DOCUMENT RESUME

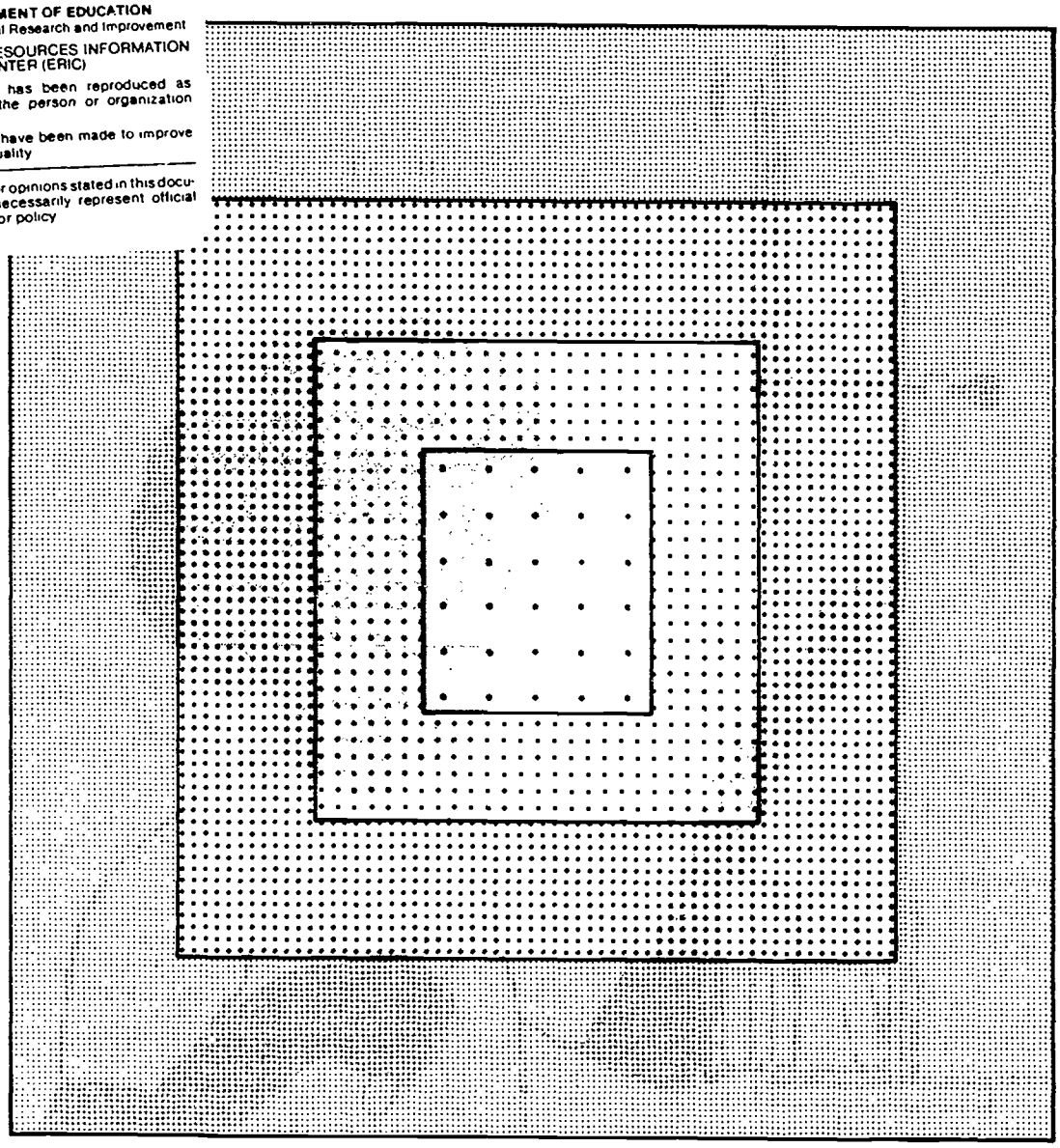
ED 351 402 UD 028 889

TITLE	Opening up the Mathematics and Science Filters: Our Schools Did It, So Can Yours! A Nine Step Guide to Increasing Minority Student Participation in Mathematics and Science.
INSTITUTION	American Univ., Washington, DC. Mid-Atlantic Equity Center.
SPONS AGENCY	Department of Education, Washington, DC.
PUB DATE	92
NOTE	106p.
PUB TYPE	Guides - Non-Classroom Use (055) -- Tests/Evaluation Instruments (160)
EDRS PRICE	MF01/PC05 Plus Postage.
DESCRIPTORS	Affirmative Action; Educational Change; *Educational Opportunities; Elementary Education; *Mathematics Instruction; *Minority Group Children; Principals; *Program Implementation; Public Schools; School Counselors; *Science Instruction; Student Attitudes; *Student Participation; Teacher Attitudes; Urban Schools
IDENTIFIERS	District of Columbia Public Schools; Montgomery County Public Schools MD; Prince Georges County Public Schools MD

ABSTRACT

This publication is a practical guide to implementing the Mathematics, Science, and Minorities: K-6 (MSM: K-6) Project, a program to increase minority student participation in mathematics and sciences in the kindergarten through sixth grade levels. The guide is organized into five parts. Part 1 is an introduction that explains why minority participation in mathematics and sciences is important, describes how this particular project began, notes typical obstacles to be overcome, and describes project components. Part 2 contains four testimonials from different schools that have implemented the project in the District of Columbia metropolitan area. Two accounts are told from the teacher's point of view, one is a principal's reflection, and the other is told from the guidance counselor's point of view. Part 3 is the key section that describes a nine-step implementation process (determining the nature of the problem, deciding how to get started, developing goals, identifying leadership teams, developing intervention plans, implementing a staff development program, implementing a school-based intervention plan, disseminating and institutionalizing, and evaluating). Part 4 offers reflections on what might have been done differently at locations where the program is in place. Part 5 is a summary. Four appendixes contain research study information, a list of project consultants, a checklist for reformers, and first year reflections. (JB)

Opening Up the Mathematics and Science Filters:



Our Schools Did It, So Can Yours!

What Our Students Have to Say About Mathematics and Science After Participating in the Program:

"Science is fun because we do a lot of things with objects. Math is fun because we do a lot of things with numbers."

– Second Grade Hispanic Female

"Science means experiments, doing things with your hands, growing things, and learning. It's fun to do science with someone else or by myself. I've learned to do a lot of experiments."

– Third Grade African American Male

"Math is a way to do problems with numbers. Without math the world would not be like it is today. Math helps us count. Math is my favorite subject because when I pass math, it makes me feel smart."

– Fourth Grade African American Female

"Math is now my favorite subject. It's fun to do by yourself or with someone else. I'm good in math. It helps you learn a lot of things. I'm happy when I do math. To me, it's interesting because I learn more every day. If I don't have anything to do, I do math."

– Fifth Grade Hispanic Male

Opening Up the Mathematics and Science Filters: Our Schools Did It, So Can Yours!

A Nine Step Guide to Increasing Minority Student Participation in Mathematics and Science

Based on
The Mathematics, Science, and Minorities: K-6 Project

Developed by
DeAnna Banks Beane

THE MID-ATLANTIC EQUITY CENTER
The American University
Washington, D.C.

The Mid-Atlantic Equity Center

The Mid-Atlantic Equity Center (MAEC) is a desegregation assistance center funded by the U.S. Department of Education under Title IV of the Civil Rights Act of 1964. The Center provides technical assistance and training services to public schools and school districts in Delaware, Maryland, Pennsylvania, Virginia, West Virginia, and the District of Columbia. MAEC's mission is to assist educators in providing equitable instructional experiences to an increasingly diverse student population in three program areas: race, gender, and national origin. Services include long-term intervention as well as short-term training and support. The following are types of assistance available:

- system-wide assessment
- long-term planning and technical assistance
- data analysis and program evaluation
- administrative consultations
- training-of-trainers workshops
- staff development programs
- multicultural curriculum
- dissemination of information and publications

Acknowledgements

When the Mid-Atlantic Equity Center (MAEC) conceived the *Mathematics, Science, and Minorities: K-6 (MSM: K-6) Project* in the spring of 1985, the current fervor for reform and equity in mathematics and science was only a dream in the minds of a rather small group of educators and equity advocates. The Mathematics, Science, and Minorities Advisory Board and Steering Committee are to be commended for contributing their time, expertise, energy, and vision to the forefront of what has become a regional movement for equity and excellence in elementary science and mathematics education. Although this publication represents MAEC's effort to tell the story of this project in a way that may help other schools, it is impossible to capture on paper the dynamic nature of this experience. We have no adequate means of sharing with the reader the pride, confidence, and excitement reflected in the faces, conversations, presentations, and exhibits of the principals, teachers, and guidance counselors from the twenty elementary schools as they gathered for the culminating conference at the end of the fourth year.

Many of these same individuals, four years earlier, had listened with doubt and uncertainty as they were presented with the challenge of examining the relationship between the nature of their mathematics and science programs, and the participation and performance of African American and Hispanic students in these subjects. Not only was change evident in those *MSM: K-6 Project* principals, teachers, and guidance counselors who worked so diligently on their school-based leadership teams, but their schools also changed. African American and Hispanic students in most of these schools were no longer "listening to and watching" mathematics and science, they were ***doing*** mathematics and science. In fact, ***all*** students benefitted from the changes. We commend these dedicated educators and their colleagues for their cooperation, growth, and persistence in working with this project.

Finally, this project would have remained only a dream without the commitment and support of top level administrators: Dr. Sheila Handy, Assistant Superintendent for Instructional Support, District of Columbia Public Schools; Barron Stroud, Director of Quality Integrated Education, Montgomery County Public Schools; and Louise Waynant, Associate Superintendent for Instruction, Prince George's County Public Schools. School district support at the local level enabled MAEC, which had no designated funding for this project, to use school district resources to mobilize the schools, facilitate project planning, coordinate project events, and identify key individuals and resource materials. The *MSM: K-6 Project* has been an exciting venture demonstrating that:

- Urban and suburban school districts can pool resources, expertise, and expectations to form powerful problem-solving collaborations;
- Through participation on school-based leadership teams, teachers and counselors can be empowered as change agents for school instructional and student support programs; and
- School-based intervention in mathematics and science can improve the participation and performance of African American and Hispanic students, as well as other students.

MAEC appreciates the efforts of all of those who were involved in the project, but especially the following individuals, whose positions and/or organizational affiliations are listed here as they were at the time of the project.

Mathematics, Science, and Minorities Steering Committee

Francena Cummings	Montgomery County Public Schools
Gwendolyn Means	District of Columbia Public Schools
Susie Oliphant	District of Columbia Public Schools
Sandra Rawlings	Prince George's County Public Schools
Constance Tate	Consultant

Mathematics, Science, and Minorities Advisory Board

DeAnna Banks Beane,
Director of Education
National Urban Coalition

Bertha Clark
Regional Director, Staff Development
Prince George's County Public Schools

William Clark
Director, Department of Academic Skills
Montgomery County Public Schools

Francena Cummings
Teacher Specialist
Action Team
Department of Quality Integrated Education
Montgomery County Public Schools

Shirley Hagans
Coordinator, Summer Projects
Prince George's County Public Schools

Johnnie Hamilton
Department of Instructional Service
Fairfax County Public Schools

J. Arthur Jones
Decision Information Systems
Silver Spring, Maryland

Genevieve Knight
Professor of Mathematics
Coppin State College
Baltimore, Maryland

Ethel Gore
Supervisor for Secondary Education
District of Columbia Public Schools

Gwendolyn Means
Assistant Director, Instructional Services

Susie Oliphant
Assistant Supervising Director of Science
District of Columbia Public Schools

Gladys Pettiford
Science Specialist
Alexandria Public Schools

Claiborne Richardson
Research Specialist
Fairfax County Public Schools

Laurice Juggins
Supervisor
District of Columbia Public Schools

Charles LaRue
Science Coordinator
Montgomery County Public Schools

Thomas Rowan
Mathematics Coordinator
Montgomery County Public Schools

Barron Stroud
Director, Quality Integrated Education
Montgomery County Public Schools

Constance Tate
Consultant
Washington, D.C.

Evangeline Wise
Chapter I Specialist
Prince George's County Public Schools

Jeanne Wilson
Mathematics Supervisor
District of Columbia Public Schools

Mid-Atlantic Equity Center Project Directors

DeAnna Banks Beane (1985)
Bess Howard (1986-1987)
Warren Simmons (1987-1989)

Participating Elementary Schools

District of Columbia Public Schools

Clark Elementary School
HD Cooke Elementary School
Kingsman Elementary School
Minor Elementary School
Reed Learning Center
Simon Elementary School

Montgomery County Public Schools

Chevy Chase Elementary School
Glen Haven Elementary School
Highland Elementary School
Kensington Parkwood Elementary School
Oakland Terrace Elementary School
Rock Creek Forest Elementary School
Summit Hall Elementary School
Washington Grove Elementary School
Whetstone Elementary School
Woodlin Elementary School

Prince George's County Public Schools

Barnaby Manor Elementary School
Berkshire Elementary School
Glassmanor Elementary School
Hillcrest Heights Elementary School

We are deeply indebted to the Steering Committee for their reflections and to those who agreed to write their own stories for this publication: the *MSM: K-6 Project* teacher team from Whetstone Elementary School in Montgomery County, Maryland; the *MSM: K-6 Project* teacher team from Simon Elementary School in Washington, D.C.; Jo Anne Thompson, principal of Hillcrest Heights Elementary School in Prince George's County, Maryland; and the *MSM: K-6 Project* counselor team from Prince George's County, Maryland.

In addition, we wish to thank the following individuals for their editorial expertise and insightful suggestions to this manuscript:

Robin Boyer, Guidance Counselor, Prince George's County Public Schools
Francena Cummings, Teacher Specialist, Montgomery County Public Schools
Michael Hires, Senior Administrative Assistant
Julie Kaijser, Senior Administrative Assistant
Carolyn Kingsley, Publications Coordinator
Bette McLeod, Director of Race Equity Programs
Susan Shaffer, Director of Gender Equity Programs
Leigh Ann Sours, Graduate Fellow
Susan Strange, Staff Assistant
José Manuel Torres, Director of National Origin Equity Programs

Sheryl J. Denbo, Ph.D.
Executive Director/Senior Editor
The Mid-Atlantic Equity Center

Table of Contents

PART I: INTRODUCTION

A. Why Focus on Minority Student Participation in Elementary Mathematics and Science?

B. How the Project Began

C. Obstacles To Be Surmounted

D. Project Components

A. Why Focus on Minority Student Participation in Elementary Mathematics and Science?

The United States has traditionally promoted education as the most effective vehicle for access to intellectual development and economic independence. Although this promise has held true for some, it certainly has not been a reality for all, especially for the economically disadvantaged and many persons of color. The Mid-Atlantic Center for Race Equity (now The Mid-Atlantic Equity Center) at The American University began to explore the "who" and "why" of minority group underrepresentation in science and mathematics in 1983. The absence of these populations in mathematics and science related college majors and career fields is largely the result of limited access to quality mathematics and science instruction and support throughout the pre-college years, beginning in elementary school. The following statistics demonstrate the need for intervention:

- The complexion of the United States and its public schools is changing. In 42% of the states, the public school (K-12) population is at least one fourth minority. In 32% of the states, African Americans, Hispanics, Native Americans, and Asians comprise over one third of the public school population.

  Digest of Education Statistics, 1991
  National Center for Education Statistics,
  U.S. Department of Education

- While African American and Hispanic students have made gains in achievement as evidenced by both local test scores and performance on the National Assessments of Educational Progress in Science and Mathematics, they still lag behind their White and Asian counterparts. Science proficiency scores (1986-1987) for nine year-old African American and Hispanic students were 32.5 and 35.7 points, respectively, lower than the 231.9 point proficiency level of nine year-old White students. Performance in mathematics was similar.

