlike most of the other collaboratives where the director has served more in the policy or advisory realm, the director assumed major responsibility for developing activities, directing meetings, and ensuring that tasks got done. Early in its growth, the collaborative had co-coordinators who worked with the director. One performed duties related to the activities of the collaborative while the other's duties were initially directed toward planning and personal intervention. The collaborative functioned with the funds from the Ford Foundation, in-kind support from the university, and financial support from the districts. An issue facing the collaborative at the end of this reporting period is that of raising funds as Ford funding declined. One action taken was to reduce the administrative staff to a single person, to be paid by the San Diego Unified School District, who serves as a mathematics resource person and, as part of this position, as the collaborative director/coordinator.

The collaboratives are faced with a paradox from their beginning. In order to receive a grant from the Ford Foundation, a group from a prospective collaborative site is invited to write a proposal. The intention of the proposal is to generate a plan for empowering mathematics teachers, reducing their isolation, and linking them with those from business, higher education, and others from the community. The process of preparing a proposal generally requires a small group of people willing to work together to generate a plan. The fact that a collaborative is needed implies that there is not an existing organization to form linkages among the diverse groups envisioned in the collaborative concept. The proposal-writing process develops a group of people who become vested in the enterprise and form the core for structuring the collaborative. Those from the larger community, who are essential to the collaborative and who are asked to support and become active in the collaborative as it develops, have difficulty generating the same interest as this vested group, however, because they were not involved from the beginning. Thus, a necessary beginning task that requires the work of a few makes it difficult for the broader community to become interested, which is essential for a successful collaborative. This seemed to happen in San Diego.

The Ford Foundation initially contacted mathematics educators at SDSU and asked them to prepare a proposal. A group of 15 people, including 8 secondary teachers, drafted the proposal. The administration of the collaborative and the governing group, the Executive Committee, were essentially all members of the proposal-writing group, which was actually known as the Executive Committee. This committee was composed of faculty and others associated with San Diego State University and SDUSD teachers and school district administrators. As the result of a unique chain of events, Alma Marosz, who had just retired from SDSU, volunteered to be the director. She served in this capacity from the collaborative's beginning in 1986 through April, 1990. Her time was considered as an in-kind contribution from SDSU. The initial proposal noted the provision for two committees, one advisory and one executive, to govern the collaborative. The Advisory Committee would deal with policy issues and would include representation from business and the community. However, due to the press of generating activities for teachers and the dearth of people to serve on the Advisory Committee, the Advisory Committee was merged with the Executive Committee. The Executive Committee met monthly from the fall of 1986 through the school year, making the major decisions for the collaborative. For three years, through the 1988-89 school year, the administrative structure included a collaborative director, the co-coordinators, and the Executive Committee to guide the

collaborative. Attempts were made by the director and coordinators to develop some links with business by making presentations to the members of the American Electronics Association and by interacting with the less than stable San Diego High-Technology Industry and Education Consortium.

Over the first three years of the collaborative, teachers became increasingly more involved in its governance. But not until the collaborative was required to submit a proposal to the Ford Foundation to describe a plan that would lead to some state of permanence did teachers really immerse themselves in long-range planning for the collaborative. A teacher planning committee was formed in December, 1988, and over the next semester drafted goals, objectives, and an organizational structure for the collaborative. As a result of the work of this group, a decision was made for a teacher to chair the Executive Committee, which had been previously chaired by the collaborative director. In April, 1989, the Education Development Center (EDC) arranged for Dr. Arthur Ellis to facilitate the involvement of people from business and the larger community with the collaborative. Meetings held in the summer of 1989 included representatives from the military, business, school board, parents, and community organizations. Small committees were formed by the Executive Committee (nominating committee, by-laws committee, activities committee, and budget analysis committee) and through the work of Dr. Ellis (community steering committee). In the fall of 1989, the collaborative was restructured, adopting a bicameral form of governance that included a 25-member Board of Directors that met quarterly and a Council of Mathematics Educators that met monthly. This organization resulted in the participation of a larger community in making policy decisions and plans while involving teachers (one representative from each of the target schools) and other mathematics educators from the district and SDSU in making program decisions. The restructuring was completed in May when William Wible, a mathematics resource teacher for the San Diego Unified School District, became the part-time director/coordinator for the collaborative, assuming the role that had been performed previously by the director and co-coordinators.

