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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 Memphis UMC from its entry into the program in 1986 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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MEMPHIS 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

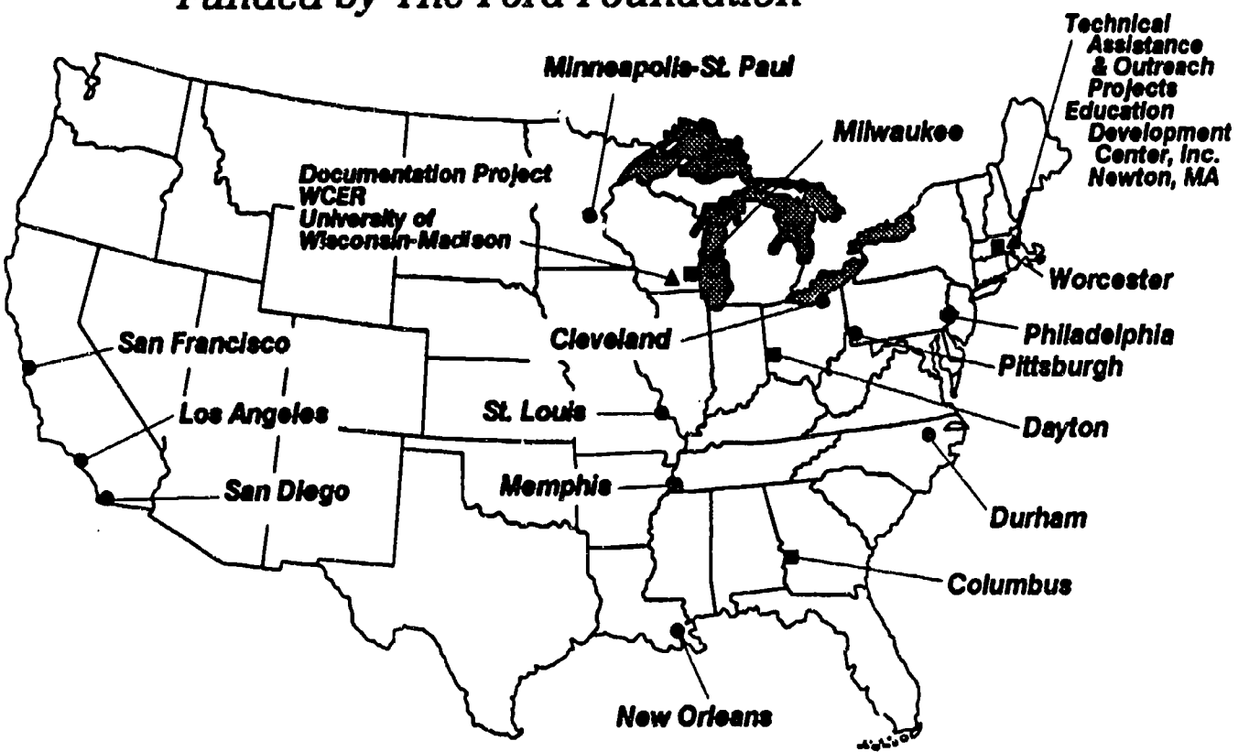
This document is a four-year Site Report on the Memphis Urban Mathematics Collaborative from its inception in 1986 through June, 1990. The intent is to reflect on the development of the collaborative, noting the changes that have taken place in regard to the context in which the collaborative operated, 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 both the collaborative's development and achievements in light of its specific goals as well as the goals 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 activities 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, the climate of mathematics education in the United States has undergone major change. 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. Developing 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 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 the Documentation Project staff.

II. FOUR YEAR SUMMARY: 1986 TO 1990

A. Overview

The Memphis Urban Mathematics Collaborative (MUMC), one of the last of the eleven original collaboratives to be established, has changed the professional environment for K-12 mathematics teachers in the Memphis area. Through its activities and programs, the collaborative has reached nearly 70 percent of the 500 teachers of mathematics in the secondary and middle grades and nearly 100 elementary teachers. Over the four years, teachers have participated in professional development experiences both in Memphis and in other locations around the nation, and have learned to write proposals for grant monies offered by a variety of organizations. Several teachers have served as interns in local businesses and health care facilities and many have drawn upon the Speakers Bureau organized through the collaborative. They have gained support from other teachers and the school district administration in new ways. In addition to feeling more self-confident, some teachers have changed what they are doing in their classrooms--increasing the use of computers and calculators, doing more with statistics, and incorporating more practical applications of mathematics. The benefits of the collaborative have extended to others who have become involved. Active members from universities and colleges have worked with collaborative members to help structure grant requests and have participated in institutes supported by successful grants. The collaborative has served as a major vehicle for the district to provide inservice to secondary mathematics teachers and as a link to the larger community. Representatives from business who have been active in the collaborative see an enlivened and enthused group of mathematics teachers who will encourage more students to go into mathematics-related fields.

The Memphis Urban League, the collaborative's host agency, and its executive director not only attended to the monetary concerns of the collaborative, but pursued the issue of advancing the education of minority children. The collaborative coordinator and associate coordinator, with the advice and direction of the Advisory Committee and Teacher Council, developed the program for the collaborative. The organizational structure of the collaborative, which grew out of contact with the Memphis City Schools (MCS), allowed people from all sectors to become actively involved in the operations of the collaborative. This has resulted in strong on-going support from business and higher education as well as from the school district. The MUMC has offered teachers in the

Memphis City Schools a range of programs that span the mathematics curriculum, opportunities to attend meetings across the country, gatherings for socializing and getting to know other teachers as well as representatives of the business and higher education communities, internships, and a variety of other activities. At the end of four years, the collaborative was in the process of changing its host agency from the Memphis Urban League to Memphis State University. A series of activities were planned for the 1990-91 year, partially funded by grants, and plans to include more elementary teachers were underway. All of these indicate that the collaborative will continue to provide a strong and viable program to the teachers in the Memphis City Schools.

B. Purpose

Over its first three years, the stated goal of the MUMC was to promote an environment of professionalism for mathematics teachers, to develop a creative working relationship with those in the other sectors, and to conduct projects to improve the abilities of teachers to relate mathematical concepts to students. The collaborative's purpose, as stated in the final proposal which was submitted to the Ford Foundation at the end of the third year, emphasized the leadership of teachers in creating a dynamic organization in association with their supporters from the Memphis City Schools, businesses, and academic institutions, and the expansion of the target audience to include elementary teachers. While the teachers' role was prominent, the purpose statement acknowledged the importance of working with the administration of the school district and increasing public awareness of the collaborative. According to the goals stated in the final proposal, the collaborative will:

1. Promote an environment of professionalism;
2. Promote closer creative working relationships with other professionals in elementary and secondary schools, colleges, and universities, and in business and industry;
3. Develop additional creative projects that will broaden teachers' horizons;
4. Seek additional financial commitment and moral support from the Memphis City Schools administration; and
5. Promote greater public awareness of the work of MUMC and its constituents.