  Digest of Education Statistics, 1991
  National Center for Education Statistics,
  U.S. Department of Education

- African Americans and Hispanics are underrepresented in advanced high school mathematics courses, which are essential for further

success in science courses and science-related careers. In 1986-1987, Algebra II was the highest level of mathematics taken by 42% of the White seventeen year-old student population participating in the National Assessment of Educational Progress in Mathematics. However, only 31% of the African American and 28% of the Hispanic students had completed Algebra II.

The Mathematics Report Card: Are We Measuring Up? Trends and Achievement on the 1986 National Assessment
Educational Testing Service, 1989

- Though minority students comprised approximately 25% of the total 1986 college-age population, only 14% were enrolled in institutions of higher education. The proportion of Hispanics and African American high school graduates entering college declined from 36% and 33% respectively in 1976, to 29.4% for Hispanics and 28.6% for African Americans in 1986.

Education That Works: An Action Plan for the Education of Minorities
Quality Education for Minorities Project, 1990

- African Americans and Hispanics comprise approximately 17% of the total workforce in the United States, but represent only 4.5% of the nation's scientists and engineers.

Women and Minorities in Science and Engineering
National Science Foundation, 1990

When considering issues related to minority group underparticipation in science and mathematics, national and international contexts must be recognized. With the now emerging global economy, our nation's businesses beg for technologically literate workers, while at the same time, the National Science Foundation projects a shortage of over half a million scientists and engineers by 2010. Widespread alarm exists over the generally poor performance by United States' students on national and international science and mathematics proficiency assessments.

The performance of U.S. students is of particular concern since mathematics and science have been identified as "the critical filters" for access to and success in mathematics- and science- related courses and careers. The development of this mathematics and science proficiency begins well before age 13. The importance of building foundations in elementary school science and mathematics courses for conceptual

understanding, higher order thinking, and academic self-confidence must not be underestimated. Curricular and instructional practices which were used one hundred years ago do not adequately prepare students to be successful in a technologically-based society.

The widely publicized reform movements currently underway in pre-college mathematics and science education are unquestionably intended to address this national crisis which crosses race, socioeconomic, gender, and cultural lines. However, African Americans and Hispanics, those traditionally underserved and underrepresented in these fields, manifest the symptoms of the crisis more dramatically with even lower levels of performance. The growing racial and cultural diversity in our schools must be fully understood and deliberately addressed as a major part of any reform movement if we are to be successful in preparing *all* children for full participation in the workforce of the information age.

The elementary schools in the *MSM: K-6 Project* have utilized research findings to develop their own reform programs which were specifically tailored for their teachers, students, and resources. Although the programs differ from school to school, they all represent sustained efforts to put theory into practice. Upon reflecting on the national crisis in mathematics and science education, it is significant that these educators deliberately sought to build their mathematics and science reforms on instructional practices which would enhance African American and Hispanic students' participation in these traditionally "exclusive" disciplines. **These educators held a philosophical position that minority students can and must succeed in their mathematics and science classes.**

B. How the Project Began

In 1985, MAEC initiated the *MSM: K-6 Project*. The project represented a collaborative effort to develop a practical response to the pressing need to increase the participation and performance of underrepresented African American and Hispanic students in mathematics and science. The focus was on the elementary school level where many of the requisite attitudes and skills are acquired for future success. MAEC brought together three school districts (the District of Columbia Public Schools; Montgomery County Public Schools, Maryland; and Prince George's County Public Schools, Maryland), in the fall of 1985. Together they worked cooperatively to develop an intervention model which would assist teachers in recognizing and addressing the math-

ematics and science instructional needs of African American and Hispanic students. The programmatic elements of this model were guided by the research findings described in MAEC's publication *Mathematics and Science: Critical Filters for the Future of Minority Students* (Beane, 1985).

The model was conceptualized in late spring of 1985 by MAEC, and the *MSM: K-6 Project* Advisory Board, which consisted largely of representatives from the three school districts. As the school districts worked with the model, they maintained its core components, supplemented by the districts' own mathematics and science curricula. However, the model began to serve as more of a catalyst, inspiring participants from twenty schools to create a flexible framework for instructional improvement. The participants assessed their own school programs and shared an expressed need to: increase African American and Hispanic student interest in mathematics and science; replace the lecture/pencil/paper approach to mathematics with hands-on experiences, which enhance conceptual understanding; encourage students to work together rather than individually; and offer more opportunities to engage students in science and mathematics related activities.

C. Obstacles to be Surmounted

Throughout the course of the four year project, obstacles and challenges were identified by the project steering committee. While none of the participating schools demonstrated all of these conditions, collectively, these challenges included:

- The persistent conviction of many teachers that the deficiencies are rooted in African American and Hispanic children, their cultures and/or poverty, and not in the school climate, traditional curriculum, instructional practices, or teachers' expectations.
- Teachers' insecurities about their own college preparation in science and mathematics.
- Participants' perceptions of insufficient school district support for the project.
- A principal with high science and mathematics anxiety.
- Yearly changes in the membership of the school-based leadership teams.

- Little or no time for the teams to meet.
- No structured opportunities in some schools for project participants to share instructional strategies with non-participants.
- No funds, in many schools, for the purchasing of hands-on materials or for additional training.
- Difficulties in coordinating the project's staff development schedule with the calendars of three school districts.
- Designing a staff development program which supported project outcomes *and* satisfied widely varying perceived participant needs.

Nonetheless, these committed teams found ways of surmounting these obstacles, and they have been rewarded for their efforts. Those schools which have continued to work in concert with the project's core components now proudly point to changes in instruction, attitudes, and learning behaviors. They now report greater student interest and motivation in mathematics and science, higher scores on standardized tests, increased participation in science and mathematics fairs and competitions, greater parent involvement, reduced teacher anxiety about science and mathematics, and a greater spirit of collaboration among staff members. In **Part II: Our Schools Did It, So Can Yours!** (pages 17 through 34), principals, teachers, and counselors will tell you, in their own words, what this project meant to them and their schools.

D. Project Components

Let us begin by outlining, in chart form, the key components of this project. They include:

Chart I: **Research Base**

Chart II: ***MSM: K-6 Project* Organizational Structure**

Chart III: **District Level Organizational Structures**

Chart IV: **Administrative Support**

Chart V: **Diversified Instruction and Curriculum**

Chart VI: **Examples of Outcomes for Various Schools**

Prior to the development and implementation of the *MSM: K-6 Project*, the MAEC conducted research exploring the factors that contribute to minority student academic performance, particularly in mathematics and science. The affective, cognitive, and classroom factors that the research has demonstrated to be the most vital to increasing and maintaining minority student achievement on the next page.

Chart I

Research Base

- **Attitudes:** Minority students have positive attitudes toward mathematics and science beginning in the early grades developing through the seventh grade. Unfortunately, these positive attitudes frequently do not result in high academic achievement in these disciplines.
- **Persistence:** Those students who are unsuccessful in mathematics and science have not developed the ability to persist. Having the ability to persist in the face of conflict is essentially related to a positive self-concept.
- **Stereotyping:** Many teachers, both majority and minority, as well as many minority students, tend to stereotype mathematics and science as White male domains.
- **Utility:** Minority students are less likely to understand how the study of mathematics and science is applicable to everyday life, as well as valuable to their future schooling and jobs.
- **Influence of Significant Others:** Teachers, counselors, parents, and peers have a role in shaping students' participation in mathematics and science. Without this guidance, students have a more difficult time achieving in the classroom.
- **Previous Experiences:** Minority students tend to perform best when the content is related to their previous experiences; frequently, curriculum does not relate to their experiences.
- **Academic Deficiencies:** Achievement test performances by minority students indicate growing competency in basic skills, but weakness in understanding and applying concepts.
- **Language:** Limited English-proficient minority students encounter limitations in English-speaking mathematics and science classrooms, and on achievement tests.
- **Misuse of Testing and Test Data:** The use of standardized test data to predict achievement and to assess ability is detrimental to minority students.
- **Learning Styles:** Instructional strategies frequently do not complement the learning styles of many minority students.
- **Teacher Expectations:** Educators often perceive minorities as having inferior ability. This perception translates into an expectation of low achievement, which is communicated to and internalized by the minority student.
- **Teacher Anxiety:** Teachers who do not have positive attitudes about mathematics are likely to provide inadequate instruction; additionally, they are poor models for mathematical competency and interest.
- **Instructional Practices:** A number of instructional practices have been associated with underachievement in minority students.

(See Appendix I for a detailed explanation on the implications for intervention.)

Source: Beane, DeAnna Banks. *Mathematics and Science: Critical Filters for the Future of Minority Students.* The Mid-Atlantic Equity Center, The American University, 1985, reprinted 1988.

The effectiveness of the *MSM: K-6 Project* was facilitated by the organizational structure that was developed. The **Advisory Board**, composed of representatives from the three school districts and MAEC staff, conceptualized the *MSM: K-6 Project* Intervention Model.

The **Steering Committee**, staffed by curriculum and staff development specialists from the three participating school districts and MAEC, developed project goals, designed workshops, coordinated school district activities, and monitored and evaluated project progress.

Each participating school formed **school-based teams** made up of principals, classroom teachers, guidance counselors, and mathematics and science resource specialists. These teams participated in training and designing individual school improvement plans.

Though the organizational structure just described may seem at first glance to be "top-down," this framework actually served more as a catalyst where all participants provided their input to the development process, and consequently to the success of the project. The three school districts and 20 schools benefited from sharing their successful strategies.

Chart II

MSM: K-6 Project Organizational Structure

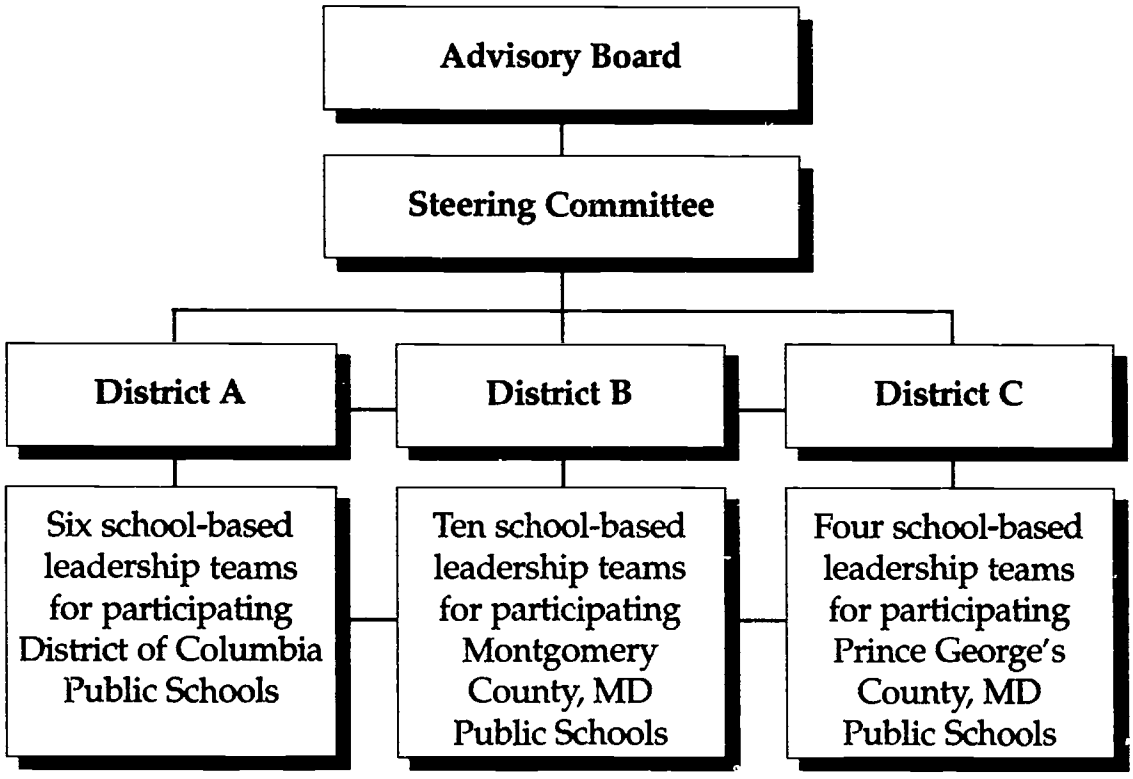


Chart III

District Level Organizational Structures

This chart, describing district level organizational structures, demonstrates the commonalities as well as the differences among the three participating school districts.

	District of Columbia (DCPS)	**Montgomery County (MCPS)**	**Prince George's County (PGCPS)**
Student Demographics	81,301 students (1989-90) 90.73% African American 4.63% Hispanic	100,259 students (1989-1990) 16.6% African American 8.2% Hispanic	105,595 students (1989-1990) 64.5% African American 3% Hispanic
District Level Management Office	Office of Curriculum and Instruction Schools were selected	Quality Integrated Education (QIE) Schools were selected	Department of Curriculum and Instruction Schools volunteered
District Coordination	Assistant Directors of Curriculum and Instruction for Science and Mathematics	Teacher Specialist from Quality Integrated Education Department	Assistant Director of Curriculum and Instruction
School-Based Leadership Teams	Principal, 1 or 2 primary teachers, 1 or 2 intermediate teachers, guidance counselor (mathematics and/or science resource teacher)	Principal, 1 or 2 primary teachers, 1 or 2 intermediate teachers, (guidance counselor)	Principal, 1 or 2 primary teachers, 1 or 2 intermediate teachers (guidance counselor)
Team Leaders	Principal or Resource Teacher	Principal or Teacher	Principal
Focus of Instructional Interventions and Support	Planning and implementation at school and classroom levels monitored by assistant directors of science and mathematics	Planning and implementation at school and classroom levels monitored by principals, elementary supervisors and Quality Integrated Education staff	Planning and implementation at school and classroom levels monitored by principals
Sources of Funding for Local Implementation	MAEC and Title II	MAEC, Quality Integrated Education Office, and Office of Instruction and Program Development	MAEC and Department of Curriculum and Instruction

Chart IV

Administrative Support

This chart lists some of the critical administrative elements which contributed to the success of the *MSM: K-6 Project.*

- Collaboration between districts and among schools.
- Securing local support and funding.
- Development of School-Based Management Teams.
- Targeted School Intervention Plans focusing on Mathematics and Science.
- Participation in Comprehensive Staff Development.
- Faculty, peer, and principal classroom observations and feedback.
- Implementation of School Intervention Plans.
- Evaluation of Outcomes.

Chart V

Diversified Instruction and Curriculum

Lectures, textbooks, tracking, and Eurocentrism have traditionally been some of the cornerstones of classroom education in our country. Cognizant of this reality, we felt compelled and challenged to incorporate new methodologies and approaches to mathematics and science education. This chart includes some of the instructional and curriculum strategies that were implemented.

- Multicultural Curriculum.
- Interdisciplinary Curriculum and Instruction.
- Heterogeneous Grouping.
- Cooperative Instruction.
- Experiential Learning and/or Hands-on Materials.
- Peer Coaching (Students and Teachers).
- Bilingual Instruction.*
- Sheltered English.*

*Recommended but not included in original project.

While not a critical component of the project, this chart summarizes a variety of results reported by the 20 participating schools.

Chart VI

Examples of Outcomes for Various Schools

I. School Organization:

- Fully functioning school-based leadership teams for mathematics and science.
- Fully equipped science labs.
- Organized systems for acquiring, distributing, and storing mathematics and science materials.