Several factors contributed to the evolution of San Diego Urban Mathematics Collaborative's governing structure, including teacher leadership and participation of people from a wide spectrum of the community. The fact that the collaborative was hosted by a university and members of its Mathematics Department was one factor. This group had access to the larger mathematics education community and had worked with

teachers and others from the districts. It was this group that formed the essential core of the collaborative in its early years, since there was no organization in San Diego, such as a public education fund, to link the education community with persons from the other sectors. A second factor is that after the collaborative had conducted some programs and established a presence, the collaborative concept was easier to describe to those outside of education, making it easier to engage their interest in what was being done. A third factor is that some teachers became committed enough to the collaborative to take the time needed to develop long-range plans and to provide leadership for the collaborative. A final factor is that the administrators of the collaborative during the first three years had the time and took major responsibility for operating the collaborative without setting priorities such as developing teacher leadership or forging a relationship between the collaborative and the community at large. The administrators of the collaborative spent most of their time involved with the daily operations of the collaborative, more so than in most of the other collaborative. Again, because the collaborative's administrators had experience in mathematics education or professional development, this area is what received their attention.

E. Project Activities

Over the four-year period 1986-1990, the San Diego Urban Mathematics Collaborative sponsored a wide variety of activities for mathematics teachers in the Sweetwater Union High School District (SUHSD) and the San Diego Unified School District (SDUSD). The collaborative's main strategy over the four-year period was to promote networking among existing resource groups in the San Diego area rather than to develop new resources. The collaborative primarily encouraged teachers to take advantage of the opportunities already available to them, although it did sponsor a variety of programs to ensure that the needs of the collaborative's mathematics teachers were being met.

The range of the San Diego collaborative's activities encompassed all four themes that had emerged from the documentation process as being dominant in the programming for the collaboratives in general. These themes were: 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 collaboratives, 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, allowing 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, involved 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 for professional development. 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 collaborative 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 collaborative. However, since this training was initiated by EDC rather than by individual collaboratives, it is not discussed in the reports of the individual collaboratives.

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

Socialization and Networking

In its initial stages, most of the activities of the San Diego Urban Mathematics Collaborative were designed specifically to promote networking among the teachers in the target schools. The collaborative sponsored a wine and cheese reception in June, 1986, and an evening dinner and colloquium in the fall of 1986. At the beginning of the 1988-89

school year, the collaborative sponsored a reception at the home of one of the teachers to kick off the new school year. The event, however, was very poorly attended, with only twelve teachers participating. The low attendance was attributed to the heavy demands placed on teachers early in the school year as well as to the fact that the activity was scheduled on a Friday. It was also suggested that perhaps teachers were no longer interested in attending a collaborative event that was strictly social.

Each year, the collaborative sponsored an annual retreat for collaborative teachers and staff. Initially, the retreats offered an opportunity for the teachers to become better acquainted and develop a feeling of collegiality. As the collaborative moved toward maturity, the focus of the retreats evolved from being primarily a socialization activity to one which focused on various aspects of mathematics education and then to an activity in which teachers played important leadership roles in addressing key issues related to planning for the future of the collaborative.

The four retreats varied not only in focus, but in length, format, and location. Three, the May 1987, October 1987, and October 1989 retreats, were held on Fridays from approximately 4:00 to 10:00 p.m. The March 1989 retreat was held over an entire weekend. The weekend retreat, unusual among the collaboratives, represented a major effort by the San Diego collaborative to promote networking and socializing among the collaborative teachers.

Attendance at the retreats was generally good and ranged from 77 teachers at the October 1987 retreat to 16 teachers at the March 1989 weekend retreat. Among the 77 teacher participants at the 1987 retreat was a high representation of teachers from the three new target high schools that had just joined the collaborative. Even though the total number attending the March 1989 retreat was relatively low, there was still representation from eight of the nine target schools.

During the 1988-89 school year, the collaborative began to distribute a monthly mailing to all collaborative members to keep them better informed about collaborative events and actions. The mailing included minutes of the Executive Committee meetings and announcements of UMC activities, as well as other information that might be of interest to UMC members. To promote networking and communication with the larger mathematics community, the collaborative published a column in the semi-annual

publication of the Greater San Diego Mathematics Council and made sure that all UMC members received the newsletter. The collaborative also encouraged teachers to submit articles about their UMC activities to the newsletters.

Increased Knowledge of Mathematics Content

Over the four-year period, the collaborative played an important role in enhancing teachers' knowledge of mathematics topics and current issues related to curriculum reform. The collaborative provided opportunities for teachers to expand their knowledge through workshops, sessions at retreats, materials distributed to the schools, and the sponsorship of site visits to local industries. In general, the focus of all of these activities centered on the *Mathematics Framework for California Public Schools* (the guidelines for K-12 mathematics education for the State of California) and current curricular reform, including the NCTM *Curriculum and Evaluation Standards for School Mathematics*. The Mathematics Education Department at San Diego State University provided professional expertise at many of these events. Among the key contributors were Project Director Alma Marosz and Mathematics Professor Nicholas Branca.