C. Context

During the four-year period of documentation, the city of Memphis increased in population by about 2 percent to 659,000, with the racial distribution shifting from 53 percent white and 47 percent black in 1986 to an even distribution in 1989. During this time, student enrollment in the Memphis City Schools experienced a slight increase and then a decline. In 1985-86, approximately 105,000 students, of whom 72 percent were black, were enrolled in district schools; this increased to 108,000 students in the 1987-88 school year, and then declined to 98,000, 78 percent of whom were black, in the 1989-90 school year. This represents a 7 percent overall student decrease from 1985-86. The proportion of blacks increased in both the general population and in the student population. In 1988-89, less than 1 percent of the student population spoke English as a second language and nearly 58 percent of the students were eligible for free or reduced-cost lunch programs. An official dropout rate is not computed by the district; however, in 1988-89, approximately 9 percent of the high school students left school Of the Memphis City Schools students who do graduate, about 58 percent continue on to post-secondary education.

The nine-member Memphis Board of Education oversaw a budget of $313 million in 1989-90, an increase of nearly 7 percent from the previous year. The district draws 45 percent of its funding from the state, 33 percent from local resources, 2 percent in federal funds, and 19 percent from other sources. The state of Tennessee has no income tax, but the combined state and local sales tax of 7.75 percent is one of the highest in the nation.

By 1989-90, Dr. William W. Herenton had served eleven years as the superintendent of the Memphis City Schools. The district had 152 schools: 24 senior schools, 17 middle/junior high schools, 85 elementary schools, and 26 optional magnet schools. The optional magnet programs are designed to attract students in the area who are attending private/parochial schools. The percentage of students attending private/parochial schools declined from about 33 percent in the middle of the 1980s to 15 percent in 1989-90.

The mathematics curriculum, which has to conform to state objectives, is overseen by a K-12 mathematics consultant, Marietta Harris. Three other mathematics supervisors are responsible for observing and evaluating district mathematics teachers. Of the 5,871

teachers who were employed by the district in 1989-90, 350 taught mathematics in high school or middle/junior high schools. The group of mathematics teachers represents an equal number of blacks and whites. The number of mathematics teachers has essentially remained constant over the four-year period of documentation. Fifty-two percent of the high school mathematics instructors hold a master's degree, and all have earned a bachelor's degree. Of the total, 314 are certified to teach mathematics, and 81 percent of these are tenured. In 1989-90, approximately 200 elementary teachers from 8 selected elementary schools were invited to participate in collaboratives activities.

To receive a normal diploma, students are required by the district to have two units of mathematics from the following courses: High School Arithmetic, Algebra I, Algebra II, Geometry, Pre-Algebra, and Applied Algebra. For an honors diploma, three units of mathematics are required. Other mathematics courses offered include Trigonometry, Advanced Algebra, Advanced Mathematics Survey, and Calculus.

Sixty-two percent of the teachers in the Memphis City Schools are members of the Memphis Education Association, which is also their bargaining agent. The salary range for teachers in 1988 was $18,000 to $36,000 and increased in the 1989-90 school year to $20,200 to $37,790, with an average of $27,177 for a 200-day school year. All teachers received 10 inservice days during the school year; collaborative members received 2 additional release days each semester. A Teacher Career Ladder Program (CLP) administered by the State of Tennessee, provided an additional $4,000 in teacher pay for approximately 266 hours of extra work on approved projects beyond the regular nine-month contract. There are three experience/salary levels in the CLP. Level 1 teachers, who must have four years of teaching experience and a passing score on the National Teachers' Examination, receive a $1,000 bonus for a 10-month contract; Level 1 teachers who have nine years of experience and have been evaluated on the basis of one of two models can reach Level 2. Level 2 teachers receive a $2,000 bonus for a 10-month contract and are eligible to receive another $2,000 by working an additional month; Level 2 teachers with 13 years of teaching experience can reach Level 3 through an option choice similar to that in Level 2. Level 3 teachers receive a $3,000 bonus for a 10-month contract and can earn an additional $2,000 for 11 months or $4,000 for 12 months. The state specifies that hours spent fulfilling career ladder activities must focus on high priority student needs. Professional development experiences are excluded.

Both the Memphis Rotary Club and the district's Division of Curriculum Development offer grants to MCS teachers; the latter provides funds for courses in mathematics, computer science, and mathematics education at Memphis State University for selected elementary and secondary teachers. In 1989-90, the district also allowed teachers to attend an inservice project outside school hours for which they received six hours of professional development credit plus permission to forego attendance at the March district-wide inservice.

D. Management Structure

The MUMC was established with a grant from the Ford Foundation in October, 1986. The Memphis Urban League serves as the host agency for the collaborative, the only collaborative among the original 11 hosted by an Urban League. Herman Ewing, a former mathematics teacher and executive director of the Urban League, is the director of the collaborative. The Urban League agreed to be the collaborative's host agency for four reasons: the League was committed to the belief that mathematics can help students become better thinkers; it had experience in administrating and organizing programs; it had a strong record in organizing individuals to establish new projects; and it had connections and good rapport with many Memphis principals. The Urban League's experience and expertise, combined with its long-term commitment to raising the academic achievement of black students, made it an ideal host agency.

The Urban League maintains very close ties to the school system in Memphis. The superintendent of the Memphis City Schools is a former member of the Urban League Board and served on the Board's Committee of Advisors. Half of the 38 members of the Board are designated representatives of Memphis businesses. They have expressed support for the collaborative and enthusiasm for the League's role. The Board has assumed a firm position that the project should be well-coordinated with the MCS district.