II. Staff Development:

- Mathematics and science in-service activities conducted by school-based leadership teams.
- Mathematics manipulatives purchased for project elementary schools.
- Understanding factors influencing minority student achievement in mathematics and science lessons.

III. Staff Support:

- Principals observing mathematics and science lessons.
- Teachers observing and assisting each other in the use of cooperative learning strategies in mathematics and science lessons.
- Guidance counselors interacting with minority students, as well as other guidance counselors whose schools were not in the project.

IV. Curriculum and Instruction:

- Activity-based science lessons.
- Use of manipulatives in mathematics lessons.
- Special mathematics and science programs for 6th grade urban minority boys.
- Diversity in learning styles considered in planning mathematics and science lessons.
- Mathematics and science field trips.

Continued on next page

Chart VI (continued)

Examples of Outcomes for Various Schools

- Peer tutoring and cooperative learning utilized in mathematics and science classes.
- Science fairs and clubs.
- Mathematics and science career days.
- Bilingual instruction.
- Sheltered English.

V. Support for Students and Their Families:

- Guidance counselors collaborating with teachers in mathematics and science support activities with students.
- Family mathematics and family science projects and classes.
- Science project preparation workshops for parents.
- After school and Saturday science and mathematics programs.

VI. Increased Parent Involvement:

- Parent participation in career days.
- Parent participation in homework.
- Family Math and Family Science.

VII. Increased Student Participation and Performance in Mathematics and Science:

- Demonstrated achievement in mathematics and science.
- Increased minority participation in science fairs.
- Increased minority participation in mathematics and science extracurricular activities.
- Increased minority participation in independent projects and field trips.
- Increased minority participation in classroom activities in mathematics and science.
- Increased performance in mathematics on standardized tests.

PART II:
OUR SCHOOLS DID IT, SO CAN YOURS!

PROJECT PARTICIPANTS TELL THEIR STORIES

A. Teachers Tell Their Story: *Whetstone Elementary School (Montgomery County, Maryland)*

B. Teachers Tell Their Story: *Simon Elementary School (Washington, D.C.)*

C. A Principal's Reflection: *Hillcrest Heights Elementary School (Prince George's County, Maryland)*

D. Guidance Counselors Tell Their Story: *(Prince George's County, Maryland)*

A. Teachers Tell Their Story: *Whetstone Elementary School (Montgomery County, Maryland)*

Our Students

Whetstone Elementary School, located in Montgomery Village, serves a diverse community in the northern section of Montgomery County, Maryland, and has a population which reflects all of the changes that are characteristic of our society today. Every socioeconomic group is represented, from children living in federally subsidized apartments to those in spacious, affluent single family homes. Many children come from single parent families, while others have both parents working. Minority students are primarily African American, Hispanic, and Asian.

Whetstone, however, has not always had such a diverse population. During the late 1970s and the early 1980s the demographics were much more homogeneous. With the continual changes in its family and student population, the need for a new emphasis in education for the variety of racial and ethnic groups became apparent. MAEC's *MSM: K-6 Project* became an important, integral part of helping Whetstone refashion attitudes, programs, and instructional techniques which addressed the needs of the changing population.

Population changes in grades 3-6 at Whetstone during the *MSM: K-6 Project* were as follows:

	June 1985		*June 1989*	
White	262	87%	275	72%
African American	22	7%	55	14%
Hispanic	7	2%	30	8%
Native American	0	0%	1	1%
Asian	11	4%	20	5%
Total	302	100%	381	100%

According to the Criterion Referenced Test Scores (CRTS) administered in 1985 in mathematics for grades 3-6, minority students' test scores were significantly lower than majority students' in mathematics.

Most instruction in mathematics and science was conducted with textbooks, paper, pencil, and some kits. Within each grade level, science experiments were regularly carried out by only a few teachers who were comfortable with "hands-on" materials. In 1985, some teachers were not

comfortable with the new mathematics program, the noise of hands-on activities, or the use of manipulatives to teach the mathematics curriculum objectives.

Our School-Based Leadership Team

Whetstone's principal arranged for the Whetstone Team to be involved in the *MSM: K-6 Project* in the fall of 1985. She worked diligently with the team until she was selected to open a new school three years later. Stability of our school-based leadership team was shaken frequently by changes such as personnel transfers to other schools, position changes within Whetstone, retirement, and changes in administration. Of the six people involved in the first year school-based leadership team, only one was with the team for the four year duration of the project. Over the course of four years, a total of sixteen people served on our team, but never more than six at one time.

Despite frequent personnel changes; however, there was a core of team members who were able to consistently carry out the objectives of the *MSM: K-6 Project*. Vacated roles were filled with a new enthusiasm, allowing the team to function aggressively and productively. We were never without a coordinator to attend regularly scheduled monthly meetings, as well as any additional meetings that came up.

As we moved through the project, our principal ensured that funds were provided for the acquisition of mathematics and science materials. She introduced a Comprehensive School Mathematics Program to our primary grades and encouraged staff members to participate in events and activities such as: *Invent America!*, *Family Math*, *ASK*, and *Creating Opportunities*. She secured the services of an area specialist to organize our science materials and their warehousing. The assistant principal chaired our *MSM: K-6 Project* school-based leadership team for the first two years, managing, organizing, and inspiring its great suc ss. This project became a primary focus of our school-wide objectives.

Each team member assumed specific duties of a given project which had been planned by the entire team, such as staff in-services, grade level contacts, resource distribution, etc. (See page 48 for a list of descriptions characterizing our team.)

Our Implementation Activities

During our first year in the *MSM: K-6 Project*, we focused our intervention activities on the learning styles and the academic deficien-

cies of our students, as well as on our own anxiety about science and mathematics. Through in-service sessions, we focused on the importance of recognizing and accommodating differences in learning styles among students. In other sessions, we worked with manipulatives appropriate for our mathematics problem solving objectives and practiced hands-on science activities.

In the second year, we concentrated on increasing the use of mathematics and science activity based lessons with our students. We also worked to expand our repertoire of strategies to increase student participation and student persistence. Mathematics and science specialists from the school district's area office provided in-class demonstration lessons using manipulative materials for mathematics and hands-on activities for science. All teachers on the team used the mathematics and science manipulatives in lessons provided by the *MSM: K-6 Project* workshops.

Cooperative learning and problem solving strategies were the themes of our project intervention plans for year three. Project teachers began to share information with non-project colleagues so that teachers could benefit from the cooperative learning techniques presented at the *MSM: K-6 Project* workshops that year. The entire Whetstone staff tried out our new problem solving strategies and instructional techniques recommended to meet learning style differences. The *Family Math* program was also launched that year, with special efforts used to involve minority families.

In the 1988-89 school year, our team really lived up to its name by providing in-services and demonstration lessons for the entire staff. In addition, during back-to-school night it presented activities to increase parents' awareness of the importance of excellence in mathematics and science.

All team members used and shared activities from *MSM: K-6 Project* meetings. Some staff members became immediate believers and tried activities quickly, while others asked for more information and guidance. The entire fourth grade team of three made their combined yearly objectives from 1987-89 one of using a hands-on process approach in both mathematics and science. They planned activities together and shared all materials so that each fourth grader could have the same opportunity. The demonstration lessons presented at in-services or in classes always included cooperative learning, manipulatives, varying teaching styles, and were always designed to fulfill one, or more, of the MCPS curriculum objectives.

The guidance counselor (also a team member) organized group counseling to improve risk-taking and self-concepts in students. Pre- and post-attitudinal surveys were conducted with Whetstone students and the entire staff was surveyed to determine the impact of *MSM: K-6 Project* in the classroom.

Our Outcomes

Whetstone Elementary School has benefitted greatly from its participation in the *MSM: K-6 Project*. The entire staff has taken an active role in implementing the strategies suggested by the school-based leadership team. The faculty has experienced both success and failure; yet, has learned that persistence does bring results. As a result of the risks taken by our staff, we now have information which may guide us into making even better choices as we try to meet the needs of all students.

Even though membership of the school-based leadership team has changed yearly, the participating members have continued to work together in a cohesive manner relying on each other and the information gathered during the project. The school-based leadership team has provided in-services, acted as a resource bank, and been instrumental in organizing and managing the science and mathematics material.

Changes in Teachers and Teaching Behaviors

- All of the following cooperative learning strategies presented at the *MSM: K-6* workshops are now being used by individual Whetstone teachers with their classes:
  1. Group Problem Solving
  2. Jigsaw
  3. Learning Buddies
  4. Numbered Heads
  5. Pairs and Homework
  6. Peer Practice
  7. Round Robin
  8. Roundtable
  9. Think-Pair-Share
  10. Turn to Your Neighbor

- Whetstone teachers listed the following manipulatives they now use as a result of the four years of in-services, workshops, and demonstration lessons:
  1. Attribute Blocks
  2. Attribute Hoops
  3. Calculators
  4. Compasses
  5. Cuisenaire Rods
  6. DeSean Blocks
  7. Fraction Factory
  8. Fraction Tiles
  9. Geo-boards
  10. Many new uses of scissors and papers
  11. Meter Sticks
  12. Pattern Blocks
  13. Pentominoes
  14. Protractors
  15. Scales-Weights-Balance
  16. Tangrams
  17. Unifix Cubes

- All teachers, for instruction in all subject areas, are regularly using the following instructional strategies in all subject areas: whole group, small groups, groups of four, pairs, individual tasks, lecture, discovery and/or inquiry, visual, and audio activities.
- Many staff members have increased their participation in university and in-service courses to enhance their knowledge of current issues and procedures in mathematics and science, as well as learning styles and cooperative learning.
- A number of Whetstone teachers have become school district mathematics and science curriculum writers and leaders of in-service courses in science, cooperative learning, and gender equity.

Changes in Student Performance

Whetstone's 1988-89 CRTS mathematics scores were reviewed and analyzed. Minority achievement outcomes were encouraging with total score increases over the 1987-88 tests, especially in the problem solving area. The following are test scores of eight students who made the most dramatic gains over a one-year period:

	Percentile 1987-1988	*Percentile 1988-1989*
1. African American Male	17	30
2. African American Male	17	42
3. African American Male	17	54
4. African American Female	30	42
5. African American Female	30	50
6. Hispanic Male	42	86
7. Hispanic Female	54	99
8. African American Male	74	99

The increases are significant and speak to persistence and attitudinal changes among students, as well as an increased instructional emphasis on the "process" involved in problem solving and the importance of mathematics to the students' daily lives.

The students are now more actively involved in cooperative learning, using manipulatives, and enjoying science and mathematics classes

due to the staff at Whetstone having embraced the philosophy espoused by the *MSM: K-6 Project*. Activities provided by the school-based leadership team have added to the creation of a more open sharing attitude among all staff members. The faculty can be heard organizing their classrooms. The energy that has come from this project has revitalized our entire school; and each professional at Whetstone is excited about trying updated techniques, becoming a risk-taker, and using what they have learned with their students. Students are now ***doing***, not just reading in a vicarious manner. Boys and girls are feeling good about each other, enjoying cooperative group work, and finding many ways to solve problems. They are finding their own styles for learning from the guidance of a staff, who is thankful for being chosen to participate in such a worthwhile project. Thank you, Montgomery County Public Schools, for allowing us a chance to learn, improve, and be proud of what we at Whetstone are doing for all our students. Thank you, Mid-Atlantic Equity Center, for giving the Whetstone team this opportunity to share its experience with the larger educational community.

B. Teachers Tell Their Story: *Simon Elementary School (Washington, D.C.)*

Simon Elementary School, located in the far southeast corner of Washington, D.C., serves students, 99% of whom are African American and come from lower income families. Prior to our involvement with the *MSM: K-6 Project*, our mathematics and science program was similar to many others:

- Students and teachers exhibited little interest in science.
- Classroom teachers, uncomfortable with teaching science, left most of the science instruction to the science resource teacher.
- Lectures and textbooks were the common forms of classroom instruction.
- Total responsibility for leadership and training in mathematics and science fell to the mathematics and science resource teachers, who faced an uphill struggle with little support.
- Student achievement on standardized tests in mathematics and science was low.
- Students did the required mathematics and science assignments, but demonstrated no motivation to go beyond the minimum.

Our Vision

The Simon *MSM: K-6 Project* school-based leadership team entered the *MSM: K-6 Project* hoping that our participation would eventually increase student and teacher interest in science and mathematics. As a team of six (and later eight) elementary educators, we *clearly* recognized the need for this project and were motivated by the school-wide outcome we envisioned.

Our Growth

From the *MSM: K-6 Project* awareness conference and early interdistrict workshops, we began to understand the cognitive and affective factors which our team needed to deal with if we wanted Simon students involved and successful in science and mathematics courses and careers. Since we were allowed to identify and concentrate on areas which we felt represented our greatest problems, we were able to develop an intervention plan which could be supported by the principal, our co-workers, and by the school district science and mathematics supervisors. We identified target groups and clearly defined our short- and long-term objectives. The principal arranged release time for us to attend the project's workshops, provided coverage for our classes, coordinated communication efforts, helped parents understand our project, and usually attended the project workshops with us. After the third year in the project, a new and equally supportive principal was assigned to our school.

As we participated in the *MSM: K-6 Project* workshops with teachers from other school districts, we began to share solutions to common problems, and embrace new methodologies in teaching mathematics and science. We felt confident in bringing our newly acquired information and instructional approaches back to other Simon teachers. With assistance from our school district's assistant directors of mathematics and science, we were constantly trying to phase in new approaches such as hands-on science lessons, mathematics using manipulatives, peer tutoring, and cooperative learning. We also encouraged non-team teachers to try some of these strategies and provided assistance whenever we could. Especially helpful in introducing these new approaches to non-team teachers, were the science and mathematics resource teachers and the guidance counselor, all of whom were a part of our *MSM: K-6 Project* school-based leadership team. In fact, the guidance counselor was our team leader for the early phases of the project. (Later, we began to rotate team leadership annually). Similar to counselors in other *MSM: K-6*

Project schools, our counselor developed career awareness activities for students and activities designed to foster new attitudes about the usefulness of science and mathematics in the workplace. Through parent workshops, we worked together to help parents become more aware of the importance of cultivating and maintaining children's interest and skills in mathematics and science.

Our team functioned well and became a major force of support, not only for improvements in mathematics and science, but for all areas of the school's program. We found ourselves more willing to assist in any school activity and were genuinely supportive of each other.

Our Results

The payoff for our team has been the opportunity to witness the realization of our vision of Simon as a school with high levels of interest and activity in science and mathematics.

- As teachers, our attitudes toward science and mathematics are more positive.
- We are eager to teach science and mathematics because we feel more at ease with the material.
- We have become more competent in a variety of instructional practices, including cooperative learning, team teaching, peer tutoring, and activity-based learning.
- We use manipulatives in our mathematics lessons.
- We provide our students with hands-on lab activities in science.
- Mathematics and science often provide the content for communication lessons which focus on writing and speaking skills.
- Some teachers are taking additional science courses to increase their understanding in science.
- We are proud to have had other teachers voluntarily join us in this effort.
- Instruction has become more individualized.
- We use peer tutoring and often pair low achieving students with their high achieving peers.

Most importantly

- Our standardized test scores in mathematics and science have improved, especially in grades three and six.
- Science fair participation has increased by 100%.
- Our students now talk about going to college and becoming scientists.

Perhaps one of the most innovative outcomes has been the special mathematics and science program which we developed for the sixth grade boys at Simon. This program is designed to help our boys change their attitudes about themselves and about school. Through the additional academic support and field trip encounters with positive African American role models, we hope to develop aspiring scientists. Several students in this special program have developed award winning projects, and one has been able to continue his investigations with the help of research scientists at the National Institute of Health.