Over the four-year period, the collaborative sponsored a variety of workshops, including an 11-session mini-course on discrete mathematics in the fall of 1986; a day-long workshop series, "Technology in the Classroom," in October, 1986, which featured demonstrations as well as hands-on experience with new software programs; and a workshop co-sponsored with the San Diego Mathematics Project held in April, 1988, which was designed to provide teachers with an overview of the *Standards* and an opportunity to compare the *Standards* to the California *Mathematics Framework*--a workshop that proved to be one of the collaborative's best-attended events. Two Saturday morning workshop series, one in 1987-88 and one in the 1988-89 school year, were designed to address topics related to California's *Mathematics Framework*. (The 1987-88 series addressed problem solving, an introduction to logic and problem solving, the computer and mathematics, the *Geometric Supposer* software, mental math estimation, and hands-on geometry; the 1988-89 series focused on operations and computer skills, graphic calculators, the *Geometric Supposer*, and cooperative learning.) A week-long workshop, "Contemporary Topics in Mathematics Using Technology," co-sponsored with SDUSD late

in August, 1988, was designed to introduce teachers to the new curriculum materials that were developed at the North Carolina School of Science and Mathematics and to demonstrate how calculators and computer software can be used to teach mathematical concepts. An all-day workshop on cooperative learning, in September, 1988, was led by Professor Neil Davidson of the University of Maryland, and a workshop on contemporary applied mathematics was held in November, 1989. The response to this workshop, which was designed for teachers of Grades 7-12, was extremely favorable--teachers felt that they got some concrete ideas about interjecting the latest mathematics concepts into traditional mathematics courses.

In addition to conducting its own workshops, the collaborative also sponsored the attendance of teachers at workshops held by other organizations. In December, 1987, for example, the collaborative sent five teachers to a workshop sponsored by the Bureau of Education and Research, "Increasing Students' Mathematics Achievement by Breaking Through Basic Skills to Critical Thinking," led by well-known textbook author and mathematics education lecturer Lola May.

The collaborative also used programming at the annual retreats to address topics in mathematics education. At the October 1987 retreat, for example, sessions were held to address the CAP Test, problem solving and writing in remedial math, Math A topics, geometric games using calculators to find patterns, geoboard geometry, and the *Geometric Supposer*. The spring 1987 retreat included a two-hour discussion of the California *Mathematics Framework*, with participants divided into junior- and senior-high school groups. The 1989-90 annual retreat focused on technology in the classroom. Participants had the opportunity to attend workshops from among the 11 one-hour sessions that were offered. Among the workshop topics were: geometric probability, problem-solving strategies using LOGO, a robotics demonstration, graphic calculators, teaching mathematics concepts with calculators, mathematics videotapes, and Math A.

At the 1987 retreat, the collaborative distributed to each of the six original target schools six instructional packages, each containing eighteen books related to mathematics research, instruction, activities, and methods. The books, which offered suggestions about ways to implement the California *Mathematics Framework* in the classroom, were meant to

serve as the foundation of a permanent resource library at each site. The collaborative hoped to provide a set of materials to all of the target schools.

The collaborative sponsored two site visits to address the issue of real-world applications of mathematics in the classroom. The collaborative sponsored a tour of Teledyne Ryan Electronics Corporation in May, 1988, to acquaint teachers with mathematics in the real world. Prior to the visit, Professor Marosz met with Teledyne engineers to help determine what would be of interest to teachers. The tour was the beginning in establishing relationships between teachers and those in industry. The second industry applications tour, held in May, 1988, was at the Union Bank. The teachers toured the bank's data center and listened to a discussion of mathematics requirements for employees. The low attendance at the site tours raised questions about how valuable teachers found the visits and whether the visits were scheduled at convenient times.

Teacher Professionalism

From the beginning, the collaborative recognized the importance of offering teachers opportunities to participate in professional experiences. In 1986-87, the collaborative paid for all 71 mathematics teachers from the six target schools to enroll in the Greater San Diego Mathematics Council. In subsequent years, the collaborative paid the full membership of teachers new to the collaborative and half of the fee for veteran members. The collaborative encouraged the active participation of collaborative teachers in the meetings and workshops sponsored by the Council and offered financial support to teachers to attend conferences sponsored by other organizations out of a conviction that enabling teachers to attend conferences would expose them to new ideas and approaches they would then bring back and share with their colleagues. In addition, these experiences would increase the self-esteem of the teachers and help them to feel that they are abreast of current trends in their field. The collaborative, therefore, offered financial support to well over 200 teachers to attend numerous local, regional, and national conferences and workshops over the four-year period, including annual conferences of the Greater San Diego Mathematics Council, annual conferences of the Southern Section of the California Mathematics Council, annual conferences on Secondary School Mathematics and Computers at Phillips Exeter Academy in New Hampshire, and annual meetings of the National Council of Teachers of Mathematics.