The administrative structure of the MUMC benefited from the experience of earlier collaboratives while adapting to local circumstances. Nancy Gates, a mathematics teacher and a recipient of the Presidential Award for Excellence in Mathematics Teaching, was appointed as part-time coordinator to oversee the development of the collaborative's program, while the staff of the Memphis Urban League provided the administrative

support. However, an increase in administrative tasks put such pressure on the staff that in the second year an associate coordinator, Fatima Durham, was appointed 80 percent time. An Executive Committee was established to facilitate communication among the principle decision makers of the collaborative, meeting monthly during the 1987-88 school year and as needed after that time. When Ms. Durham resigned the following year, Anne White assumed the position of associate coordinator, which was increased to full time. Ms. White is responsible for office operations, the Teacher Internship Program, Speakers Bureau scheduling, the collaborative newsletter, and the development of outside funding sources. Donna Porter, a full-time mathematics teacher, was appointed as workshop coordinator during the third year of the collaborative. Initially, the collaborative was housed at the Memphis Urban League's office, but after two years was moved to White Station High School when Ms. Gates, her total salary paid by the district, resumed teaching 60 percent time at the school. Ms. Gates has been with the collaborative from its inception and has provided continuity in leadership. She assumed the position of co-director of the collaborative when the collaborative's host agency shifted to Memphis State University in the summer of 1990.

From the beginning, the collaborative administration was supported by a group of committed and active representatives from business, higher education, the school district, and the community, who served on advisory or governing committees. The director of the district's Division of Optional Schools/Ford Foundation Projects, for example, was a member of the collaborative's Advisory Committee and provided direct access to the school district's administration. The Advisory Committee, which met quarterly, was the major decision-making body for the collaborative until the governing structure was reorganized while planning for permanence in 1989-90. The Advisory Committee was comprised of a nearly equal distribution of teachers, representatives from higher education, and representatives from business and industry. In addition, an administrator from the school district regularly attended the Advisory Committee meetings. At various times, the Advisory Committee formed sub-committees to attend to specific responsibilities such as planning, policy, nominations, liaisons with the schools, and program. The Memphis Urban League Board retained responsibility for fiscal matters and approved all expenditures.

A Teacher Committee was formed, composed of teachers who enthusiastically brainstormed about projects and programs that the collaborative could offer. The

members of this committee provided a core group of teachers willing to become involved in planning and implementing collaborative programming. The membership of the Teacher Committee reflected the collaborative's view of the importance of including a representative mix of teachers in terms of ethnicity, grade-level, and home schools. A project subcommittee of the Advisory Committee served as the link between that group and the Teacher Committee.

In March of 1989, the formal development of a permanence proposal was initiated. A 24-member Think Tank was appointed by the Advisory Committee to develop the proposal and to reflect on the current governing structure, financial condition, and administrative support of the collaborative, and to propose a structure that would provide for the permanence of the collaborative. The Think Tank developed a list of the areas in which the collaborative had impacted on education in the district, including enhanced communication among teachers, and between teachers and representatives from higher education; motivation to try new techniques and ideas; and a greater sense of professionalism among teachers. In addition, the group identified areas needing more attention, such as increasing interaction among teachers, principals, supervisors, and the Memphis State University mathematics department. In June, 1989, the MUMC proposal for permanence was approved by the Ford Foundation. The proposal requested two years of funding for a transition period in which the collaborative would operate with the current administrative structure, supported by a 25-member Governing Committee that would be the primary decision-making body for the collaborative and also would solicit funds to support collaborative projects. This would evolve into a governance structure comprised of the Governing Committee, an Operating Committee composed of eight teachers and the two coordinators, and an Executive Committee. In addition, the Memphis Urban League would transfer policymaking responsibility to the Governing Committee.

In 1989-90, the Governing Committee assumed greater responsibility for directing the collaborative, including increased control over fiscal matters. In March, 1990, the Memphis Urban League transferred $3,000 to an account controlled by the Committee and its treasurer. After exploring different possibilities, the Governing Committee, in cooperation with the Memphis Urban League, decided to transfer the host agency's responsibilities to Memphis State University. This transition began in the summer of 1990. The Operating Committee of eight teachers, fulfilling their Career Ladder II and III requirements, identified, planned, and coordinated the collaborative's activities.

In its first year of operation, the collaborative designated 20 of the 53 high schools and junior highs in the district as target schools. These schools were chosen to ensure equal representation from the four district areas, taking into consideration the racial mix of a school's student body and teaching staff. In addition, the principals of the target schools had to express willingness to cooperate with the project. In subsequent years, all high school and middle/junior high school mathematics teachers were eligible to register as collaborative members. In 1989-90, membership in the collaborative was opened to teachers at eight elementary schools with the assumption that teachers from the other elementary schools would be eligible in future years.

The development of the collaborative into a working organization with a strong program did not transcend some of the issues that have been facing the community of Memphis for years. As the host agency, the Memphis Urban League, whose main mission is to advocate for blacks and the poor, concentrated on issues of equity and on servicing the black student population. Although this was compatible with the collaborative's ultimate purpose, the immediate focus for the collaborative was on improving the professional environment for mathematics teachers in the district. At times, this difference in agendas resulted in tension within the administration of the collaborative that was manifested in not paying bills for programs in a timely fashion, delaying the payment of an approved salary increase for the associate coordinator, and lack of coordination in planning meetings related to internships. The formation of the Executive Committee was a direct effort to facilitate understanding between the Memphis Urban League and what it saw as important and those responsible for developing the collaborative's program. While the collaborative was deeply concerned with equal representation of teachers from different racial groups, the collaborative's director felt that the program did not go far enough in raising key issues and developing a consensus on important goals. In this regard, the Memphis collaborative, hosted as it was by a special interest group, was challenged more than other collaboratives by the different perspectives represented. Although the processes of collaboration did not resolve all of the differences that existed before the collaborative was created, it did provide another forum for discussion. This resulted in closer attention to an equitable distribution of resources and a change in the host agency.

E. Project Activities

Over the four-year period 1986-1990, the Memphis Urban Mathematics Collaborative sponsored a wide variety of activities for secondary mathematics teachers (Grades 7-12) in the Memphis City Schools. At the beginning of the 1989-90 school year, elementary teachers from eight targeted schools were invited to join the collaborative and participate in its activities.

The range of the Memphis collaborative's activities addressed the four themes that had emerged from the documentation process as being dominant in collaborative programming. 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 since they brought members of the mathematics community together, enabled them to get to know one another, and promoted 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 available grants and other opportunities for professional development. Some collaboratives paid teachers' dues for organization membership 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 professional 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 the collaboratives, it is not discussed in the reports of individual collaboratives.

In reflecting on collaborative activities as they related to the four themes, considerable overlap was noted, since most activities served multiple purposes. A single activity may, therefore, be discussed under several headings.