Our New Goals for Simon

Now that we have a high level of interest in science and mathematics at Simon, our team has expanded its vision to include:

- Restructuring science and mathematics curricula to be consistently integrated with other disciplines.
- Establishment of a Mathematics and Science Center at Simon, complete with state-of-the-art equipment and curriculum materials.
- Recognition by the community that Simon is the school to send your child if you want him or her to excel in science.

C. A Principal's Reflection: *Hillcrest Heights Elementary School (Prince George's County, Maryland)*

During the summer of 1985, Hillcrest Heights was identified as a Comer Process school, utilizing the program developed by Dr. James Comer of Yale University. In addition, it was part of the Effective School Process, under the consultantship of Dr. Lawrence Lezzotte, which all Prince George's County Public Schools were undertaking to assure quality education and equal opportunity for each student. At the same time, Hillcrest Heights was given a chance to participate in the *MSM:*

K-6 Project sponsored by MAEC at The American University. As principal of Hillcrest Heights, it was my decision to accept the invitation to join the four year program aimed at improving the delivery of mathematics and science education to minority populations. Our school had a 95% minority student population, and the staff and I were already interested in strengthening the delivery of the curriculum for our students, especially in mathematics and science.

Interestingly enough, the undertaking of these three major projects blended well together. The Comer Process produced an umbrella effect drawing together various elements of community, social and developmental influences to enhance the students' self-esteem, and the Effective School Process. Together, these programs empowered the staff, parents, and community members to identify the needs and desired outcomes for our students. Using disaggregated data to direct strategies for improvement, the *MSM: K-6 Project* gave a broad spectrum of background research into mathematics and science learning, African American cultural history, interactional styles, and learning preferences.

There were several factors of major importance which contributed to these three projects working so well together. Most important, was the underlying premise that all students are avid learners and that it is the school's responsibility, through its curriculum, to capitalize on this natural developmental learning process. Each of the three projects utilized the available information about the student population to identify pathways for achieving the desired outcomes.

The Comer Process relies heavily on adult interaction and role modeling, getting active involvement of parents and community members in the educational process, while the educational staff uses the developmental growth of each student to help them reach for maximum potential. Dr. Lawrence Lezzotte and the Effective School Process is data driven. Collectable data for the individual student and the school/school system is disaggregated to compile a graphic picture from which school base goals with measurable outcomes can be jointly arrived at by staff, parents, and community members through consensus. Finally, through the *MSM: K-6 Project*, we implemented a school team approach in which the principal and school counselor had to be committed members, along with teachers who taught mathematics and science at the primary and intermediate levels. This team, then meeting with other teams from the tri-district project area – Washington, D.C., Prince George's County, and Montgomery County – received regular in-services on the

following topics during the three year period: learning styles, persistence, academic deficiencies, teacher expectations, and teacher anxiety. Within these topics, the importance of cooperative learning, hands-on experiences, peer coaching, and teacher observational feedback produced a network for improving the delivery of instruction. This information and experience, gained first-hand by members of the *MSM: K-6 Project* mathematics and science team, was then returned to the individual schools and shared with the staff to the benefit of all students.

Hillcrest Heights Elementary School found its involvement in these three major projects very rewarding. Our four year involvement in *MSM: K-6 Project* with MAEC has made it possible for Hillcrest Heights to move from "textbook science" to "hands-on science." Our activity-based science program incorporates strong study skills and emphasizes the application of mathematics skills. The *MSM: K-6 Project* team has taken the leadership in establishing a complete science lab with science tables, microscopes, science kits, glassware, batteries, etc.

The Hillcrest Heights Science Fair Day program, another positive spin-off of *MSM: K-6 Project*, has evolved from a few science projects in individual classrooms (1985), to an exciting school-wide event with science lessons taught by students, as well as staff and community members. Every student is invited (and expected) to participate. Each year we organize a parents' meeting to increase their awareness of things which can help their children with their science projects. Once the students have completed their projects, they must give a presentation to their peers explaining the project, what they learned, and the scientific principles involved. All students set up their projects in the exhibition room, where they remain on display for parents to view that evening. Then, each class chooses the top five projects to represent them in the school science fair, which is judged by adult volunteers from the community. What do our science fairs tell us about participation in science? The 370 projects in 1989-90 represented a 64% increase over the 240 projects in our first science fair three years earlier. Not only are Hillcrest Heights students more involved in science, but the teachers and parents are too.

Our staff is also encouraged by the academic growth as exemplified by our third graders' twenty percentile point increase and our fifth graders' twenty three percentile point increase in mathematics on the California Achievement Test (CAT). Perhaps the most important reward of our involvement has been the way teaching techniques, so critical to minority students' accelerated learning, have become part of our daily routine.

D. Guidance Counselors Tell Their Story: *(Prince George's County, Maryland)*

Our roles were varied, as were the roles of the other participants; from the onset, the teams' perceptions of our roles varied, as well. Teams were selected in the fall of 1985 when the scope of the project was somewhat vague. Our response to the "opportunity" of being participants in the project could be plotted on a continuum.

- *"What do I have to do with mathematics and science?"*
- *"I'm overloaded already . . .six meetings a year!!"*
- *"Another project."*
- *"Wait and see."*
- *"Cooperative learning needs to be facilitated."*
- *"There is an acute shortage of minority professionals in mathematics and science related curriculum opportunities and professions. This has been addressed in a shotgun fashion."*
- *"Maybe this will get at the root of the problem and help."*

Prior to our first team meeting, we were familiar and comfortable with our traditional roles of: individual and small group counseling, classroom guidance lessons, parent outreach, consultants to parents and staff, student advocacy, developing social skills, and gate keeper for students' options.

Our first team meeting in October 1985 gave specifics on the scope of the project. Again, our responses and our team members' responses varied, but there could be no denial of the problem and its relevance to us as educators. The *Startling Statements* activity gave us some of the parameters of the challenge. *Mathematics and Science: Critical Filters for the Future*, (Beane, 1985) illustrated the cognitive and affective domains which needed to be explored. The issue of relevance began to shift away from "Why?" to "How?" and "Where do I best fit in?"

Teams were left with assignments for the next meeting(s) and the task of team building was launched. Team leadership varied. In some schools, principals led; in others, principals designated leaders; and in others, team consensus mechanisms emerged, but again, our roles varied.

We wore many hats, and in most cases, we were participants. In some cases, the role of facilitator emerged for us. At times, we wore the hat of leadership, directly or indirectly.

The format of periodic team meetings set the stage for a systematic approach to the problem of creating greater involvement and success in mathematics and science. Barriers were inevitable and were considered by each team.

Barriers included:

- Mathematics and science anxiety and the attitude of the staff.
- Finding and creating time for meetings.
- Effective inclusion of total staff project goals.
- Resistance to change - such as the tendency for stereotyping and the predominant auditory vocal learning style.
- Resistance to the concept of counselor as a viable instructional leader.

Challenges included:

- Mainstreaming the affective focus as a component of the team plan.
- Affirming and developing a broadened role as risk takers and change agents.
- Facilitating team building and finding an appropriate niche, which would have the flexibility to change as the team grew.
- Maintaining a positive outlook and commitment to project goals amidst competing priorities.

The following summarizes some of the counseling related components with the *MSM: K-6 Project*.

Outcomes

At the end of this project, we were able to describe a wide range of positive outcomes for our students, our schools, and ourselves. One of the most interesting changes was the way that our roles were perceived in the schools. Some of us are now perceived as true leaders for change within our schools; others of us are perceived as facilitators and support-

ers of change. Collectively, we feel we have crafted images which portray counselors as empowered advocates for change related to mathematics, science, and minority students.

Curricular Outcomes

The curriculum for guidance was broadened by the inclusion of the factors related to mathematics, science, and minorities. These topics included:

- Locus of control.
- Learning styles.
- Persistence.
- Academic self-esteem.
- Critical thinking skills, etc.

Cooperative learning became another tool for delivering the guidance curriculum. By using this tool, we were able to focus on the social skills which are crucial in setting up cooperative classrooms.

The typical career day activities expanded and included focus on the use of minority role models, goal setting activities, and other activities designed to process career day.

We often used small groups in which mathematics and science activities became the focus. Through these activities, minority students were encouraged to become involved with science and mathematics fairs.

Personal Development Outcomes

As we expanded our ways of delivering our guidance curriculum, we were able to achieve personal growth through the following activities:

- Providing staff development activities for the local schools.
- Providing staff development for district counselors (elementary and secondary).
- Serving as resources for new staff members.
- Serving as advocates for the placement of minority students in higher level mathematics and science classes.

Student Outcomes

While no formalized methods for evaluating student outcomes were utilized, we were able to report positive changes for students including:

- Improved social skills resulting from student participation in cooperative learning and other group activities.
- Reduced anxiety in mathematics, with some students who previously showed little affinity for mathematics citing it as their favorite subject.
- Increased use of problem solving strategies.
- Increased use of mathematics and science vocabulary in other subjects.

Systemic Changes

We were able to take what we learned in the *MSM: K-6 Project* not only to our individual schools, but back to the other elementary counselors in our system.

Outcomes resulting from our participation in the *MSM: K-6 Project* included:

- Counselors providing in-service training to other elementary counselors in the system on the major components of the project.
- Guidance supervisors incorporating *MSM: K-6 Project* components into the expected workload of elementary counselors.
- Project participants sharing materials utilized in the project with other schools.
- Opportunities for parental involvement to increase mathematics and science learning as part of school plans.
- In-services on mathematics and science for elementary and middle school counselors.
- Specific mathematics and science programs for a selected number of sixth grade students.
- Counselors becoming "advocates and risk takers" by requesting higher placement for minority students in higher mathematics (pre-algebra) classes.

Conclusion

The *MSM: K-6 Project* afforded us the opportunity, over time, to develop awareness, skills, and a framework for using our traditional "counseling skills" more effectively to foster increased participation of minority students in mathematics and science. We emerged with a more defined sense of how we could serve as pro-active school team members, instrumental in changing the academic climate and horizons of choice for minority children in the areas of mathematics and science. We became personally involved in the cognitive aspect of learning these subjects, confronting issues of equity, high expectations, and diversity of learning styles. Our new focus was how these issues, in reality, must be addressed in schools and classrooms, particularly crucial at the elementary level.

PART III:
A NINE STEP GUIDE TO INCREASING MINORITY PARTICIPATION IN MATHEMATICS AND SCIENCE
THE IMPLEMENTATION PROCESS

The Implementation Process

The following section describes the Nine Steps which can guide any school or school district committed to replicating or adapting the *MSM: K-6 Project* model. Each step contains a **Project History** describing the evolution of the project, an **Action Plan** outlining specific strategies to implement, and a **Points to Remember** highlighting the significant items learned during the four year process.

STEP I **Is There Something Wrong Here?**
Determine the Nature of the Problem

STEP II **How Do We Get Started?**
Organize a Steering Committee (Planning Group) to Guide the Efforts to Change

STEP III **What Are Our Priorities?**
Develop Project Goals

STEP IV **Who Will Direct Our School's Efforts?**
Identify Participating Schools and Form School-Based Leadership Teams

STEP V **How Do We Plan for Change?**
Develop Intervention Plans

STEP VI **How Do We Gain the Skills We Need to Implement Our Plan?**
Design and Implement a Comprehensive Staff Development Program

STEP VII **How Do We Begin the Change Process?**
Design and Implement a School-Based Intervention Plan

STEP VIII **How Do We Share Our Successes?**
Disseminate and Institutionalize

STEP IX **How Are We Doing?**
EVALUATE! EVALUATE!

STEP I: Is There Something Wrong Here?

Determine the Nature of the Problem

Project History

The three school districts involved in this project–the District of Columbia Public Schools, Montgomery County Public Schools, and Prince George's County Public Schools–were all keenly aware of the data on their minority students. Separately, these districts had reviewed the performance of African American and Hispanic students on local, state, and national assessment instruments. While exceptions existed in all three districts, on a whole, these students scored significantly lower than their White and Asian classmates in mathematics. The same was true for science achievement for the district in which it was tested. MAEC staff, having provided previous technical assistance to each of these districts as they explored achievement-linked issues such as teacher expectations, school climate, and grouping practices, was familiar with the differences in student performance.

The districts recognized other indicators of African American and Hispanic students' underrepresentation in the school districts' science and mathematics programs: little involvement in science fairs and mathematics competitions; limited involvement in science-related extracurricular activities; and insufficient enrollment in advanced levels of mathematics and science in high school.

While intervention strategies may have been implemented in some secondary schools, it was decided that effective intervention in this case had to begin during the K-6 years.

The experiences of the science and mathematics supervisors in all three school districts pointed to a serious need in assisting elementary teachers to develop greater comfort and competency in science and mathematics instruction, particularly in the use of instructional strategies identified as effective for African American and Hispanic students. Teachers also needed assistance in recognizing and addressing the affective issues involved in instruction in mathematics and science.

Action Plan

Collect and analyze the following data:

- Participation in science fairs and mathematics competitions.

- Test scores and report card grades in mathematics and science.
- High school course enrollment data, especially for algebra I and II, geometry, pre-calculus, calculus, chemistry, and physics.

Points to Remember

- All data must be disaggregated by race and ethnicity, and within each of these categories data must be disaggregated by gender.
- The exact nature of the problem may differ from school to school. For each individual school, mathematics and science achievement data of African American and Hispanic students should be reviewed and compared with that of White and Asian students.
- It is often easier to "blame the victims" than it is to assess honestly our own attitudes and behaviors in the classroom.
- There may be a tendency to deny or minimize the problem, or to decide the problem is so large that it cannot be addressed.

STEP II: How Do We Get Started?

Organize a Steering Committee (Planning Group) to Guide the Efforts to Change

Project History

Interdistrict Collaboration and District Level Management:

In the summer of 1985, after several productive meetings of the Advisory Board, MAEC established a steering committee. The committee officially named this endeavor the *Mathematics, Science, and Minorities: K-6 Project*, better known to participants as *MSM: K-6 Project*. Since the inception of the project, the steering committee served as the guiding force in this effort to improve mathematics and science instruction in targeted public schools in the District of Columbia, Montgomery County, and Prince George's County. This committee, composed largely of curriculum supervisors and staff development specialists from these three districts, met regularly under the auspices of MAEC. Though the three school districts collaborated in their planning, each district managed this project as follows:

- *District of Columbia*

  In the District of Columbia, the assistant director of mathematics instruction and the assistant director of science instruction repre-

sented the District on the steering committee. Both assumed responsibility for project management in the District throughout the entire four year period.

- *Montgomery County, Maryland*

  For this project, the Montgomery County superintendent of schools delegated district level leadership responsibilities to the Office of Quality Integrated Education (QIE). A QIE teacher specialist with a concentration in science, and curriculum and instruction, represented the district on the steering committee, provided leadership in the district, and coordinated a district-level facilitating team for the project. This facilitating team was comprised of those with the authority and resources to make the project work in that district: science and mathematics coordinators; representatives from the Department of Staff Development; the Office of Gifted and Talented; and elementary supervisors from each of the three administrative areas. This local facilitating team provided guidance in planning project workshops, participated in the decision making process, and served as a central district conduit for communicating about the project. At the end of the fourth year, the facilitating team issued a formal recommendation to the superintendent that support for the process and activities of the *MSM: K-6 Project* be continued through formal inclusion in the district's budget. The document further recommended the inclusion of new schools which had requested to join the project during the preceding years.

- *Prince George's County, Maryland*

  MSM: K-6 Project leadership in Prince George's County began as a responsibility of a representative from the Staff Development Office. Subsequently, it was shifted to the Department of Curriculum and Instruction, a move designed to increase the involvement of supervisors of mathematics and science. The district's representatives on the Steering Committee, the assistant to the director of curriculum and instruction, and a staff development specialist, became the liaison among the Steering Committee, the curriculum supervisors, the Office of Staff Development, and the school-based leadership teams.