Throughout the four-year period, the collaborative also kept teachers informed about the variety of grants and scholarship programs available to them and offered teachers support in submitting proposals and applications. In March, 1987, the collaborative offered four grant-writing workshops. Although only seven teachers, including four non-mathematics teachers, participated in the series, the teachers felt that the workshops were worthwhile. One of the teacher participants wrote a successful proposal to the Teacher Education and Computing (TEC) Center, obtaining a grant for a project that will focus on problem solving, calculators, computational skills, estimation, and computers in mathematics and science content. In the 1987-88 school year, a teacher won a scholarship to the Summer Mathematics Project at Mount Holyoke. During the 1988-89 school year, a collaborative teacher applied for and received funds from the California Mathematics Project to develop a department office in his or her school.

The San Diego collaborative is based within a strong tradition of mathematics education. San Diego State University has a very active mathematical sciences faculty that has developed and implemented a number of projects for area teachers. Many mathematics teachers are taking advantage of the wide variety of activities and professional opportunities available to them in the San Diego area. During the summer of 1987, ten teachers participated in the San Diego State University Mathematics Project and six teachers participated in the San Diego Mathematics Teacher Enhancement Project.

Several of the activities that the collaborative sponsored were also designed specifically to promote the professional development of teachers. In April, 1990, the collaborative and the San Diego Mathematics Project co-sponsored a colloquium to discuss and critique the draft of the NCTM Professional Standards for Teaching Mathematics. Nearly 50 educators participated in the colloquium, which was led by Dr. Nicholas Branca and included eight collaborative teachers and two guests from the newly formed collaborative in Columbus, Georgia. A preliminary draft of the participants' reactions and responses to the NCTM draft was sent to the NCTM Commission charged with revising the document. The colloquium provided an opportunity for teachers to discuss teaching and to reflect on what it means to be a professional.

The collaborative staff identified equity as one of its critical issues in the first year of the collaborative's operation. In February, 1987, the Executive Committee invited Dr. Uri Treisman, who was then a mathematics professor at the University of California-

Berkeley, to work with teachers and their high school classes and also to present workshops on how to implement cooperative learning group activities among mathematics students. In March, 1988, the collaborative invited the principal and department chair from each collaborative school to attend a special reception and advance private screening of the movie "Stand and Deliver." All of the 18 collaborative members who attended found it an inspiring and thought-provoking experience. Equity was also one of the main themes of the 1989 collaborative retreat.

The annual collaborative retreats provided another opportunity for the professional development of teachers. The March 1989 retreat, in particular, addressed issues related to developing a sense of professionalism among teachers and fostered a professional spirit among the teacher participants as they assumed a greater role in planning and decisionmaking for the collaborative. Presentations during the retreat focused on three critical issues: the permanence of the collaborative and the organizational structure the collaborative should assume; professionalism--addressing such questions as, What is professionalism? What makes teaching a profession? How can teachers be strengthened?; and equity.

It is evident that several of the mathematics departments were energized through the efforts of the collaborative and as a result, during the 1988-89 school year, began to meet periodically. Teachers have given the collaborative credit for getting to know the other people in their departments and for the new feeling of cohesiveness within their departments.

Teacher Leadership

The collaborative's administrators believed in providing teachers with opportunities to take responsibility for and to direct their own professional development. From the onset, many of the workshops that the collaborative offered were led by teachers. In October, 1986, only months after it was established, the collaborative sponsored a day-long workshop on technology, at which district teachers as well as faculty from San Diego State University and the University of California-San Diego, led workshops. In January, 1987, the collaborative sponsored an after-school workshop that was developed and presented by teachers. The workshop, "Bell Teachers Share Their Success," focused on one school's

success in attaining increased collegiality among teachers, high staff moral, administrative support, dramatically improved student achievement, and an atmosphere conducive to learning. A SDUSD teacher also taught a week-long workshop, Contemporary Topics in Mathematics Using Technology. The workshop, which was held prior to the opening of the 1988-89 school year, was co-sponsored by the collaborative and the SDUSD. Two members of the UMC Los Angeles +PLUS+ project also participated as instructors for one day.

Teachers also played an important role in the Saturday Morning Workshops Series that addressed topics related to the California *Mathematics Framework*. Most of the sessions in the 1987-88 series and all of the sessions in the 1988-89 Saturday morning workshop series were led by collaborative teachers.