Socialization and Networking

A primary goal of the Memphis Urban Mathematics Collaborative was to establish linkages between Memphis mathematics teachers and other mathematics professionals in business and higher education. Initially, the Memphis collaborative seemed to place a greater emphasis on creating contacts between teachers and representatives of other sectors than most other collaboratives. Many of the programs the collaborative sponsored, especially during its first year, were designed to foster interaction among teachers, business people, and those from higher education.

Dinner Meetings

To provide teachers an opportunity to meet with one another as well as to address important topics in mathematics education, the collaborative sponsored eight dinner meetings throughout the four-year period. All MUMC teachers were invited to attend most of the meetings, although some of the dinners were targeted to a specific audience. The collaborative's first official event was a "Kick-Off" Dinner held in January, 1987, to publicize the collaborative and to promote its activities. The event was attended by 105 people, including teachers, school district administrators, and representatives of the business and higher education communities. A dinner meeting for pre-algebra teachers was held in January, 1988. The fifteen teachers and five school administrators who attended heard an address on the role of pre-algebra in the curriculum by Chicago Public Schools Director of Mathematics Dorothy Strong. In June, 1988, 35 people attended a Year-End Reception for everyone who had participated in an MUMC event. Keynote speaker Dan Teague of the North Carolina School of Science and Mathematics addressed the uses of computers for pre-calculus. In March, 1988, the collaborative and IBM co-sponsored a dinner symposium titled "How to Use Technical Teaching Styles and Technical Curriculum." Breakout sessions included a tour of the IBM Center and work sessions on mathematics software. The event was so successful that in April, 1990,

MUMC and IBM co-sponsored a second IBM Technology Conference and Dinner to expose teachers to the latest in technology and to demonstrate how computers and graphic calculators can be incorporated into their curriculums. In August, 1988, 56 people attended a dinner symposium to kick off the 1988-89 school year and to promote the NCTM *Standards*. Thomas A Romberg, professor of Curriculum and Instruction at the University of Wisconsin-Madison and chair of the NCTM Standards Commission, was the guest speaker. In January, 1989, MUMC sponsored a colloquium and reception targeted primarily at teachers of Algebra II through Calculus. Twenty-three people attended the colloquium, which featured Dr. Mary Treanor of Valparaiso University, who discussed connections among inequalities, limits, and proofs. In March, 1990, a dinner symposium was held for the MUMC Governing Board and selected guests that focused on mathematics as communication for minority students. The symposium was co-sponsored by the Miami Desegregation Center and the Memphis City Schools.

Speakers Bureau

During the 1987-88 school year, the MUMC established a Speakers Bureau that offered a list of approximately 50 representatives from universities, business, and the school system who are willing to speak to mathematics classes and teachers' groups on a variety of topics, ranging from engineering and accounting to the history of mathematics and number theory. The Speakers Bureau creates opportunities or forums in which teachers can interact one-on-one with those from business and higher education and in which these professionals can directly affect students. In October, 1988, the Speakers Bureau Directory was updated and its distribution was expanded to include not only the mathematics teachers in the 20 targeted schools in Memphis, but all secondary Memphis City School mathematics teachers. The directory contains biographical information on each speaker and lists nearly 70 presentations the speakers are willing to make. By the end of the documentation period, teachers had begun to take responsibility for calling the speakers directly, instead of asking the MUMC office to make the contact.

Collaborative Newsletter

In the fall of 1987, the collaborative began the publication of a semiannual newsletter, *The MUMC Bulletin*. The newsletter is an important vehicle for distributing information to collaborative teachers regarding collaborative events, conferences, activities, issues in mathematics, and teaching suggestions. Beginning in 1989-90, the newsletter was edited by two members of the Operating Committee rather than by the associate coordinator. Also in 1989-90, the distribution of the newsletter was expanded to include teachers in targeted elementary schools. It was distributed to approximately 350 elementary and secondary teachers, as well as to representatives of the business and university communities who serve on the Governing Committee.

Increased Knowledge of Mathematics Content

The activities of the MUMC have provided teachers with a variety of experiences that address the range of content in the secondary mathematics curriculum; topics related to the elementary mathematics curriculum were addressed beginning with the 1989-90 school year. Although the collaborative leadership has a strong background in mathematics and mathematics education, much of the mathematics focus of the project, especially during its initial years, was in direct response to the needs and interests of the teachers. The topics for the initial series of Summer Workshops, for example, were based on the teachers' expressed interest in their content areas. Several programs were offered on the *Geometric Supposer* software, which was being implemented in the district.

Collaborative Workshops, Seminars, and Institutes

Workshops were an important vehicle for increasing the knowledge of mathematics content on the part of MUMC teachers. Over the four-year period, the collaborative sponsored 19 workshops, the majority of which were held during the summer. In general, the workshops were able to accommodate all of the teachers who wanted to attend, with participation ranging from 11 to 60 teachers, but waiting lists had to be developed for some of the more popular programs. The workshops addressed a wide range of topics in

the secondary and elementary mathematics curriculum. Many of the workshops were planned and taught by MUMC teachers and incorporated information from national conferences and workshops that teachers had attended. In the summer of 1987, four workshop series were offered: "Mathematics Across the Curriculum," "Probability," "Geometry," and "Second Year Algebra." In the summer of 1988, the collaborative, with support from the North Carolina School of Science and Mathematics (NCSSM), sponsored a one-week workshop to provide teachers of fourth-year high school mathematics courses with training in the newest techniques and applications for pre-calculus instruction. The workshop, which was attended by 13 participates, was conducted by 2 MUMC teachers who had received collaborative funding to attend a curriculum workshop at NCSSM during the summer of 1987. The collaborative alsc sponsored a four-day, 16-hour workshop, "Topics Taught in BC Calculus," that was attended by 18 collaborative teachers. In March, 1989, 60 teachers, including 48 MUMC teachers, participated in a one-day workshop, "Mathematics for the 1990s," planned by a teacher subcommittee to introduce participants to new trends in mathematics. In the summer of 1989, the collaborative sponsored a "Mathematics in Applications" workshop to showcase practical application problems for a variety of topics. The workshop was planned completely by teachers, with business persons serving as resources. The 38 teachers who participated in the workshop experienced business-teacher interaction and teacher-teacher interaction and produced a set of classroom problems to increase the impact of the workshop experience.