Action Plan

Establish a steering committee composed of representatives of a school, a school district, or a number of school districts. The composition of the committee depends upon whether or not the project is for one school, several schools, or several school districts.

Ensure that the steering committee will be responsible for:

- Developing the overall goals for the project.
- Determining project policy.
- Securing the support and cooperation of school personnel.
- Facilitating the development of school-based intervention plans.
- Planning activities to meet the ongoing needs of participating elementary educators for skill development, training, team building, and resource identification.
- Designing training workshops for project participants and school district curriculum specialists.
- Coordinating local school involvement.
- Monitoring the project at the school level.
- Assessing schools and districts concerning issues related to the project.

Points to Remember

- Steering committee members should be individuals with enough authority to ensure that planning group decisions are carried out at the district, school, and classroom levels.
- Someone must assume responsibility for scheduling, coordinating meetings, and conducting follow-up on decisions reached.
- All members must be committed to equity in science and mathematics for African American and Hispanic children.
- Classroom teachers should be represented on the steering committee. Though we did not do this in our project, we realized, in retrospect, that it would have been better to have included classroom teachers.

- Those responsible for supervising the school district's science and mathematics curriculum and instruction must be directly involved in the planning and implementation stages.
- The Staff Development Office can facilitate coordinating activities to meet the project's staff training needs.
- There must be a "hands-on" liaison person with the steering committee and the schools.

STEP III: What Are Our Priorities?

Develop Project Goals

Project History

In this project, the stated goal was to increase African American and Hispanic students' participation and performance in mathematics and science. The development of this goal followed analysis of the data and recognition of the problem. Project activities were guided by a number of objectives designed to support the goal. It has been the experience of MAEC and the three cooperating school districts that project goals should be quantified as much as possible. It is also important that an evaluation component be developed along with goals and objectives, so that everyone knows from the beginning how success will be measured. The increase in achievement that occurred in the schools participating in our program was attained as a result of administrators, counselors, and teachers becoming increasingly competent in recognizing and nurturing African American and Hispanic students' positive attitudes toward mathematics and science.

Action Plan

Develop one or more goals for the project at the initial steering committee meeting. Individual school teams will develop specific objectives to fit their unique needs.

Include the following types of **goals**:

- Increasing African American and Hispanic minority student participation and performance in mathematics and science for grades K through 6.
- Recognizing and addressing cognitive, affective, and instructional factors which most likely affect minority students' achievement in mathematics and science.

- Providing professional development for principals, teachers, counselors, and education specialists so that they are able to develop school-based intervention programs to increase minority students' interest and performance in mathematics and science.
- Equipping school staff with the necessary information, vision, skills, and support to reform mathematics and science instructional programs serving minority students.

Include the following types of **objectives**:

- Increasing teachers' content knowledge in selected mathematics and science topics.
- Increasing the variety of instructional strategies utilized to teach mathematics and science.
- Correlating mathematics and science concepts, focusing on process skills and using "hands-on" activities.
- Demonstrating teacher behaviors that will positively affect minority students' attitudes, performance, and participation in mathematics and science.
- Providing minority students with information and experiences in the application of mathematics and science concepts and skills.
- Implementing school-based intervention programs first among team members and later throughout an entire school.

Points to Remember

- Project goals should be consistent with school district policy and curriculum.
- An evaluator should be involved in this aspect of planning, so that desired outcomes will be documentable and measurable.
- To meet each goal, develop specific objectives and allocate sufficient time for appropriate staff development activities.

STEP IV: Who Will Direct Our School's Efforts?

Identify Participating Schools and Form School-Based Leadership Teams

Project History

In some cases, the Steering Committee helped to identify the individual schools that would participate in the project. In other cases, the schools volunteered or were selected by the superintendent's office. Initially, the principals signed a letter of commitment to actively support the project and to participate as members of their school-based leadership teams. The pivotal part of the success of the *MSM: K-6 Project* were those school-based leadership teams which acted as the basic mechanisms for planning, organizing, and implementing interventions in mathematics and science instruction in the classroom.

It was originally envisioned that teams would consist of the principal, two primary teachers, two intermediate teachers, the guidance counselor, and mathematics and/or science resource teachers. However, local needs and variations in staffing patterns resulted in effective teams which varied in size from three to six persons and varied in the make-up of personnel.

The teams were responsible for:

- Developing individual school intervention plans which included objectives that were congruent with district curricula and the goals of the project.
- Resolving school level problems regarding mathematics and science programs.
- Assisting, observing, coaching, and supporting one another in performing project activities.
- Coordinating local school resources with those from the school district's regional and central offices.
- Participating in regularly scheduled *MSM: K-6 Project* local and interdistrict workshops.
- Serving as models in the school, demonstrating the project's prescribed teaching behaviors.

- Sharing the project's information and instructional strategies with the entire school staff.

The principals and counselors were asked to assume a major role in "team building." All project schools had a designated team leader. In some schools, it was the principal, in other schools, it was a teacher or a guidance counselor. Some teams rotated the leadership annually, which promoted enhanced leadership skills among all the team members. In all schools, it was the principal who selected the teachers for the team, established a positive climate for the project, and allocated the time and resources needed by the team for planning and implementation.

Action Plan

- Identify individual schools that are willing to participate in the project.
- Identify school-based leadership teams for each school, consisting of the principal, teachers, counselors, and specialists.
- Ensure that the members of the school-based leadership teams are committed to the following responsibilities:

  Team Principal:

  - Serves as climate setter, catalyst, and leader for team building.
  - Facilitates needs assessment and data analysis activities.
  - Ensures an adequate inventory of mathematics and science resources and materials.
  - Assists in the development of local school intervention plan.
  - Develops a plan to gain necessary resources.
  - Allocates time for regular team meetings.
  - Assists and supports team in accomplishing activities of the intervention plan.
  - Keeps staff and the school district's *MSM: K-6 Project* coordinator apprised of the team's progress.
  - Evaluates the effectiveness of the school's science and mathematics program for African American and Hispanic students.
  - Participates, with team, in project staff development activities.

Team Teachers:

- Develop local school intervention plan.
- Participate in training to develop teaching behaviors that address factors affecting minority students in mathematics and science instructional settings.
- Model prescribed teaching behaviors.
- Serve as information disseminators to entire school staff and parents.
- Participate in peer coaching.

Team Counselors:

- Assist in developing local school intervention plan.
- Assist team in implementing the plan.
- Serve as climate setters.
- Develop activities and workshops to enhance the self-esteem of African American and Hispanic students.
- Provide mathematics- and science-related career education for teachers and parents.
- Assist school teams in maximizing the use of community resources.
- Help increase African American and Hispanic parent involvement.

Points to Remember

- Schools that volunteer to participate are more open to change than schools that are forced to participate.
- Commitment to individual change, and to the goals of the project, are crucial to the leadership team.
- Team stability enhances its effectiveness. If possible, all team members should make a long-term commitment. (Turnover can be both disruptive and demoralizing).
- It takes approximately two years before teams see their effectiveness and begin to function well.

- Trust and communication are essential to the overall success of the project.
- Time must be scheduled regularly (at least twice a month) for team meetings for feedback, planning, and assessing progress.
- "Team-building" is a process which requires training and support.
- One person on each team should assume the role of "Data Manager," reminding colleagues of what is needed, setting timelines, collecting data and other materials from them, and maintaining these materials in an easily accessible manner. This is essential for documenting and assessing the progress of the project.

A Team Describes Itself

After four years in *MSM: K-6 Project*, we are:

- Risk takers
- Aware of a need for change
- Receptive to new strategies
- Believers in "hands-on"
- Enthusiastic about working together for the benefit of children
- Willing to share experiences and ideas
- Process-oriented
- Naturally interested in mathematics and science
- Frontier forgers
- Able to value new ideas
- Encouragers of peer teachers
- Able to utilize strengths of individual team members in order to provide a stronger group outcome
- Supportive of each other
- Believers in integration of mathematics and science curricula
- Promoters of research
- Sensitive to child-like qualities
- Aware of the effect of students' attitudes toward learning
- Able to value student input
- Able to simplify and clarify
- Organizers
- Understanding of differences in learning styles
- Appreciative of discovery and inquiry
- Goal setters

MSM: K-6 Project
School-Based Leadership Team
Whetstone Elementary School
Montgomery County Public Schools

Through Teamwork At Our School . . .

- We observed and coached each other on behaviors that communicate high expectations.
- We established a "Nature Trail" as part of the school-wide mini unit.
- The principal observed our mathematics and science lessons.
- Peer tutoring has been initiated.
- We instituted "Science Night" and "Computer Night."
- A science lab has been established with students as lab assistants.
- More science field trips were taken.
- Cooperative learning strategies are now used in all team members' classrooms (and in the classrooms of many other teachers).
- The counselors were able to initiate a student leadership group during the third year of the project.
- The entire school learned that the more hands-on experiences students had, the more interest they had in mathematics, science, and school in general.
- The interest and achievement of minority students in mathematics and science has improved dramatically.

MSM: K-6 Project
School-Based Leadership Team
Highland Elementary School
Montgomery County Public Schools

STEP V: How Do We Plan for Change?

Develop Intervention Plans

Project History

Each participating school was asked to develop a school intervention plan based upon the needs assessment for the school. These plans included:

I. Project Goal for Individual School

II. Objectives

III. Intervention Strategies

IV. Success Indicators

V. Time Line, Personnel, Costs

VI. Outcomes and/or Accomplishments

Action Plan

- Conduct needs assessment and analyze data.
- Develop a long-term, school-based intervention plan for mathematics and science (see I - VI above).
- Develop Evaluation Components.

Points to Remember

- Allocate sufficient time and resources for staff development activities required to achieve each desired outcome.
- Understand that instructional and curriculum change must be supported by district commitment for change. One cannot change classroom practices unless they are supported by institutional policies and programs. Furthermore, commitment to individual change is critical.
- Recognize that staff development is only one strategy, others could include: peer coaching, increased principal supervision, changes in program organization, changes in schedules, changes in policies, etc.

STEP VI: How Do We Gain the Skills We Need to Implement Our Plan?

Design and Implement a Comprehensive Staff Development Program

Project History

An important part of each school plan was a staff development focus for the year. The Steering Committee developed topics and identified consultants for staff development, based on the objectives and activities proposed by the school-based leadership teams in their intervention plans.

Staff development was essential to help everyone involved become active agents of change. Four to six times a year, school-based leadership teams met to participate in staff development programs. This project emphasized training for all members of the participating teams: teachers, guidance counselors, and principals, as well as mathematics and science specialists. The staff development model utilized by the *MSM: K-6 Project* was based on the following workshop assumptions:

WORKSHOP ASSUMPTIONS

- Mathematics is a "critical filter" to sustained participation in science.
- *All* students can learn mathematics and science and, equally important, maintain positive attitudes toward the study of these disciplines.
- The elementary level is the most effective place to initiate this intervention.
- Most students learn mathematics and science concepts and skills more effectively if they are actively involved in the lessons, for example, using manipulatives to apply the concepts in the problem solving process.
- Mathematics and science must not be taught in isolation. Students must see how these subjects relate to their everyday lives. Many concepts can be correlated with other disciplines.

- Teachers can present effective activity-based science and mathematics lessons in their classrooms, with administrative support and training, which addresses both the cognitive and affective domains.
- The essential resources for change exist within the school district.
- A well designed teacher training program, which improves the quality of mathematics and science experienced by minority students, will result in a higher quality of experience for ***all*** students.

WORKSHOP COMPONENTS FOR ALL PARTICIPANTS

- *Identifying and Addressing Factors Influencing Minority Students in Mathematics and Science*
  - Academic deficiencies
  - Attitudes
  - Influence of significant others
  - Language
  - Learning styles
  - Misuse of testing
  - Perceived utility
  - Persistence
  - Previous experiences
  - Stereotyping
  - Teacher anxiety in mathematics and science
  - Teacher expectations

- *Effective Instruction*
  - Bilingual instruction
  - Communication of high expectations
  - Concept formation
  - Discovery and inquiry
  - Higher order thinking
  - Managing the activity-based classroom
  - Peer coaching for teachers
  - Posing and solving problems
  - Sheltered English
  - Teaching social skills
  - Utilization of multicultural interdisciplinary curriculum and role models

- Utilization of simple and complex cooperative work group models such as: *Brainstorming, Color-coded Co-op cards, Co-op, Cooperative Review Games, Data Sharing, Group Investigation, Jigsaw Methods, Number Heads, Partners, Roundtable,* and *Think-Pair-Share*

■ *Mathematics Content Themes with Applications in Science*

- Algorithmic procedure
- Application of mathematics to real life experiences
- Calculators and computers
- Logical reasoning
- Measurement
- Numbers theory
- Pre-algebra
- Probability and statistics
- Problem solving
- Ratio and proportion

(Use of manipulatives emphasized)

■ *Science Content Themes with Applications in Mathematics*

- Application of science to real life experiences
- Electricity
- Energy systems
- Forces
- Forms of matter
- Laboratory procedures
- Living things
- Physical and chemical changes
- Sound

(Hands-on activities emphasized)

■ *Creating Cooperative Building-level Teams*

- Disseminating materials and resources to other faculty
- Mentoring
- Peer Coaching
- Team Building

ADDITIONAL COMPONENTS FOR SPECIALISTS, GUIDANCE COUNSELORS, AND PRINCIPALS

- *Staff Development for Mathematics and Science Specialists*

  Specific preparatory workshops for mathematics and science teacher specialists were designed to enable curriculum specialists to assist the school teams at the school site and in the classroom. The MAEC model includes an interdistrict training preview for curriculum specialists, prior to the day of the interdistrict workshop for the teams. The curriculum specialists were trained to help by facilitating the work of one or two small groups during team workshops. They also provided manipulatives or laboratory materials for each workshop, feedback to the project managers and consultants, and coaching and support to the school teams between interdistrict team seminars.

- *Staff Development for Guidance Counselors*

  Specific training for guidance counselors was designed for the interdistrict team workshops. Time was allocated for special sessions with guidance counselors to expand their repertoire of support activities which they could offer the teachers, students, and parents. These special sessions for counselors covered the following topics:

  - Assisting teachers in understanding minority student needs
  - Becoming more sensitive to minority student needs
  - Coordinating their elementary schools with junior high or middle schools
  - Disseminating information
  - Enhancing career awareness programs for minority students, emphasizing mathematics and science-related careers
  - Increasing minority student self-esteem
  - Interpreting student records and student labeling
  - Interpreting test scores
  - Nurturing social skills
  - Perceiving their roles as change agents
  - Recognizing differences in learning styles among teachers and students
  - Seeing themselves as climate setters

- *Staff Development for Principals*

  During the interdistrict workshops, principals worked in small group sessions, focusing on their specific roles in the project. In addition, the steering committee hosted several principals' breakfast meetings to provide them with additional support. Topics explored during these meetings included:

  - Conducting observations in activity based classrooms
  - Developing inventory and acquiring science and mathematics materials
  - Establishing and maintaining a healthy, positive climate
  - Evaluating outcomes
  - Facilitating peer coaching
  - Identifying inhibitors of effective science learning
  - Implementing the intervention plan
  - Monitoring program implementation

DISTRICT LEVEL SPIN-OFFS

Staff development also occurred at the district school level. In two of the districts, several schools clustered for further training on specific topics. This made it possible for the consultants to teach some demonstration lessons in the classrooms of *MSM: K-6 Project* teachers. In keeping with the original intent of the project, many schools planned staff development workshops on *MSM: K-6 Project* topics for the entire staff. While summer workshops in elementary science and mathematics are now being offered by the school districts, in the initial years of this project there were very few school district-sponsored staff development programs in science for elementary teachers.