The annual collaborative retreats provided teachers with an opportunity to demonstrate leadership skills. Collaborative teachers led many of the workshop sessions that were presented as part of the October 1987 retreat and took an active role in planning the 1989 retreat. The goals of that retreat, as established by the teacher-dominated Planning Committee, were to provide an atmosphere of collegiality and opportunities for professional development; to create an environment that would foster a power base within the mathematics community for effecting change; to develop leadership skills; and to promote equity and professionalism. Topics discussed during the weekend included the goals and objectives of the UMC project, the collaborative's organizational structure, assessing and meeting the needs of teachers, deciding whether to become a political force in the state, and equity issues. Teachers also played a major role in planning the fourth annual collaborative retreat, which focused on the theme, "Technology in the Classroom."

F. Reflections

The San Diego Urban Mathematics Collaborative developed from an organization administered primarily by collaborative staff and directed toward providing professional experiences for mathematics teachers to an organization that is focused on systemic reform and is one in which teachers assume a major role in administration. In its first year, the collaborative administrators and the Executive Committee spent most of their time

planning and making arrangements for teacher activities. For the first two years, the teachers functioned as consumers of its programs and activities. By contrast, in 1989-90 nearly all of the time in collaborative committees was spent on developing a lasting structure that would enable the collaborative to address issues of equity, reform in mathematics education, and teacher empowerment. Teachers functioned no longer as consumers, but as owners. In the beginning, the collaborative was comprised of mathematics educators from the university, the school districts, and teachers. Four years later, the collaborative had reached out to the larger community to form a Board of Directors. The Board was chaired by a person working for the U. S. Navy and included eight others from business, industry and the military; some from community services; parents; teachers; staff from the two districts; and several persons from higher education.

The approach taken in developing the collaborative was to provide activities related to mathematics education reform and other professional opportunities for mathematics teachers from a limited number of schools and then to expand to an increasingly larger number of schools. A choice was made at the beginning to work with Grade 7-12 teachers from six schools--two high schools and their feeder schools. Mathematics departments were given personal attention by the collaborative administration to encourage them to meet regularly and to increase the interaction among the department members. A major effort was made to provide teachers with workshops and retreats that would inform them of the latest advances in mathematics and mathematics education. Workshops and sessions on technology, cooperative learning, discrete mathematics, and the reform documents were offered. The collaborative prodded teachers to become more active in local, regional, and national mathematics education organizations and agreed to pay their membership dues in the Greater San Diego Mathematics Council (GSDMC) for one year; paying full or partial expenses to attend meetings of the GSDMC, of the Southern Section of the California Mathematics Council, and of the NCTM; and working with the districts to make arrangements for teachers to be released to attend these events. During the collaborative's evolution, an increasing number of presentations were given by collaborative teachers as they themselves became more knowledgeable about new approaches as a result of attending other activities. The collaborative continually raised the issue of equity to the teachers and others. Prior to the existence of the collaborative, some teachers did not view equity as a problem. Now teachers are thinking in terms of equity.

The collaborative has successfully built on teachers' leadership cap[illegible] and strengthened these by training a small core of 10 to 20 teachers. Rather than specifically focus on skills development, it has given teachers numerous opportunities to use their leadership talents. These teachers played an important role in restructuring the collaborative and then assumed positions of responsibility on committees to help with its administration. Collaborative retreats and workshops have informed teachers of new techniques and content aligned with the California *Mathematics Framework* and the NCTM *Curriculum and Evaluation Standards*. Teachers have become better informed and through the collaborative experience have become more accepting of reform initiatives. Rather than reacting to new ideas such as the *Standards* in a defensive matter, they are responding to change in a more constructive way through being more supportive of the district's initiative and assuming responsibility themselves. Those teachers who have been most active in the collaborative, those who have served on the committees and on the Council, have valued the opportunity to get to know each other and to be able to interact with each other. As such, they have generated a new reference group. Those responsible for inservices for mathematics teachers in both of the districts have valued the workshops that the collaborative provided. The San Diego mathematics supervisor has used collaborative teachers, who have learned more about calculators and computers through the collaborative and are using them with students, as examples of what can be achieved. Even though the business sector did not become involved in the collaborative until the end of the four-year period, a few teachers have benefited from meeting representatives of business and industry through the collaborative. These interactions have opened the door for at least one teacher to take her students to visit a laboratory to observe firsthand applications of mathematics. The collaborative has successfully increased the professional activities of a core group of mathematics teachers; acquainted teachers with technology to the extent that teachers are using graphing calculators and computers more with their students; informed teachers of recent reform recommendations; and attracted individuals in business as well as industry, and others from the community to serve on its Board of Directors and help chart its course for the future.