Many of the workshops sponsored during the 1989-90 school year reflected the expansion of the collaborative to include elementary school teachers from the eight targeted schools. In the fall of 1989, the collaborative sponsored two series of afternoon workshops, one for secondary teachers and one for elementary teachers, to provide teachers with an alternate way of earning professional development credit. All of the workshops were led by teachers, whose presentations were based on information they had obtained from attendance at various summer workshops. The topics for the secondary workshop series were: Geometry, Graphing Calculators, Probability and Statistics, and Patterning for Arithmetic. The elementary workshop series focused on Mathematics Made Meaningful, a holistic approach to critical thinking skills in mathematics. In March, 1990, MUMC sponsored a half-day workshop, "Hands-On Equations," to introduce a concrete approach to solving algebraic linear equations. This was the first workshop at which MUMC collected fees from non-members. In June, 1990, the collaborative sponsored a summer course, "Meaningful Mathematics," for teachers of Grades K-2. The eight-day

course, which was conducted by two teachers from St. Louis, was designed to help teachers understand how children learn and how to develop useful problem-solving skills using concrete materials and real-life situations as well as to help teachers implement the current NCTM *Standards* in the primary mathematics program. Also in June, the collaborative and IBM co-sponsored two two and one half-day seminars on the use of mathematics software--one on algebra and one on geometry. These very popular seminars were designed to provide teachers with instruction on the use of IBM software so they would be able to help other teachers integrate the software programs into the curriculum.

The Memphis collaborative sponsored two five-day Woodrow Wilson National Fellowship Foundation Institutes, one during the summer of 1989 and one during the summer of 1990. In the summer of 1989, an Institute on the Effects of Technology in Mathematics, targeting teachers of Algebra II, Advanced Mathematics, and Calculus, was co-sponsored with the UMC Technical Assistance Project at EDC. Among the 27 participants were eleven MUMC teachers. The Institute on Mathematics Modeling, held in the summer of 1990, was attended by 22 teachers, including 13 collaborative teachers.

The collaborative has been the main force in training MCS mathematics teachers in the use of the *Geometric Supposer*. Over a two-year period, four *Geometric Supposer* Workshops were held. In August, 1987, the collaborative sponsored a workshop led by one of the developers of the software program, Richard Houde, of Massachusetts. In the summer of 1988, the collaborative sponsored a one-day workshop presented by a teacher from the Philadelphia collaborative. In July, 1989, the collaborative sponsored a one-day workshop to provide hands-on training on the *Geometric Supposer*. The workshop, which was conducted by two MUMC teachers, was for geometry teachers who were interested in using the software package during the 1989-90 school year. In November, 1989, 12 teachers attended a dinner meeting for teachers who had received the *Geometric Supposer* software from the school district. The meeting was a first step toward establishing a support network that would allow user teachers to share tips and ideas with teachers who had not previously used the software.

"Mathematics Made Meaningful" Open House and Family Math Night

As the collaborative expanded to include more elementary teachers, it worked with K-6 teachers to sponsor programs. On two days in April, 1989, 78 teachers attended an after-school open house in a kindergarten teacher's classroom to see how she introduced mathematics to her students. This activity not only provided an opportunity for teachers to learn from one of their peers, but was a positive step toward an articulated K-12 mathematics program.

In February, 1990, the collaborative sponsored a Family Math Night, a family-oriented program to teach kindergarten and first-grade parents how to provide their children with meaningful concrete experiences that contribute to a true understanding of the patterns, language, and symbols needed to perform numerical operations. Over 40 families participated in the program. Both the Open Houses and the Family Math Night provided teachers and other members of the community an opportunity to become more aware of new ideas being implemented in the elementary grades.

Attendance at Regional and National Workshops and Conferences

Throughout the four-year period, the collaborative provided financial support to 35 teachers for attendance at mathematics workshops and institutes. The teachers were encouraged to bring back new ideas and to share them with other teachers. The collaborative supported three teachers to attend a Pre-Calculus Workshop at the North Carolina School of Science and Mathematics in the summer of 1987 and two teachers to return for a follow-up workshop in February, 1989; seven teachers to participate in a one-week Woodrow Wilson Institute on Geometry at Rhodes College in the summer of 1987; two teachers' attendance at a two-day LOGO conference in Massachusetts in August, 1988; four teachers' attendance at the Phillips Exeter Conference on Computers and Mathematics in June, 1989; one teacher to attend the Ohio State University Calculator and Computer PreCalculus Project; two teachers to attend the Advanced Placement Calculus Course; two teachers to attend the Mathematics Their Way Conference; two teachers and the assistant coordinator to attend the 1989 Illinois Institute for Statistics Education; four teachers to attend the three-week conference, Teachers Teaching Teachers Discrete Mathematics Institute in Iowa in the summer of 1989; one teacher to attend the two-week C^2PC

Graphing Calculator Workshop at Ohio State; two teachers to attend the Advanced Placement Calculus Workshop at the University of Alabama in July, 1989; two elementary teachers to attend a Mathematics Their Way Conference in January, 1990, in California; and one elementary teacher to attend "Math--A Way of Thinking for Grades 4-6," a one-week workshop in Nashville, Tennessee, in July, 1990.

Teacher Professionalism

Since its inception, a major focus of the Memphis Urban Mathematics Collaborative has been on promoting an environment of professionalism for mathematics teachers. To achieve this goal, the collaborative provided teachers with opportunities to influence curriculum development in the Memphis City Schools, sponsored teachers' attendance at meetings and conferences of professional organizations, and encouraged teachers to apply for grants to support classroom projects or further study of mathematics. The collaborative also worked to foster professional relationships among the mathematics teachers in the Memphis City Schools and has planned specific programs such as the Resource Associates Program and the Summer Internship Program to provide teachers with opportunities to establish close working relationships with mathematics professionals from other sectors and to experience working as professionals in a business environment.

Curriculum Development

The collaborative has been instrumental in creating opportunities for teachers to be involved in curriculum development and planning for the district. Not only have teachers appreciated being able to participate in this professional responsibility, but they recognize that the process of interacting with school administrators has helped to enhance their sense of professional self-esteem. In March, 1988, four teachers were invited to meet with three mathematics supervisors to discuss the NCTM's proposed Curriculum and Evaluation Standards for School Mathematics. The meeting was sponsored by the collaborative and the Memphis City Schools. All seven participants recommended promoting the new *Standards*. On May 15 and 16, 1989, the collaborative sponsored a workshop that provided 69 junior and senior high school teachers who had been nominated by their principals a

chance to review the present MCS curriculum and make recommendations for change. The recommendations from the workshop were presented to the curriculum coordinator, with summaries made available to all MUMC teachers.