Many schools desiring to involve parents as significant others in the mathematics and science improvement effort sought training in *Family Math, Family Science,* and *Say "YES" Saturday Mathematics and Science for Families.* Some have launched exciting, school-based, family centered mathematics and science programs targeted to minority families.

Action Plan

- Examine individual school plans, and thereupon develop a staff development program with strategies for school teams which include assisting teachers and administrators in implementing improvement plans.

- Include special sessions for principals and guidance counselors at team meetings.
- Develop a separate staff development program for curriculum specialists that can equip them to assist in team training and in follow-up at the school building.
- Schedule principal meetings, or breakfasts, to assist principals to become better instructional leaders in mathematics and science.
- Evaluate each staff development workshop.

Points to Remember

- Staff development programs must be designed to meet the individual school needs of the teachers and administrative staff at each school.
- Staff development is only the beginning of institutional change, *NOT THE END.* It supplies the participants with skills necessary to make change. After staff development, the change process really begins. That is, as a result of staff development, changes can then be made in policy, program, curriculum, and instruction.

STEP VII: How Do We Begin the Change Process?

Design and Implement a School-Based Intervention Plan

Project History

One of the first tasks participants engaged in was the development of intervention plans for their schools. This planning session gave them a sense of ownership, but it was the subsequent *MSM: K-6 Project* staff development which gave them the skills to make changes in their classrooms and schools. The impetus for implementing new instructional behaviors usually came from the professional development experiences which occurred in the *MSM: K-6 Project* workshops.

At the workshops, school-based leadership teams were encouraged to try instructional innovations in their classrooms. They were also reminded to review and revise their school intervention plans if necessary to incorporate the recommended instructional innovations.

Classroom visits by the principal, curriculum specialists, resource teachers, and/or peers assisted team teachers in assessing their progress with a new prescribed teaching behavior. In the workshops, teachers were given opportunities to share their experiences. They also described highlights of their school intervention plan activities which included:

- Use of new cooperative instructional strategies.
- Use of hands-on and experiential learning.
- Techniques to address factors that enhance African American and Hispanic students' understanding of concepts.
- Peer coaching scheduled to support and encourage classroom changes.
- An inventory and scheduled use of science equipment.
- A career day.
- Creation of a mathematics/science newsletter.
- Organization of a science fair.
- Workshops for school staff.
- Integration of mathematics and science curriculum with each other and with other curriculum.

Action Plan

- Continually review team plans, timelines, activities, and individual assignments. The teams must hold themselves accountable for accomplishing the objectives of their plans, or making group decisions to alter original plans.
- Ensure that all team plans are fully implemented. Each plan contains timelines, responsibilities for implementation, and proposed outcomes for the various team members. It is the principal's responsibility to see that school plans are fully implemented.

Points to Remember

- It may frequently become the task of the steering committee to assist in the implementation of individual components in the intervention plan.
- Staff development must precede implementation of some components. Teachers will need ongoing support.

- Implementation of even one component involves careful planning and feedback.
- Implementation means "hands-on" involvement by team members.
- New issues in classroom management may emerge. Teachers may need assistance in resolving them.
- Mastery of new teaching behaviors is not immediate, but improves with use over time.
- The pedagogical and moral support of a peer coaching system can be extremely helpful when implementing new prescribed behaviors; but peer coaching, too, requires training and trust.
- The principal and team must keep staff and parents informed of the project's activities and progress.
- Support from the coordinator, curriculum specialist, and/or principal is crucial to team morale when problems arise.
- After each workshop, the intervention plan should be reviewed. Implementation of elements of the school plan should be coordinated with introduction of the new instructional behavior.
- **Successful implementation does not mean that staff development took place; rather, the success of implementation is measured through the improvement of school policies, programs, instructional strategies, and teaching skills, resulting in increased participation and achievement of African American and Hispanic students in mathematics and science.**

STEP VIII: How Do We Share Our Successes?

Disseminate and Institutionalize

Project History

Fundamental to the design of the *MSM: K-6 Project* was the mechanism for first level dissemination and institutionalization. The school-based leadership teams had the ongoing responsibility for keeping the entire school staff informed of the new instructional strategies, materials, and activities generated through the team's involvement in the *MSM: K-6 Project* staff development program. Teams were given time during

faculty meetings to relate information that they received during project workshops and were asked to conduct workshops for their colleagues during school-based, in-service days.

Most dissemination beyond the school level was largely the task of the Steering Committee's project coordinator who delivered status and evaluation reports to the districts' top level administrators. Such dissemination efforts, when done consistently, did expedite the institutionalization process. Although most dissemination efforts have been concentrated at the local level, *MSM: K-6 Project* Steering Committee members and teachers have made presentations at several national and regional conferences, including the National Science Teachers Association.

THE INSTITUTIONALIZATION PROCESS IN THE THREE SCHOOL DISTRICTS

District of Columbia Public Schools

In the District of Columbia, a foundation grant enabled the *MSM: K-6 Project* schools to become pilot sites for the National Urban Coalition's mathematics/science/technology program, *Say Yes To A Youngster's Future.* These school teams continue to receive staff development and materials; but they also now have a Saturday family hands-on mathematics and science program, which includes science/mathematics-related field trips and career awareness information. The *Say Yes Program,* with the *MSM: K-6 Project* core components is being expanded to encompass a total of 12 District of Columbia elementary schools.

Montgomery County Public Schools

For several years prior to the inception of this project, improving the achievement and participation of minority students had been a goal in Montgomery County Public Schools. This goal and the goal of the *MSM: K-6 Project* were congruent, and this factor, to a great extent, facilitated the implementation of the *MSM: K-6 Project* in the ten selected schools. Though all schools did not initially embrace the project, enthusiasm for the project grew as staff members observed progress being made with the mathematics and science programs. After five years of implementation, there were signs of the project "sticking around" in the project schools. In addition, there were some indications that the district was planning to institutionalize some aspects of the project in science and mathematics at the county level.

The first sign of the district's continued support occurred at the end of year four when the Montgomery County *MSM: K-6 Project* facilitating team made a decision to find resources to support the project for a fifth year. This team, serving in an advisory and planning capacity, provided three general training workshops and additional funds for mathematics and science manipulatives. Local schools were also given funds to support local school training.

A second sign of the district's support for the project occurred at the district level in the Department of Academic Skills. (This department is responsible for coordinating mathematics, science, and other disciplines). For the 1990-1991 school year, the department proposed supporting the project through general workshops and additional funds for mathematics and science materials. Beyond 1990-1991, the department proposed the following:

- The activities and goals of the *MSM: K-6 Project* will be incorporated into the department's plans and goals.
- As the mathematics and science curricula are revised within the next four years, strands from the *MSM: K-6 Project* training model will be included, for example, hands-on mathematics and science activities, emphasizing equity factors related to minority students.
- Recommendations have been made to extend the project to other schools which have high minority student populations, and a need to improve their science and mathematics programs.
- The *MSM: K-6 Project* is to be clearly identified as a line item for the 1992 fiscal year.

At the school level, administrators have included mathematics and science objectives as a part of their management plan. This communicates to the staff and the area associate superintendent that science and mathematics are priority items, and resources and activities will be designated to meet the goal. In addition, the Department of Quality Integrated Education, as the designated liaison for this project, is committed to checking with schools periodically to provide support as needed. The intent is to create a climate of continued improvement in science and mathe matics through empowering principals, teachers, and guidance counselors.

While resources and circumstances in Montgomery County have paved the way for assimilation of the *MSM: K-6 Project* objectives and

activities into the total district's plan for elementary curriculum and instruction, the other two districts have taken different routes to maintain the project's core components.

Prince George's County Public Schools

In Prince George's County, Maryland, the courts accepted a desegregation plan which recognized that 14 schools with student populations above 90% African American could not be integrated because it would require excessive travel time. To compensate, these schools (often referred to as Milliken II Schools) have been allocated extra resources for the purpose of correcting the academic inequities which often accompany racial isolation. Although the four Milliken II Schools, which were in the *MSM: K-6 Project*, are now in the vanguard of the district's elementary mathematics and science reform, the remaining ten Milliken II Schools have benefitted from an interesting spin-off of the *MSM: K-6 Project*.

When the Project began in 1985, Prince George's County elementary schools were no different from most others in the nation. They had very little science instruction, and what they had was largely textbook-based. With an Eisenhower grant, however, the district has been able to provide a science resource teacher to work very closely with all of the Milliken II Schools. This former classroom teacher began to specialize in science, and became involved in the *MSM: K-6 Project*, which provided an important focus for hands-on science work. The teacher incorporated "the factors" (Appendix I) in every science lesson and workshop she presented for the schools and for the elementary science coordinators. She attributes to the *MSM: K-6 Project* her understanding of the equity issues for minorities in science and mathematics.

Thus, teachers in predominantly minority schools, which are not a part of the *MSM: K-6 Project*, have access in their schools to ongoing training with the *MSM: K-6 Project* philosophy of science instruction—thanks to this highly motivated, itinerant science resource teacher.

The Prince George's County middle school mathematics initiative was designed by one of the school district's *MSM: K-6 Project* specialists. Through this initiative, all middle schools are expected to emphasize cooperative learning activities and hands-on manipulatives in their mathematics classes.

Action Plan

- Develop methods to disseminate information and skills gained during professional development activities to colleagues who could not participate in these workshops. Dissemination of information is a school-based leadership team responsibility.
- Disseminate changes in policies and programs outlined in the school intervention plan to the entire school population.
- Create an environment that allows teachers to identify their own needs and deficiencies and gain the additional assistance they may need to meet new goals and objectives. Helping to create a conducive environment is a principal's responsibility.

Points to Remember

- School-based leadership teams have led science and mathematics reforms in their schools, but they require ongoing time and support.
- The principal's expectation, support, and monitoring determine whether all other teachers will incorporate the new, prescribed teaching behaviors.
- Student populations may change, but the prescribed teaching behaviors are effective with ***all*** students.
- There must be a flow of accurate information about the project going to all levels of the school district.
- Teachers, counselors, principals, and project coordinators should be encouraged to make presentations on the project at local, regional, and national professional meetings.

STEP IX: How Are We Doing?

EVALUATE! EVALUATE!

Project History

Evaluation was an important component of the intervention plan. Though the evaluation phase is discussed in isolation here, it should be emphasized that an evaluation plan should be designed at the beginning of the project and should be an ongoing process, which permeates every other component.

To help this project stay on target, MAEC hired an outside evaluator. The external evaluation of the first year of the *MSM: K-6 Project* reported that:

- Over 90% of the participants stated that each of the professional development workshop activities was helpful.
- Over 90% of the participants reported being aware of the factors related to minority student achievement.
- Two-thirds of the participants included these factors in their planning.
- 87% and 91% of the participants reported changes in teaching behaviors for mathematics and science instruction, respectively.

The goal and objectives of the project were developed in a way which facilitated assessment of the project's efforts. The formative evaluation report actually became an effective tool in refining the project's programs in the second, third, and fourth years.

PRINCIPALS REPORTED THE FOLLOWING OUTCOMES

- Increased CAT mathematics scores.
- Increased positive attitudes toward subjects of mathematics and science.
- Increased number of students involved in hands-on projects.
- Decreased inappropriate behaviors when students were working on cooperative learning activities.
- Increased time-on-task opportunities in classroom.
- Increased wait-time, allowing for more active participation of all students.
- Increased participation in science fairs.
- Improved grades of minority students in mathematics and science subjects.

A summative evaluation, prepared at the end of the fourth year, revealed that despite the scheduling, management, and programming challenges, 87% of the teachers surveyed felt the project was highly successful. The following is an excerpt from that report:

Mathematics, Science, and Minorities: K-6
After Four Years – An Evaluator's Conclusion

The *MSM: K-6 Project* was an ambitious effort to change schools in ways that would enhance the achievement of minority students. It demonstrated effective collaboration between MAEC, a desegregation assistance center, and public school systems. Strong claims can be made for the project's impact on schools. Teams were formed, and functioned throughout the life of the project. Teachers have incorporated strategies and materials demonstrated in project workshops in their classrooms. The data show, however, that the behavior of teachers has changed more rapidly than some of their attitudes, which is congruent with human behavior theory. Nonetheless, the project seems to have renewed the skills and enthusiasm of the staff involved (teachers, principals, and counselors) for teaching in general, and for working with African American and Hispanic students in particular.

The strongest evidence of this project's success is in the overwhelming appreciation of the school personnel and in the transformations that have occurred in classrooms. Many of the classrooms are now literally "alive" with plants, insects, and animals and have become a place where students work on projects and experiments rather than assignments. The "best" classrooms have emerged from the project as communities ***doing*** science and mathematics, rather than learning mathematics skills and, occasionally, some science.

This project also demonstrated that funding is important. The consultants, meeting sites, parking, lunches, and refreshments were not inexpensive. Even more important than funding, however, are people with commitment and ideas. This project found those people in the school systems and at MAEC. The ideas generated by this project continue to thrive in the schools and the people touched by it.

Action Plan

- *Conduct a Formative Evaluation:*

  All project participants, especially the school-based leadership teams, should be asked to regularly collect the data which can help them answer the question "How are we doing?" *MSM: K-6 Project* teams collected data from a variety of sources to keep them informed on the progress of their intervention plan: number of student awards; science fair participation; attendance data; staff information sharing; workshop surveys; classroom observations by principals; parent, student, and teacher input (maintained in anecdotal records); parent, student, and staff questionnaires; teacher classroom observations; student attitudinal surveys; mathematics competitions; frequency of teachers' use of science lab, science kits, or science and mathematics materials' storeroom; and performance on teacher-made and standardized tests.

- *Conduct a Summative Evaluation:*

  This evaluation should be performed by someone outside the project. If possible, the evaluator looks back at the project to analyze the outcomes in terms of the objectives of the project and/or the objectives of the intervention plans.

  The staff of the school district's testing and evaluation department can be an excellent resource in the development, training, and implementation of the evaluation component of the project–but the full cooperation of all project participants is essential.

SOURCES FOR ASSESSING

- Team minutes.
- Interviews with team members, staff, and parents.
- Observations/questionnaires assessing the history of the team's membership:
  - Who served, in what role, and for how long?
  - Who were the salient members?
  - How stable was the team?
- School district records.

- Report cards.
- Norm referenced tests.
- Science fair records (for levels of participation).
- Interviews with teachers, students, and parents.
- Teacher and student interviews.
- Classroom observations.
- Request for and use of manipulatives in a cooperative context.
- Accounts of special mathematics- or science-related events.

Points to Remember

- Improving minority student participation and achievement in mathematics and science is the goal! Monitor this through the data.
- Evaluation is a crucial component of the implementation of an innovation.
- The evaluator should be involved in project design from the beginning.
- All project participants must understand their roles in the project evaluation process.
- If something is not working, honest reflection and change are essential.
- A school-based leadership team needs time at the end of the school year to prepare a report based on project data and anecdotal records. At this time, the team can develop the plan for the next school year.