The collaborative has fallen short in some areas. The expansion strategy to increase the number of targeted schools did not reach its goal. Of the 38 middle, junior, and high schools in the San Diego Unified School District and the 20 schools in Sweetwater Union High School District, the collaborative only reached 9 of the schools targeted. Not

all of the potential 58 member schools in the two districts are inner-city schools, but the number that are or that face similar urban issues exceeds the nine that were brought into the process. The expansion strategy was retarded by other factors including the illness of a coordinator and the need to plan for permanence. Another problem that has arisen is that only a small number of teachers has assumed responsibility for providing leadership for the collaborative. These teachers have become known, are asked to become involved in other activities, and soon become over-committed. Other teachers have not been found to replenish this leadership nor is there a strategy in place to address the issue. Some of the most active collaborative teachers were reaching a point of exhaustion toward the end of 1989-90 school year. The collaborative has not succeeded in spreading leadership responsibility among a larger number of teachers, nor expanding its leadership base so that others are willing to step forward and help. A related issue is the inclusion of minority teachers in the collaborative activities. Some minority teachers have been active, but teachers have identified the importance of having a greater number of minorities involved as one area in which the collaborative could improve. One problem is that only 20 percent of the teachers in the two districts are from underrepresented groups. Finally, the collaborative has not been visible enough within the community. Many from the community who gathered to talk about the collaborative in 1989 were not aware of its existence prior to being invited to the meeting. This is related to having too little business involvement in the early years of the collaborative and could be a greater problem in the future when trying to raise funds.

In retrospect, certain steps could have been taken to reduce some of these problems. From the beginning, the director assumed the major responsibility for planning the activities and the operations of the collaborative. This reduced the amount of time she could spend on strategic and long-range planning. This situation is related to having the collaborative operated by a mathematics education group with its specific focus rather than through a public education fund that would be more predisposed to community strategic planning. The result of the director's active involvement in programming was that while rich mathematics and mathematics education experiences were offered to teachers, the issues of expansion or teacher leadership were not given the attention required to sustain the organization. After two years, teachers demonstrated that they had the qualities to assume some of the administrative responsibilities for the collaborative. If this could have been recognized earlier, it is possible that the teachers would have assumed responsibility for reaching teachers from new target schools so that the expansion of the

collaborative could have continued at a faster pace. A broader base in the community needed to be developed earlier in the collaborative's history. One possible step would have been to publicize the collaborative more extensively so that it could have established its own identity--which would have helped in recruiting those from business and industry. Another untapped resource were faculty members from the University of California-San Diego who were working with some of the same collaborative teachers. Those at the UCSD were never brought into the process. If some of these issues had been dealt with as the collaborative progressed, it is reasonable to assume that the collaborative would have grown larger and generated a more extensive support system.

Collaboration Outcomes

Collaboration between the two districts, San Diego Unified School District and Sweetwater Union High School District, increased as the collaborative became more effective. Teachers from both of the districts began to share ideas and work together in planning for the collaborative. Collaboration between those in business and industry and the teachers did not really evolve until the Board of Directors was formed--motivated by the requirement for a structure that would increase the probability of the collaborative becoming a permanent organization in the San Diego area. Through contacts made with Board of Directors members from business and industry, some teachers began to use them as resources.

Certain successes have been specifically attributed to the mathematics collaborative. One is that some mathematics departments are now working as cohesive groups. Collaborative teachers report that communication among mathematics teachers at their school has increased; there have been more department meetings, and the department is dealing more with issues. A principal at a San Diego high school has noted a difference between the mathematics department and departments in other content areas. She noted that the mathematics teachers are being served, they are happy, and they are learning. The new confidence of the department has increased teachers' perceptions of what can be accomplished. Mathematics departments from collaborative schools have been viewed by school administrators as innovative and progressive compared to other departments.

Another outcome is that the mathematics teachers have a greater knowledge of current trends in their field of education. Opportunities to attend workshops and national conferences have contributed to an expansion of the knowledge teachers have of mathematics and the mathematics they need to teach. The collaborative has also directed the attention of the teachers to the issue of equity. Over the past ten years, the teachers have experienced more culturally diverse classroom populations. The district curriculum director for SUHSD sees as spin-offs of the collaborative the fact that mathematics teachers are dealing more with equity in mathematics, as well as with technology, and they are showing greater initiative in assuming leadership.