A committee of teachers of Calculus and Advanced Mathematics from each optional school and volunteers from the collaboratives' Advisory Committee, including representatives from business and higher education, was established to create a new curriculum for the fourth year of mathematics. A committee of collaborative teachers also developed a fifth-year mathematics course that will be offered to students as an alternative to Calculus. In addition, one of the teachers who attended the NCSSM Institute in Durham modified the curriculum for the Advanced Mathematics course to incorporate the new methods presented at the Institute.

Grants

The collaborative has helped to promote the professional development of teachers by playing an instrumental role in helping teachers obtain funding for special projects. Members of the MUMC Advisory Committee serve on the Grant Selection Committee for the Teacher Initiative Grants Program, the first effort of the Memphis Public Education Fund when it was established in 1987. This annual program offers teachers grants of up to $200 each to implement creative activities that enrich classroom instruction or to apply toward tuition for graduate or undergraduate mathematics courses at a college or university.

The collaborative has offered workshops to improve teachers' skills in grant writing and technical communication. The response to an initial grant-writing workshop held in May, 1988, was so positive that workshops were offered in December, 1989, and in February, 1990.

During the 1988-89 school year, collaborative teachers submitted two grant proposals to the Department of Education. One of the proposals sought funding for a graphing calculator project that would correspond with the focus on the NCTM *Standards*, and one sought support for a middle-grades project on algebra, geometry, and probability.

In September, 1989, collaborative teachers, collaborative associate coordinator Anne White, and Dr. Hugh McHenry of Memphis State University submitted a proposal to the Tennessee Higher Education Fund to support a one-week Transitional Arithmetic Institute in the summer of 1990 for teams of arithmetic teachers of Grades 7-9. The project, which received a $30,000 grant, is designed to help high school mathematics teachers incorporate algebraic approaches into the teaching of arithmetic so that students in applied mathematics classes can make a smoother transition to Algebra I. In addition, the collaborative received a subcontract to offer workshops during the summer of 1990 as part of a grant that a professor from LeMoyne-Owen received from the National Science Foundation (NSF) for PROJECT MERGE+.

Teachers on the Operating Committee submitted a proposal to the Education Development Center for an Outreach Grant to develop strategies for dealing with equity in mathematics education. The collaborative was awarded a $5,000 grant to fund work by 20 teachers, beginning in fall of 1990, on the development and application of techniques to help disadvantaged students.

Swap Shop Workshop Series

Collaborative teachers planned and implemented a series of six workshops in December, 1987, to provide outstanding teachers at various levels of mathematics an opportunity to work together to collect and document the effective teaching techniques they use in their classrooms. Workshop topics included: Pre-algebra and Algebra I; Algebra II; Geometry; Advanced Mathematics, Trigonometry and Calculus; Seventh and Eighth Grade Mathematics; and Ninth Grade and Applied Mathematics. A series of idea booklets based on the Swap Shops were shared with Memphis City Schools mathematics teachers at a follow-up inservice in January, 1988, providing an opportunity for all teachers to take advantage of the rich discussions that occurred at the Swap Shops.

Resource Associates Program

The Resource Associates Program was created during the first year of the collaborative to develop a mentor program that would foster one-on-one relationships

between teachers and mathematicians in business and industry as well as mathematics professors from colleges and universities. Mentors made a commitment to work with one or two teachers during the project year, providing teachers with opportunities to discuss teaching techniques, curriculum activities, and business-related mathematics concepts. In March, 1987, 37 pairings involving 40 teachers were initiated. In December, a dinner was held to provide teachers and their associates an opportunity to develop preliminary plans for the year.

Summer Internship Program

In the summer of 1987, the MUMC initiated a summer internship program to provide teachers an opportunity to work in a business environment and experience the ways in which mathematics is used in the world of work. Four internships were offered the first year, three in the summer of 1988, and five in the summer of 1989. While it had been hoped that more teachers would have an opportunity to be interns, the teachers who did participate in the internship program were very enthusiastic about their experience. Teacher interns commented that working in business was very different from teaching and that in the business setting, they were treated as professionals--not the way they felt teachers are normally treated. Teacher interns met at the end of the summer to discuss their experiences and to develop ways to apply their experiences so these would impact positively on their classroom teaching.

Meetings and Conferences of Professional Organizations

Collaborative teachers receive four professional leave days annually from the MCS for attendance at both local and national conferences and workshops. The collaborative provided financial support for teachers to attend conferences and meetings of professional organizations; for many teachers it was their first such experience. The collaborative funded 10 teachers to attend the 1988 Annual Meeting of the National Council of Teachers of Mathematics (NCTM) in Chicago, 12 teachers to attend the 1989 NCTM Annual Meeting in Orlando, and 8 teachers to attend the 1990 Annual Meeting in Salt Lake City; 3 teachers to attend the NCTM Regional Meeting in Chattanooga, Tennessee, in March,

1990; and 4 teachers to attend the Mathematics Reform and Teacher Professionalism Conference at the North Carolina School of Science and Mathematics in June, 1988.

Teacher Leadership

MUMC teachers have begun to assume a leadership role in the mathematics education reform movement within the Memphis City Schools and to exert pressure for change within the system. A subcommittee of the Teacher Committee prepared a statement on changes that were needed districtwide if the NCTM *Standards* were to be implemented. The statement was prepared to follow up on the list of needs teachers had generated at an inservice on the *Standards* that featured a presentation by Dr. Thomas A. Romberg, of the University of Wisconsin, who chaired the NCTM Commission that developed the *Standards*. The teachers, after incorporating suggestions from the Advisory Committee, submitted the statement to the Deputy Superintendent.

Collaborative teachers also developed a fifth-year mathematics course, Introduction to College Mathematics, as an alternative to Calculus. The proposed course included statistics and other topics supported in the NCTM *Standards*. The course failed to receive approval from the state Board of Education. Rather than allowing the issue to die, the teachers continued their efforts, adding the topics to another course on the state-approved list. The course will be offered to students under the state title, Advanced Algebra.

F. Reflections

The intent of the Memphis Urban Mathematics Collaborative--to promote an environment for professionalism among mathematics teachers--remained the same during its first four years. Over the four-year period, however, mathematics teachers assumed a greater responsibility for conducting the business of the collaborative. At the end of that time, a teacher served as the chair of the Governing Committee, another served as the treasurer and a group of teachers formed the Operating Committee to develop activities and write grant proposals. Other changes involved including some elementary teachers in

the collaborative membership and expanding the collaborative's programs and activities targeted at a small group of middle and secondary school mathematics teachers to a program for nearly 70 percent of the mathematics teachers in the middle and secondary grades and another 150 elementary teachers. This expansion in the collaborative's activities provided teachers with even greater leadership responsibility.