PART IV:
WHAT WE SHOULD HAVE DONE DIFFERENTLY

What We Should Have Done Differently

In retrospect we would have done a number of things differently, time and money allowing:

- Trained all of the teachers in the schools instead of just the school-based leadership teams.
- Paid more attention to the specific needs of language minority students, including bilingual and sheltered-English programs.
- Provided each school with a consultant to conduct class observations and provide feedback to school personnel implementing instructional and program change.
- Provided a more extensive parent participation program.
- Tested all students who participated in the project for their mathematics and science performance prior to the implementation of the *MSM: K-6 Project*. This baseline data would have allowed for a clearer indication of the project's success.
- Developed a more structured timeline for how often the school-based leadership teams should meet, preferably more often than once every month. This would have aided in the coordination and communication between participants.
- Encouraged every school-based leadership team to have a specific task for project implementation assigned to each participant. At team meetings, participants should have discussed the progress or problems of their tasks, thus improving overall group communication and involvement.
- Provided school-based leadership teams with procedures, methods and resources to monitor and evaluate the success of their projects, in such areas as student participation, performance, and attitudes.
- Encouraged more peer counseling, communication, and cooperation between the teachers and counselors in each school.
- Encouraged teachers to provide minority students the option to catch up on the mathematics and science work which they have fallen behind.

PART V: SUMMARY

SUMMARY

Schools can make a difference. While the economic and social issues that face us as a nation are difficult and complex, effective schools research demonstrates that schools can be successful in teaching economically disadvantaged and minority children. Teachers, administrators, and parents want to succeed in providing students with the knowledge and skills they will need in the 21st century.

Success can be achieved when efforts are focused around subject areas such as mathematics, science, or reading. Programs such as the *MSM: K-6 Project* have made a difference in instruction and student outcomes. Schools have learned how to better identify and address their own needs, as well as help each other in this process. This project has combined key elements that the Mid-Atlantic Equity Center believes have been responsible for its success. These include:

- Developing goals which target increasing the performance and participation of minority students in mathematics and science.
- Increasing cooperation and coordination among school districts and individual schools.
- Identifying the factors which have contributed to the achievement and underachievement of African American and Hispanic students in mathematics and science.
- Addressing these factors through a variety of techniques that included:
  - (1) Developing objectives which target increasing the performance and participation of minority students in mathematics and science.
  - (2) Monitoring performance and participation data of African American and Hispanic students in mathematics and science.
  - (3) Identifying and implementing policies and procedures which facilitate the use of hands-on materials, experiential learning, and cooperative instructional strategies.
  - (4) Developing school-based leadership teams that focus on mathematics and science.

(5) Developing and implementing intervention plans which focus on the mathematics and science instruction and the participation of African American and Hispanic students.

(6) Helping principals to become better instructional leaders in mathematics and science.

(7) Preparing supervisors to support and monitor teachers' mathematics and science instruction of African American and Hispanic students.

(8) Encouraging teachers to utilize a variety of instructional strategies that: demonstrate high expectations; utilize cooperative learning; emphasize experiential learning; and incorporate mathematics and science applications to real life experiences and other academic disciplines.

(9) Encouraging peer coaching and principal monitoring of instruction.

(10) Training counselors to be supportive of student, teacher, and administrator efforts to increase African American and Hispanic student performance and participation in mathematics and science.

(11) Monitoring progress of plan implementation and evaluating success based upon increased participation and performance of African American and Hispanic students in mathematics and science.

Many of us across the United States of America are concerned about the increasing opportunities for ***all*** of our children. The staff of MAEC is pleased to share with you examples of our successes, as well as our omissions, obstacles, and challenges. We wish you success in your efforts to improve the achievements of ***all*** students, and invite you to contact us if we can assist you in your efforts.

Remember, all young people have the capacity to excel in mathematics and science education, and should be treated as not merely average, but better than average.

The Average Child

(anonymous)

I don't cause teachers trouble
my grades have been okay.
I listen in my classes
and I'm in school every day.

My teachers think I'm average
my parents think so too.
I wish I didn't know that
'cause there's a lot I'd like to do.

I'd like to build a rocket,
I have a book that tells you how.
Or start a stamp collection
well, no use in starting now.

Because since I found I'm average
I'm just smart enough, you see
to know there's nothing special
that I should expect of me.

I'm part of that majority
you know, that hump part of the bell,
who spends life unnoticed
in an average kind of hell.

APPENDICES

I. Student and Teacher Related Factors Influencing Minority Student Participation and Performance in Mathematics and Science: Summary and Implications

II. Project Consultants

III. Opening Up the Mathematics And Science Filters: A Checklist for Reformers

IV. Tell Us How You're Doing: Reflection On Your First Year's Reform Effort

APPENDIX I:
Student and Teacher Related Factors Influencing Minority Student Participation and Performance in Mathematics and Science: Summary and Implications

Source: Beane, DeAnna Banks.
Mathematics and Science: Critical Filters for the Future of Minority Students. The Mid-Atlantic Equity Center, The American University, 1985, reprinted 1988.

ATTITUDES

Factor

Minority students have positive attitudes toward mathematics and science in early grades.

Implications For Intervention

1. To maintain these attitudes, students must continually be involved in challenging, "hands-on" activities related to their real world.
2. They must see others, from a cultural background like theirs, who have maintained this interest in science and mathematics.

PERSISTENCE

Factor

Those who are most successful in mathematics and science have developed the ability to persist. Having the ability to persist in the face of barriers or conflict is essential to the development of a positive self-concept.

Implications For Intervention

3. To develop this quality, children must be encouraged through teachers' feedback and guidance to persevere as they work their way through appropriately challenging problems and situations.
4. They must be encouraged to take risks and make decisions, experience success, receive praise and constructive criticism, and recognize the relationship between their decisions, their actions and their success.

5. Teachers may require training in identifying the key elements of risk-taking and persistence in an academic setting, and in designing strategies to develop them in children.

STEREOTYPING

Factor

Many teachers, majority and minority, as well as minority students, tend to stereotype mathematics and science as White male domains.

Implications For Intervention

6. Teachers should introduce male and female minority persons with mathematics and science-related careers. These role models can counteract race and sex stereotyping.
7. The historical and contemporary accomplishments of minorities in mathematics and science must be systematically included in the curriculum.
8. Students and teachers must become alert to the presence of race and sex stereotyping in instructional and advertising materials.
9. Multicultural audiovisual programs developed to provide children with information about science concepts and careers should be used in the classroom and at home to counteract stereotyped images.

UTILITY

Factor

Minority students are frequently less likely to understand how the study of mathematics and science is applicable to everyday life, and valuable to their future schooling and jobs.

Implications For Intervention

10. Good counseling by teachers and guidance counselors can provide a realistic picture of the relationship between students' present actions and future course and career options.
11. Exposure to people who use mathematics and science in the work-place expands the awareness of minority students regarding the usefulness of these disciplines.
12. Science and mathematics should be taught in an interdisciplinary manner, enabling students to experience mathematics as an essential tool of science.

13. Minority students must have many regular opportunities to use computers for more than drill and practice and computer-assisted instruction. Access to computer technology for creative and higher level activities increases motivation and awareness of useful applications of mathematics and science.

14. The curriculum should focus on problems, investigations, discussions, trips, and activities designed to integrate mathematics and science skills into the everyday experiences of the students.

INFLUENCE OF SIGNIFICANT OTHERS

Factor

Teachers, counselors, parents, and peers have a role in shaping students' attitudes toward mathematics and science.

Implications For Intervention

15. Encouraging minority students to take the more challenging educational path conveys a message of confidence in their abilities.

16. Positive, substantive interactions which communicate high expectations can become a self-fulfilling prophecy.

17. Interactions with successful older minority students, teamwork, peer tutoring, and cooperative learning strategies are effective ways to positively utilize peer influence.

18. Parent education programs help parents become aware of the importance of mathematics to their children's futures. Such programs should offer suggestions and activities for parents to use in nurturing children's interest in mathematics and science.

COGNITIVE FACTORS:

PREVIOUS EXPERIENCES

Factor

Minority students tend to perform best when the content is related to their previous experiences.

Implications For Intervention

19. Mathematics and science instruction must provide out-of-school experiences to make up for experiential deficits. The school curriculum should include field trips to zoos, museums, laboratories,

ponds, streams, vacant lots, farms, generating plants, planetariums, aquariums, various worksites, hospitals, college campuses, etc.

20. Instruction in the classroom must be designed to include the kinds of enrichment experiences which contribute to knowledge, build self-confidence, and develop thinking skills.

ACADEMIC DEFICIENCIES

Factor

Achievement test performances by minority students indicate growing competency in basic skills, but weakness in understanding and applying concepts.

Implications For Intervention

21. Instructional programs which teach strategies for attacking and solving word problems in mathematics must be a curriculum component at each grade level.

22. All instructional activities must be systematically organized with clear objectives.

23. Student progress in mathematics and science must be monitored daily.

24. Activity-based science programs, when implemented with sufficient teacher training and support, significantly improve minority student performance in science process skills, science content, mathematics, and language development.

25. Mathematics labs with manipulatives and high interest computer software can be used to develop competency in application of concepts.

26. Student teamwork and cooperative learning strategies improve motivation and achievement.

LANGUAGE

Factor

Language minority students encounter limitations in English speaking mathematics and science classrooms, and on achievement tests.

Implications For Intervention

27. Activity based programs in mathematics and science with built-in linguistic objectives can increase language proficiency.

---

28. Teaching mathematics as a component of bilingual programs can improve the achievement of language minority children.

29. Participating in carefully structured cooperative work groups for activity-based problem solving in science and mathematics enhances achievement, self-concept, and oral and written communication skills of language minority students.

30. Direct instruction in word problem solving should emphasize tools for decoding the words and phrases.

31. Mathematics and science content presented to students in simplified or "sheltered" English increases language competencies, as well as provides content in a comprehensible form.

MISUSE OF TESTING AND TEST DATA

Factor

The use of standardized test data to predict achievement and to assess ability is detrimental to minority students.

Implications For Intervention

32. Tests should be used to determine a child's actual progress rather than his/her disability.

33. Teachers should receive training on the proper use of test data and the purpose of diagnostic, criterion-referenced, norm-referenced, and pre-and post-tests.

34. Student performance on tests must be analyzed, and errors examined, to identify specific skill and concept deficiencies.

35. There must be flexibility in grouping. An analysis of errors on practice assignments and tests can be the basis on which flexible groups are formed. Activity-based science and mathematics programs also provide opportunities for flexible, heterogeneous grouping.

36. Tests should be culturally fair and should assess the skills and content actually taught.

37. The teaching of test taking skills should be integrated throughout the ongoing curriculum.

LEARNING STYLES

Factor

Instructional strategies frequently do not complement the learning styles of many minority students.

Implications For Intervention

38. Through observations and/or diagnostic assessments, the learning style preferences of students can be determined.

39. Concept and skill mastery activities should include: manipulatives, experiments, listening, reading, discussion, audiovisuals, movement, practical experiences, group and individual work, contracts, learning centers, writing, role playing, simulations, interviewing, and computers for problem solving.

40. Teachers should receive training on teaching styles and learning styles, followed by instructional support for developing and implementing alternative instructional strategies like those cited above. Some experiences should be designed to help students gradually learn how to function successfully in situations which do not complement their basic learning style preferences.

TEACHER EXPECTATIONS

Factor

Educators often perceive minorities as having inferior ability. This perception translates into an expectation of low achievement, which is communicated to and internalized by the minority child.

Implications For Intervention

41. Honest self-assessment by educators is the first step in breaking this cycle. Questions like these must be asked:

    a. Who are my low achievers?
    - Is there an overrepresentation of minority students in this group?

    b. How do I relate to minority students and low achievers?

    c. Do I
    - Interact more with high achievers and ignore and interrupt low achievers more frequently?
    - Ask more and higher level questions of high achievers and provide low achievers with questions that require only simple recall?

- Follow up with probing questions for high achievers and call on someone else if a low achiever is unable to provide a prompt, accurate response?
- Provide a longer wait-time for high achievers to respond to a question, and cut off response time for low achievers who hesitate?
- Seat high achievers closer to the teacher's usual position and cluster low achievers further away?
- Praise high achievers more often and criticize low achievers more frequently?
- Provide supportive communication for high achievers and engage in dominating behaviors with low achievers?
- Provide high achievers with detailed feedback and give less frequent, less accurate, and less precise feedback to low achievers?
- Demand more work and effort from high achievers and accept less from low achievers?

42. Once a staff is aware of the ways in which expectations are communicated to students, teachers can observe one another's interaction with identified low achievers and minority students. Individual teachers can then design plans for changing their own behavior in the classroom.

TEACHER ANXIETY: MATHEMATICS

Factor

Teachers who do not have positive attitudes about mathematics are likely to provide inadequate instruction; additionally, they are poor models for mathematical competency and interest. Teachers must present to their students positive role models to encourage mathematical competency and interest.

Implications For Intervention

43. A staff assessment of attitudes toward mathematics will (1) identify teachers experiencing mathematics anxiety or avoidance and (2) provide an opportunity for teachers to openly discuss the problem.

44. Math-anxious teachers can form a group for discussion and activities designed to change attitudes.

45. Effective in-service programs, focusing on the needs of local school mathematics courses and materials, can provide teachers with new understanding of content and teaching strategies.

TEACHER ANXIETY: SCIENCE

Factor

Many elementary teachers avoid teaching science because they lack training in science content and science teaching methods, subsequently, they have no confidence in their ability to teach scientific subject matter.

Implications For Intervention

46. Confidence and competency can be increased through regular participation in science in-service workshops which offer specific skills, techniques, and materials.

47. There must be ongoing opportunities to try out new science activities before using them in the classroom. Time should be provided at workshops, faculty meetings, or during prearranged preparation time.

48. There should be a continual updating of current research through a review of professional journals and other materials which focus on elementary school science. These journals often combine content and suggested strategies for teachers' use.

49. The development of a supportive network, which includes several science teachers from the middle or junior high schools and local college faculty, should be established.

INSTRUCTIONAL PRACTICES

Factor

A number of instructional practices have been associated with low achievement in minority students.

Implications For Intervention

The above list of intervention actions offers forty-nine effective instructional strategies. However, one cannot overstate the importance of building the core instructional program in a cooperative learning context around an activity-based or hands-on curriculum. Cooperative learning groups must be carefully structured and monitored to maximize student involvement and progress in mathematics and science.

APPENDIX II:
Project Consultants

The following have served as resource people in the *MSM: K-6 Project.* Telephone numbers are included for those who were contacted and who indicated that they are willing to assist in the development of future projects aimed at increasing minority participation in mathematics and science.