A third outcome observed by some is the participation of teachers in directing their own professional development. A former school board member for SDUSD, who is now serving on the collaborative's Board of Directors, particularly values the collaborative for its grassroots effort to encourage teachers to become trainers for their peers. She goes on to report, "The collaborative is the only resource that provides the incentive, peer coaching, sharing, opportunities, and influences that are really needed. I don't see anything else out there. The urban mathematics collaborative is the most visible and vital staff development program that exists." An SDUSD mathematics teacher supported the value of having a collaborative, ". . . if it weren't for the collaborative, everybody would probably go on doing their own thing in isolation. . . . There is much more taking place with the collaborative here."

Professionalism Outcomes

The collaborative has made progress towards addressing major issues related to the image of teachers as professionals. The collaborative has provided teachers an opportunity to use their talents in situations outside of the classroom. Having teachers responsible for conducting workshops and doing presentations for other teachers has drawn upon their leadership and organizational qualities to help each other. Attending national conferences has increased the self-esteem of mathematics teachers and helped them to feel that they are abreast of the current thinking in their field. Teachers have become less isolated and more inclined to draw upon each other as resources for information. This is a direct result of teachers working more closely with each other within their departments and of teachers getting to know their peers from other schools better. The mathematics teachers now

know what they need to be doing to effect change and are interested in attending workshops to accomplish it. Through increased awareness of the issues and knowledge of what is happening in other parts of the country, collaborative teachers see a need to learn new and different ways of teaching.

The most significant changes effected by the collaborative have been in the teachers' views of their work and the types of support they require and in their sense of enhanced departmental cohesion, with a concomitant sense of the greater capacity to make their voices heard. The two are related. As a result of their collaborative activity, teachers have assumed more responsibility for their own professional growth. One example of this is the initiative some of the teachers took in organizing a master's program at a local university.

Based on teachers' responses to the 1990 administration of the Survey of Teacher Professionalism, the image teachers had of themselves by the end of the four-year period shows considerable change from that prevailing four years earlier, particularly in their more positive views concerning the importance of professional collegiality with mathematicians, their recognition of the importance of involvement in professional organizations, and their leadership initiatives in school mathematics reform. In all of these aspects, frequent collaborative participants felt considerably stronger than did those who took part in collaborative activities only occasionally--with one third of the latter group responding negatively in each respect. The responding teachers display an enhanced belief in the need for autonomy of action in teachers' professional work. The overwhelming majority of those surveyed expressed the belief that they exercise considerable autonomy in their professional practice and believe that peers with a mathematics teaching background--such as departmental chairs--are best suited to evaluating their performance. The shift in their perceptions of themselves as professionals represent significant gains compared with their response in 1986, which was considerably less positive than the self-perception of mathematics teachers in other collaborative sites at that time.

Perhaps the most striking contrast differentiating those who have been particularly active in the project from those who were less so was that the active teachers felt that their work and worth are recognized by others and that mathematics teachers have the capability to control and evaluate their work. It should be noted that those who only occasionally took part in the collaborative were strongly divided on this latter issue.

While the teachers see themselves very much as teachers rather than as mathematicians, they feel strongly that the time spent on learning mathematics is very important, but not necessarily more so than that spent on learning new ways of teaching and classroom management.

When in 1986, teachers were asked how the collaborative could best be of help to them, they responded with a list of physical resources that could be supplied. This was linked with a stated sense of powerlessness in their work roles within their districts. By the 1987-88 school year, increased activity in professional organizations such as NCTM, GSDMC, the California Mathematics Council (CMC), and the Mathematical Association of America (MAA) was being cited as the prime impact of the collaborative. For some, this was their first participation in a local, state, or national meeting of a professional organization since Proposition 13 imposed financially stringent conditions on school districts. An underlying ambivalence about teaching as a profession persisted, however--the work being that of "more as a police officer than as a doctor or lawyer," as one teacher expressed it. The perceived low status of teaching persisted and the collaborative was seen as providing a mechanism for group identity, support, and recognition beyond the confines of the school and the district.

At the project's start, the level of cohesion varied widely between departments. By 1998-89, the significant change for a number of participating teachers was in the focused work in departments and the sense that, through coherent effort, they could challenge administration positions: "We haven't gotten there yet, but now there are more people working together."

An issue that draws attention to the ambiguities inherent in notions of professionalism is the payment of stipends. While the collaborative pays stipends to participants of events, there are those who argue that teachers should be willing to attend without compensation activities that enhance their professional skills. With the payment of the stipends, attendance has increased, but it is argued by a district administrator that the intrinsic value of the activities is now the motivating force--the teachers are well aware of the need for change and have reached a sufficient level of frustration in dealing with the pressures to change their practice. Until it is the case that professional development is integral to the work of teachers in the San Diego area, it appears that payment of stipends is important as a mark of respect for teacher time and effort.