Those teachers who have been most involved credit the collaborative with forming an active network among mathematics teachers. Prior to the existence of the collaborative, teachers associated mainly with other teachers from within their schools; now mathematics teachers know teachers from other schools across the district and are much more apt to use them as resources. In addition, a stronger link has been developed between district personnel and the business and higher education communities. Through business internships and institutes, and by serving on the Governing Board, teachers have become more knowledgeable in the applications of mathematics, as well as more aware of the expectations that businesses and higher education institutions have for their students. This increased knowledge has guided the district administration's perception that the collaborative has built a stronger and broader relationship between the district and those in business and higher education. The collaborative has also provided the district with a pilot program for generating closer relationships between the schools and the community. The workshops and other activities that teachers attended with collaborative support have provided numerous ideas that they have used in their classrooms. In some cases, these new approaches, such as use of the *Geometric Supposer*, computers, and calculators, were initiated through collaborative activities. Teachers have learned to write grant proposals and some have used this skill successfully to acquire manipulatives for their classroom and funds for conducting workshops. The collaborative also has provided occasions for discussing and working on difficult issues of equity facing teachers and the district.

The greatest impact of the collaborative has been experienced by the core group of very active teachers involved with the collaborative from its beginning, as well as by a few teachers who became involved later. The collaborative has been less successful in reaching out to the total community of school mathematics teachers and developing the needed involvement to achieve noticeable systemic change in the district's mathematics program. Even though all middle and secondary mathematics teachers are at least aware of the collaborative's existence and over three quarters of them were members of the

collaborative at some time, their involvement has often been limited to one or two activities. Thus, a focus has not yet evolved that compels all teachers to work toward common goals. Furthermore, the collaborative was not successful in overcoming the differing perspectives of the Memphis Urban League and the administrators of the collaborative. While differing beliefs about the purpose of the collaborative were discussed, participants generally gravitated to a point of co-existence where strong agreement was not obtained and true feelings were not resolved.

The Memphis Urban Mathematics Collaborative was able to accomplish a number of its objectives, although some factors, if changed, might have helped the collaborative to accomplish even more. One factor experienced by many collaboratives is lack of sufficient time at the beginning to come to terms with the collaborative's identity and what it needs to accomplish. When the concept of collaboration is not familiar to a community, there is initially a strong pressure for the collaborative to begin generating activities such as dinner meetings, workshops, or symposia to establish an identity. Since typically this must be accomplished with limited staff, there is little time for strategic planning or for people to express and resolve their different perspectives on furthering mathematics education in the district and creating a professional environment for teachers. The Memphis Urban Mathematics Collaborative experienced this dilemma. Activities were generated that benefited teachers and developed good relations across the participating sectors. What did not change, however, was that people still had to wrestle with their beliefs on issues such as equity, or structural issues strongly affecting the mathematics program such as a state-controlled curriculum and a hierarchy that gave more knowledgeable and senior teachers access to the upper division courses while restricting opportunities for the less experienced. Another problem in the early stages of collaborative formation was that key people who should have been brought into a discussion of these issues were not involved or even identified. The Memphis collaborative is not unique in trying to work out such pressing problems, but it did demonstrate that even with strong support from the district, business, and higher education, a collaborative remains limited as to what it can do in addressing structural issues grounded in tradition or state department requirements.

Collaboration Outcomes

As noted, the MUMC sponsored a wide assortment of activities that brought teachers together with each other as well as with people from business and industry, higher education, and the Memphis City Schools. This wide-spectrum approach has generated a support community for mathematics education in Memphis that includes people from all sectors who are enthusiastic about the collaborative's accomplishments. That there is a large percentage of Memphis mathematics teachers participating in collaborative activities indicates that the collaborative has reached a good representation of the mathematics teachers in the Memphis City Schools system. The Speakers Bureau, Summer Internships, and the Governing Committee have benefited teachers as well as individuals from business and industry. Through these interactions, teachers feel they are better understood by people in business, who, in turn, feel that they benefit from their involvement. A business representative on the Governing Committee, who sees her role as supporting teachers, pointed out that it is important to her both professionally and personally to have more students going into mathematics-related fields, since her collaborative commitment is looked on favorably by her department head. Before the collaborative was established, her business, a hospital, interacted infrequently with people from education. Since the involvement of this administrator with the collaborative, a high school mathematics teacher has brought two mathematics classes to visit the hospital; in addition, the hospital has sponsored internships for two mathematics teachers.

The collaborative also has brought teachers together with those from higher education to the mutual benefit of both groups. For example, college and university educators have helped teachers to develop proposal-writing skills, resulting in an increased number of mathematics teachers acquiring small grants from community organizations. Their success has led some teachers to venture further and write proposals for more ambitious projects. In September, 1990, collaborative members joined with representatives from Memphis State University to write a proposal for the Tennessee Higher Education Commission and in October, a mathematics professor from Lemoyne-Owen was awarded NSF funding for PROJECT MERGE+. This professor credits the collaborative with giving him the impetus to submit two proposals to NSF.

Another important result of the MUMC has been increased cooperation among the district administration, teachers, and others in the Memphis City Schools. The deputy

superintendent of schools views such collaboration as essential: "We have seen in education that we can no longer function in isolation from the larger community. We have to be actively involved in the business community, the social community, the civic community, and the religious community. . . . We can't go it ourselves." He feels that the collaborative has given him the opportunity needed to establish the district's commitment to a collaborative effort: "When I think of collaboration," he commented, "I think we are equal partners. I think of mutual exchanges. I do not think of any one institution emerging as 'the leader'." The deputy superintendent also valued the relationships with those in business and higher education he has established through MUMC, as well as the opportunity to share common concerns. In addition, teachers are pleased about being supported by the school administration, something they did not experience prior to the organization of the collaborative. One mathematics teacher stated that the district administration has been much more receptive to mathematics teachers than it has to teachers from other content areas, in part because the collaborative provides the teachers a voice.

Diverse forms of collaboration have resulted from the evolution of the MUMC. The examples noted above indicate that people from all sectors not only found that they could contribute to the collaborative, but could also benefit from being partners in collaborative programs. While teachers appreciated such collaboration, the form they have valued most has been the increased interaction with other teachers. What is most striking about the impact of the collaborative in Memphis is the mutual benefit that has been recognized by all of the participating sectors.