Consultant	*Area of Expertise:*
Dr. Honi Bamberger Curriculum & Instruction Department University of Maryland Benjamin Building, Rm. 2311 College Park, MD 20742-1175 (301) 405-7059	Mathematics Education: Diversity in the Classroom
Ms. DeAnna Banks Beane Independent Consultant 6908 32nd Street, N.W. Washington, D.C. 20015 (202) 362-1920	Needs Assessment and Program Development
Dr. Mary Ann Breaton Maryland State Department of Education 200 West Baltimore Street Baltimore, MD 21201 (410) 333-2311	Science Education: Thinking Skills
Dr. Neil Davidson Curriculum & Instruction Department University of Maryland Benjamin Building College Park, MD 20742-1175 (301) 405-3147	Mathematics Education: Cooperative Learning
Ms. Dee Dishon 6030 Florence Lane Alexandria, VA 22310 (703) 329-3314	Classroom Management and Cooperative Learning

Consultant	*Area of Expertise*
Ms. Sara Duff Ms. Clarissa Evans Science & Mathematics Department Division of Curriculum Development Baltimore City Public Schools 200 North Avenue Baltimore, MD 21202 (410) 396-9206	Science Education: Thinking Skills, Curriculum Development
Dr. Helené Hodges Association for Supervision and Curriculum Development 1250 N. Pitt Street Alexandria, VA 22302 (703) 549-9110	Academically At-Risk Youth, Learning Styles, and Reading Styles
Mrs. Brenda R. Holmes Teacher Specialist Montgomery County Public Schools Department of Quality Integrated Education 11721 Kemp Mill Road Silver Spring, MD 20902	Counselor Education: Staff Development and Parent Education
Dr. Bess Howard 605 Hudson Avenue, #323 Takoma Park, MD 20912 (301) 495-9316	Organization Development, Student Persistence, Mathematics Education, and Leadership Training
Dr. J. Arthur Jones Futura Technologies, Inc. 1950 Weybridge Lane Reston, VA 22091 (703) 476-4937	Mathematics Education: Staff Development, Curriculum Materials
Dr. Crystal Kuykendall 2936 Carlton Avenue, N.E. Washington, D.C. 20018 (202) 529-2042	Parent and Teacher Expectations, Student Motivation, and Young Astronauts Council

Consultant	*Area of Expertise*
Ms. Bette McLeod The Mid-Atlantic Equity Center 5010 Wisconsin Ave., N.W., Suite 310 Washington, D.C. 20016 (202) 885-8517	Cross-Cultural Communication
Dr. Ann Roseberry Technical Education Research Center 2057 Massachusetts Avenue Cambridge, MA 02140 (617) 547-0430	Limited English-Proficiency
Dr. Mary Budd Rowe School of Education Stanford University Stanford, CA 94305-3096 (415) 725-4662	Science Education
Dr. Donald H. Smith Chair, Dept. of Education The Bernard M. Baruch College City University of New York 17 Lexington Avenue New York, NY 10010 (212) 387-1731	Multicultural Education and Role of the Guidance Counselor
Ms. Constance Tate Independent Consultant 609 Delafield Place, N.W. Washington, D.C. 20012 (202) 882-0387	Science Education
Dr. Orlando Taylor, Dean School of Communications Howard University 525 Bryant Street, N.W. Washington, D.C. 20059 (202) 806-7690	Cross-Cultural Communication

Consultant	*Area of Expertise*
Dr. Leon Ukens Department of Physics Towson State University Towson, MD 21204 (301) 830-2174	Science Education
Dr. Dean Wood Hood College Frederick, MD 21701 (301) 663-3131 x205	Science Education

APPENDIX III:
Opening Up the Mathematics and Science Filters: A Checklist for Reformers

The Steering Committee for the *MSM: K-6 Project* found the following elements to be significant contributors to the positive changes experienced by many project schools. Perhaps a periodic checking of the list can help guide your endeavors.

Does your reform effort or project have:	*Yes*	*No*	*In Progress*
1. A focus on improving African American student achievement?	☐	☐	☐
2. A focus on improving Hispanic student achievement?	☐	☐	☐
3. An analysis of mathematics and science performance data by race?	☐	☐	☐
4. A project coordinator or director?	☐	☐	☐
5. On-going involvement of an evaluator?	☐	☐	☐
6. A steering or planning committee?	☐	☐	☐
7. The formal support of the superintendent?	☐	☐	☐
8. A formal commitment from the principal(s)?	☐	☐	☐
9. Involvement of the mathematics and science supervisors?	☐	☐	☐
10. A school-based leadership team?	☐	☐	☐
11. A guidance counselor on the school-based leadership team?	☐	☐	☐
12. Teachers on the school-based leadership team?	☐	☐	☐
13. A principal on the school-based leadership team?	☐	☐	☐
14. The mathematics and/or science resource teacher on the school-based leadership team?	☐	☐	☐

Continued on next page

Does your reform effort or project have:	*Yes*	*No*	*In Progress*
15. Team-building training?	☐	☐	☐
16. Rotating team leadership?	☐	☐	☐
17. A data manager for the school-based leadership team?	☐	☐	☐
18. Regular planning time scheduled for school-based leadership team?	☐	☐	☐
19. Goals and objectives for the reform effort or project?	☐	☐	☐
20. A timeline for project objectives and activities?	☐	☐	☐
21. A school-based intervention plan?	☐	☐	☐
22. Strategies for addressing cognitive and affective issues?	☐	☐	☐
23. A staff development schedule which supports all the objectives and activities of the intervention plan?	☐	☐	☐
24. Special staff development for school-based leadership team teachers?	☐	☐	☐
25. Targeted staff development for project principals?	☐	☐	☐
26. Targeted staff development for guidance counselors?	☐	☐	☐
27. Staff development to increase understanding of selected science concepts?	☐	☐	☐
28. Staff development to increase understanding of selected mathematics concepts?	☐	☐	☐
29. Staff development and implementation assistance for hands-on science lessons?	☐	☐	☐
– using manipulatives in mathematics lessons?	☐	☐	☐
– deliberately structured cooperative learning?	☐	☐	☐

Continued on next page

Does your reform effort or project have:	*Yes*	*No*	*In Progress*
– communicating high expectations to all students?	☐	☐	☐
– peer coaching for teachers?	☐	☐	☐
– sheltered-English component?	☐	☐	☐
30. Staff development on affective factors?	☐	☐	☐
31. Regular opportunities for school-based leadership team members to share new information and strategies with the rest of the faculty?	☐	☐	☐
32. Bilingual or sheltered-English mathematics and science programs?	☐	☐	☐
33. Career awareness activities?	☐	☐	☐
34. Parent involvement activities related to science and/or mathematics?	☐	☐	☐
35. Staff development for parent involvement?	☐	☐	☐

APPENDIX IV:
Tell Us How You're Doing:
Reflections On Your First Year's Reform Effort

At the end of the first year of your project, please share your experiences and reflections. If you are reporting for an entire school district rather than one school, answer only those questions which are appropriate for your project. Please print or type your responses.

Mail the completed form to:

The Mid-Atlantic Equity Center
5010 Wisconsin Avenue, N.W.
Suite 310
Washington, D.C. 20016
Attention: OMSF Survey

I. Name of School/School District/Organization: _____

_____

Address: _____

City: _____

State: _____ Zip: _____

Name of Principal/Superintendent: _____

Telephone: (_____) _____

Person completing this form: _____

Position: _____

Telephone: (_____) _____ Date: _____

Address: _____

City: _____

State: _____ Zip: _____

II. School Profile for _____ - _____ School Year (project schools)

Grade Levels Served: _____

Total Enrollment: _____

African American: _____

Asian: _____

Caucasian: _____

Hispanic: _____

Native American: _____

Other: _____

Number of Teachers: _____

Number of Guidance Counselors: _____

Science Resource Teacher: Yes ☐ No ☐

Mathematics Resource Teacher: Yes ☐ No ☐

Chapter I Program: Yes ☐ No ☐

Percentage of students eligible for free or reduced price lunch: _____

III. Briefly describe the conditions which prompted your reform effort:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

IV. Briefly summarize your reform effort:

V. Benchmarks or accomplishments from your first year:
(activities not listed in the checklist under VII)

VI. Has your reform effort used this manual as a resource?

Yes ☐ No ☐

If yes, how useful was it?

Not At All			Helpful		Extremely Helpful
0	1	2	3	4	5

VII. Indicate all the components of your reform effort:

☐ Interdistrict project (number of school districts _____)

☐ Intradistrict project (number of schools _____)

☐ Single school project (number of teachers involved _____)

☐ Project director or coordinator

☐ Ongoing involvement of an evaluator

☐ Steering or planning committee (number of members _____)

☐ Formal support of superintendent of schools

☐ Involvement of school district supervisors of mathematics and science

☐ School-based leadership team

☐ Guidance counselor as member of school-based leadership team

☐ Teachers as members of school-based leadership team

☐ Principal as member of school-based leadership team

☐ Science resource teacher as a member of school-based leadership team

☐ Mathematics resource teacher as member of school-based leadership team

- ☐ Team-building training
- ☐ Rotating team leadership
- ☐ A data manager for the team
- ☐ Regular planning time scheduled for team meetings
- ☐ Focus: improving African American student achievement
- ☐ Focus: improving Hispanic student achievement
- ☐ Collection and analysis of mathematics and/or science performance data by race
- ☐ Use of research findings on factors influencing minority students in science and mathematics
- ☐ Development of goal(s) and objective(s) for reform project
- ☐ Timeline for project objectives and activities
- ☐ Development of a school-based intervention plan
- ☐ Curriculum focus: science
- ☐ Curriculum focus: mathematics
- ☐ Other curriculum focus _____
- ☐ Staff development schedule which supports all of the objectives and activities of the intervention plan
- ☐ Special staff development for project teachers
- ☐ Special staff development for project principals
- ☐ Special staff development for project counselors
- ☐ Staff development to increase understanding of targeted science concepts

- ☐ Staff development to increase understanding of targeted mathematics concepts
- ☐ Staff development on instructional strategies
- ☐ Staff development on affective factors
- ☐ Peer coaching for teachers
- ☐ Team presentations at faculty meetings
- ☐ Team members conducting workshops for other teachers
- ☐ Hands-on science lessons
- ☐ Emphasis on inquiry and problem solving in science
- ☐ Use of manipulatives in mathematics
- ☐ Deliberately structured cooperative learning
- ☐ Heterogenous grouping
- ☐ Mathematics and science career awareness activities
- ☐ Sheltered English
- ☐ Bilingual instruction
- ☐ Enrichment activities and events in science
- ☐ Enrichment activities and events in mathematics
- ☐ Parent involvement activities related to science and/or mathematics
- ☐ Community partnerships to enhance mathematics and/or science learning

VIII. Comments or concerns?

Thank you for sharing this information with the Mid-Atlantic Equity Center.

What Participants Said About the Project:

Teachers

"I now utilize hands-on activities and cooperative learning and focus on persistence, wait-time, locus of control, as well as problem solving."

"I saw high achievement of students in math and science as well as high interest, and large participation in Family Math because it was done in Spanish and English."

"The greatest change personally is the way in which I teach math. I now try to allow for a variety of learning styles and set high expectations for all students."

Principals

"The MSM K-6 Project has set a standard for teachers: those who were involved with the project are teaching more science and mathematics . . . some feel that the MSM: K-6 Project helped prepare them for the Afrocentric curriculum currently being introduced in our district."

"In-services provided by the School-Based Leadership Teams have enabled teachers to feel more connected to what happens in the school. These in-services have made it more their project and allow them to feel responsible for project outcomes."

"Several practices or procedures have been introduced – among those are cooperative learning strategies and the use of manipulatives to develop concepts. In addition, there is an increased focus on using 'real life' situations in instruction and applying instruction to real life problem-solving."

Guidance Counselors

"The MSM: K-6 Project was the most valuable professional experience I have had since becoming a part of the Montgomery County Public Schools. The thing that made this experience different was the quality of training provided in the workshops. For me, being valued as a professional, having the opportunity to become a leader – making presentations to groups of teachers – was something I would never have considered four years ago. I feel I have gained so much from my experience with the Project. [It] helped to provide an appreciation for the diversity of cultures in our country."

"Participation in the MSM project increased my awareness of various issues concerning multicultural education and has made me more sensitive to my interactions with minority parents and students."

Project Outcomes:

Curriculum and Instruction:

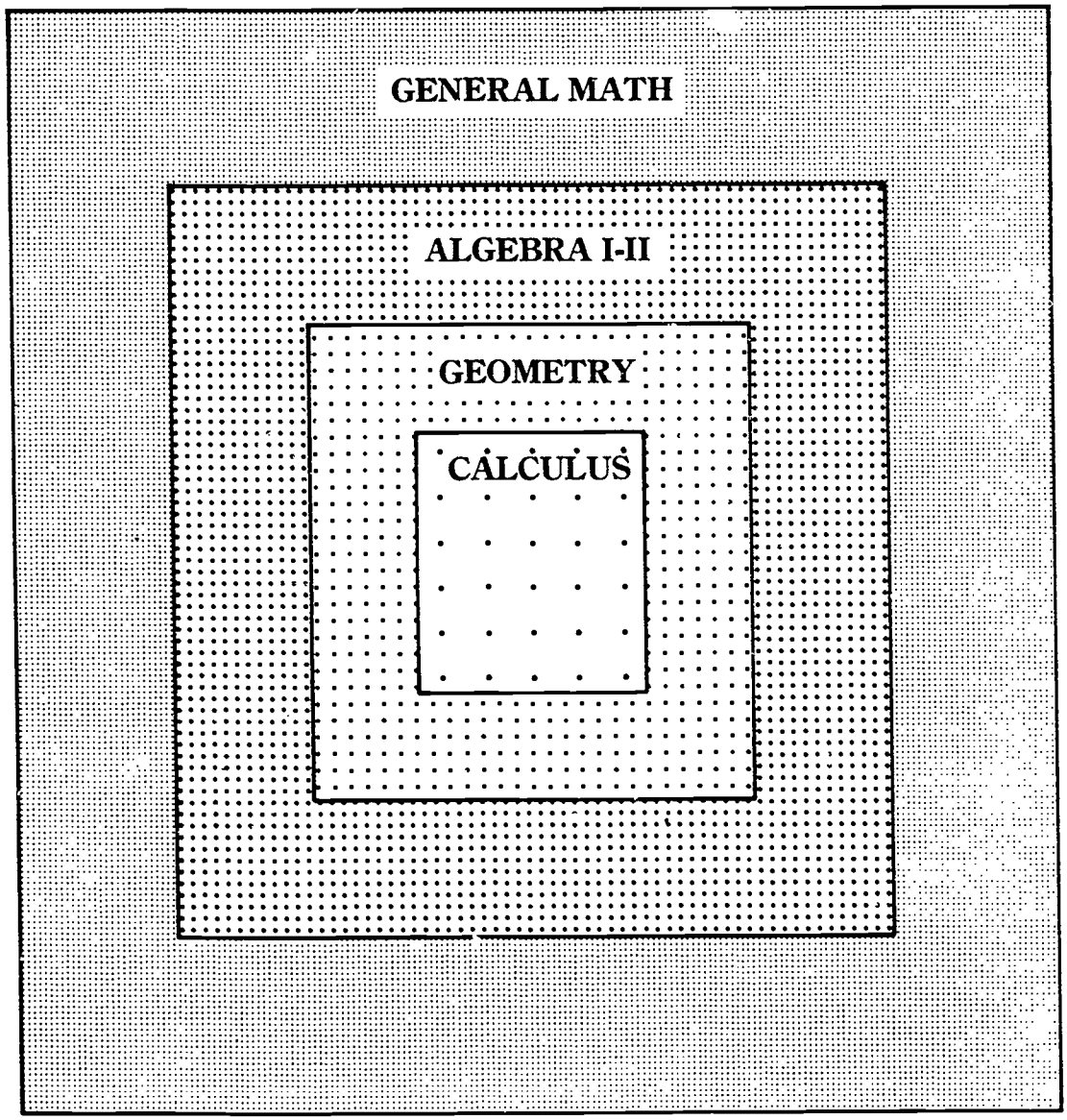
- Activity-based science lessons.
- Use of manipulatives in mathematics lessons.
- Special mathematics/science programs for 6th grade urban minority boys.
- Diversity in learning styles considered in planning mathematics and science lessons.
- Mathematics/science field trips.
- Peer tutoring.
- Cooperative learning utilized in mathematics and science classes.
- Science fairs and clubs.
- Mathematics/science career days.

Support for Students and Their Families:

- Guidance counselors collaborating with teachers in mathematics/science support activities with students.
- Family mathematics and family science projects/classes.
- Science project preparation workshops for parents.
- After school and Saturday science/mathematics programs.

Minority Student Participation and Performance in Mathematics and Science:

- Demonstrated increased achievement in mathematics and science courses.
- Increased participation in science fairs.
- Increased participation in mathematics and science extracurricular activities.
- Increased participation in independent projects and field trips.
- Increased minority participation in classroom activities in mathematics and science.
- Increased performance in mathematics on standardized tests.



THE AMERICAN UNIVERSITY
WASHINGTON, D.C.

The American University is an Equal Opportunity/Affirmative Action Employer.