As a result of their collaborative activity, mathematics teachers have assumed more responsibility for their own growth. The collaborative has served to bring people together. This mutual reinforcement has led teachers to feel that they are more knowledgeable and more respected in the community than in the past. The SDUSD mathematics supervisor noted the fact that teachers have realized the importance of communicating with each other as one of the most important outcomes of the collaborative.

Mathematics Focus Outcomes

The SDUMC has realized certain specific outcomes. One is that mathematics teachers who have been active in the collaborative are increasing the use of technology in their teaching and involving their students in a greater number of activities than was previously the case. The collaborative has motivated mathematics teachers to communicate more with each other. This has helped to increase the idea flow among teachers and has given them an opportunity to coordinate what they do in the classroom with what other teachers are doing. The collaborative has helped some teachers to clarify what mathematics is and to become more positive about mathematics. Some teachers have emerged as leaders in mathematics education and are taking initiative in dealing with important issues such as equity. The collaborative has helped teachers in the urban schools to benefit from the already very active mathematics community in the Greater San Diego area. As a greater number of mathematics teachers and others work toward reform in mathematics education, one area that needs increased attention is education of the total community about what mathematics is. A collaborative Board member points to the fact that many parents view mathematics as adding and dividing and do not have an understanding of mathematical applications. For her, it is important to educate parents along with their children if real changes in mathematics education are to be achieved. The collaborative has made significant differences in mathematics awareness and has energized a core group of mathematics teachers in the two districts.

Conclusions

The San Diego Urban Mathematics Collaborative has been shaped by being hosted at a university by people in a strong mathematics education program. As a result of being

rooted in a mathematics education program, a strong feature of the collaborative has been a program that has kept teachers on the frontier of advancements in mathematics education. Collaborative teachers note with confidence that they are aware of what is happening in mathematics education across the country. This has been a major contribution of the collaborative. What has been more difficult, at least in part because of the collaborative's strong ties to a higher education institution, has been building an organization that reaches out to the larger community and builds bridges across the sectors. The collaboration that took place in San Diego was primarily among those within the education and mathematics education communities. There also is the issue of those in higher education having a perception that they understand what mathematics school teachers need to know. This perception then influences the nature of the activities conducted and prohibits teachers from expressing freely what they think they need. In the early years of the collaborative, the Executive Committee provided a means for teachers to express their opinion. However, the fact that it was two years before a group of teachers met to do some of their own planning is some indication that teachers were either not fully comfortable doing this sooner, or simply did not have the opportunity.

An impressive feature of the San Diego Urban Mathematics Collaborative has been the strong support the district provided from the beginning and continued throughout the collaborative's history. The relationship between the two districts and the collaborative has been a testament to the value the districts have placed on the collaborative. One reason for this relationship was the credibility of the director and the work of the mathematics education faculty at SDSU with the districts prior to the existence of the collaborative. Another reason is that the administrators in both districts saw that their respective districts benefited from having teachers active in the collaborative. In the San Diego Unified School District, the mathematics supervisor now has mathematics teachers who have created prototypes of innovations that can be used to encourage other teachers to create models. In Sweetwater Union School District, a person has been given charge of equity education after the collaborative raised equity as an issue that should be addressed. A third important reason for strong district support of the collaborative is that representatives from both districts participated in the planning for the collaborative from its beginning and continually viewed the collaborative as an opportunity for their programs rather than as a burden.

At the end of the 1989-90 school year, the organizational structure for a lasting collaborative was in place but some issues remained. One issue was expansion. There are other mathematics teachers in the two districts who could benefit from being a part of the collaborative. Expanding the collaborative to include teachers from other high schools, middle schools, and junior high schools would continue to add to the vitality of the collaborative and spread its influence. Some even feel that for the collaborative to have its greatest impact, it needs to expand to Grades K-12. Another issue related to expansion is creating a mechanism that will encourage teachers to assume positions of responsibility in the collaborative. Other collaboratives have done this, but in San Diego teacher leadership has fallen on a few rather than being spread among many. A third issue is that teachers who have been active in the collaborative have changed: they no longer view their teaching practice or themselves in the same way. For these teachers to retain their interest in the collaborative, programming for them needs to respond to their current needs. This issue is facing all of the collaboratives and is not specific to San Diego.

What it is important to note is that at the close of the documentation period the collaborative had evolved to a position at which these issues can be vigorously addressed. Through the collaborative, mathematics teachers are more aware of the reform initiatives in mathematics education. They have greater knowledge of technology, equity, and new approaches to teaching mathematics. Individual teachers have felt a greater sense of professionalism and value in what they do. A cohesive group has formed that has the potential for being a force in revamping the educational system to better meet the needs of the changing population of students in the San Diego area. In these respects, the San Diego Urban Mathematics Collaborative has been very successful.

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