Professionalism Outcomes

Professionalism has assumed a new meaning for the mathematics teachers who have been active in the Memphis Urban Mathematics Collaborative. Prior to the existence of the collaborative, mathematics teachers reported feeling isolated, burned out, and confined by existing notions of mathematics and the state-mandated curriculum. Now mathematics teachers talk about sharing ideas, maintaining a support group, piloting curriculum materials, seeking new ways of teaching, implementing new trends in mathematics, and experiencing increased self-esteem. There is no question that the collaborative has

motivated at least some of the mathematics teachers in Memphis toward new achievements in their classroom teaching.

Not only has the collaborative brought Memphis mathematics teachers together, it has also expanded their relationships to teachers in other collaboratives in the UMC Network. Teachers in Memphis have shared their experiences and ideas with teachers from other parts of the country and are viewing the role of the teacher in a different way--as that of a facilitator responsible for seeking new, exciting ways to teach old and new ideas and topics.

Mathematics teachers have taken on more responsibilities for their own profession. The collaborative has given teachers the opportunity to attend the Annual Meetings of the NCTM, statistical institutes, one-week Woodrow Wilson Summer Institutes, and the EDC's Teacher Leadership Conferences. Teachers who have participated in these events have returned to Memphis invigorated and many have led workshops for other Memphis teachers. The curriculum review process also has become more open to teachers. Prior to the establishment of the collaborative, mathematics teachers felt constrained by the state-mandated curriculum. Now they are engaged in piloting new curriculum materials. Teachers on the Operating Committee are involved in proposal writing. All of these activities indicate that Memphis teachers have become more responsible for their own professional lives and are enjoying what they are doing to a greater extent.

In response to the second Survey of Teacher Professionalism that was administered to teachers in all the collaboratives during the spring of 1990, MUMC mathematics teachers revealed a moderate level of commitment to their work. Teachers who were Frequent participants in collaborative activities were convinced of the social benefits of what they were doing. The degree of involvement in the collaborative appeared to be strongly related to teachers' perceptions that their work was recognized by others; while very few Occasional participants held this view, about half of the Frequent participants felt their work was recognized by others. The teachers who responded saw themselves as teachers first and mathematicians second, although this was not as strongly expressed by Frequent participants. Frequent participants were more interested in continued training in mathematics than in enhancing teaching and classroom management skills. Also, a higher percentage of Frequent participants felt stronger about interacting with mathematicians and other users of mathematics. Overall, there was mild support for the view that

mathematics teachers had sufficient control over their day-to-day decisions. The sense of control was unrelated to degree of involvement in the collaborative.

Another distinguishing factor between the Frequent and the Occasional participants was that the Occasional participants felt stronger about teachers having control over the evaluation of themselves and their peers. The Frequent participants placed a higher value on professional organizations than did the Occasional participants--i.e., in having professional organizations assume responsibility for setting standards and initiating reform. The teachers who felt most strongly about this were those who reported reading the journals and taking part in professional meetings. The results of the Survey of Teacher Professionalism support the existence of a relationship between collaborative participation and viewing teaching as a profession. In general, all mathematics teachers felt that they had some control over classroom decisions. But teachers who had participated in collaborative activities were more apt to feel recognized by others, to be more receptive to changes in mathematics and to professional development experiences in mathematics, to be less interested in control over their own evaluation, and to place greater value in professional organizations than teachers who were nonparticipants in collaborative activity.

The results of the Survey and other evidence indicate that the collaborative has helped strengthen the self-image of teachers and has supported the valuable role they have in society. Teachers had felt their professionalism compromised by the control imposed on them by the district and by the evidence that students were becoming harder to reach. The collaborative has given teachers greater access to those in administration and the other sectors. It has enhanced the teachers' sense that they have a say in curriculum and in other decisions. Collaborative activities have given teachers new ideas and new support. This has increased their enthusiasm--made teaching more fun--and has motivated them to be more responsive to the needs of today's students.

Mathematics Focus Outcomes

The MUMC provided a variety of experiences over a range of content and grade levels. Activities addressing a wide spectrum of mathematical topics were offered during the four-year period. Topics included geometry, graphing calculators, probability and

statistics, arithmetic patterns, functions, critical thinking skills, linear equations, communication for minority students, technology, mental mathematics, mathematics modeling, transitional arithmetic, discrete mathematics, *Mathematics Their Way*, and advanced placement calculus. Activities were planned for elementary, middle, and secondary grade levels. The range of activities indicates that no particular mathematics focus has been defined; rather, activities are decided upon according to the interests of teachers, or because some teachers have had experiences they would like to share with other teachers.

The experiences that collaborative programming has given teachers are changing their conception of mathematics for the school curriculum and encouraging them to make changes in their classrooms. One teacher who had attended a statistics institute in Illinois had never gotten to the statistics in the textbook during the school year, partially out of fear that it was too difficult for her students. The institute provided her with new terminology and new approaches through the use of manipulatives such as dice. She tried the material with her students and reported, ". . . my children really did learn . . . ."

Teachers who have been active in the collaborative feel they are keeping current on the latest trends in mathematics education and have ideas they can use in their teaching. For one teacher, the availability of optional approaches is important in keeping students motivated: "One of the primary problems in teaching mathematics is getting students motivated to learn mathematics. The more ideas you have and the more ways you have to discuss something, . . . the better able you are to meet those challenges from the students." Some of the new information that teachers are gaining through the collaborative has to do with the use of technology in the classroom and the availability of software. One department chair no longer feels stagnant: "I use calculators and computers much more frequently [because of the collaborative]." Another teacher is able to direct her students to work many examples of Cramer's rule with matrices through the use of computers and software she had learned about in collaborative workshops and conferences.

Conclusions

At the end of four years, the Memphis Urban Mathematics Collaborative had the characteristics of a healthy collaborative--good leadership provided by the collaborative administration and teachers, a working organizational structure, a large number of district mathematics teachers who were aware of its existence and had participated in some way, and an active program. As in other collaboratives, a key factor in the development of the Memphis collaborative has been a commitment to making the collaborative work by teachers, district administrators, its host organization the Memphis Urban League, and by business people, and academicians. The collaborative has created an environment of professionalism for mathematics teachers that has prompted a number of mathematics teachers to become more involved professionally. As a consequence, not only teachers, but the district, students, businesses, and institutions of higher education have all benefited. The collaborative has been able to address many of the issues that face mathematics education in Memphis and provides a unique association of people in a position to begin dealing with the most critical of these issues, such as reaching underachieving students and mathematics teachers who have become settled in their ways. The Memphis Urban Mathematics Collaborative appears to be well-positioned to address these difficult issues vigorously in the future.

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