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AUTHOR	Huinker, DeAnn; And Others
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ABSTRACT

This document is a report of an intensive study of the K-12 mathematics and science programs in Milwaukee (Wisconsin) public schools (n=40) based on classroom observations, interviews, surveys, and focus group discussions. Results showed that students want practical experiences, less teacher talk, and more student talk. Teacher interviews indicated that staff development needs are greatest in practical instructional methods, integrated curriculum, and use of technology. Principals interviewed believed that barriers to effective instruction include time constraints, few resources, and reduced central office support for principals. Observations of 190 mathematics and science classes showed that: (1) About half of the observed classes at all levels were traditional in format; (2) Only about five percent of the teachers made any attempt to connect lessons to real life; (3) Computers were rarely used at any level; (4) Calculators were seldom used in elementary classes and in only about one-third of the high school classes; (5) Race and ethnic but not gender inequities were found in advanced mathematics and science class enrollments; (6) Diverse grouping arrangements in elementary classes encouraged student interaction regardless of race, ethnicity, or gender; (7) High school science classes had the most opportunity for student interaction; high school mathematics classes, the least; and (8) Many elementary and middle school classrooms were overcrowded. Teachers identified the following major obstacles to teaching mathematics and science effectively: student apathy and fear of mathematics; poor student background or skills; absenteeism and student mobility; lack of parental support; poor student behavior; lack of adequate time for planning; lack of student interest; large class sizes; and limited or no access to technology and current textbooks. Appendices include a guide to site visits and data collection, survey instruments, and focus group questions. (MKR)

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A Study of the Milwaukee Public Schools

DeAnn Huinker

Lynn H. Doyle

Gretchen E. Pearson

Center for Mathematics and Science Education Research

University of Wisconsin-Milwaukee

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DeAnn Huinker

Lynn H. Doyle

Gretchen E. Pearson

Center for Mathematics and Science Education Research
University of Wisconsin-Milwaukee
Enderis Hall, Room 265
Milwaukee, WI 53201-0413

phone: 414-229-6646
fax: 414-229-4855
email: huinker@csd.uwm.edu

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CONTENTS

ACKNOWLEDGMENTS

To create a landscape painting is an extensive undertaking. This portrait of mathematics and science education in the Milwaukee Public Schools (MPS) was a collaborative work which required the help of many individuals. Without their time and effort, the study could never have been accomplished.

Members of the Working Group helped plan, investigate, and dream of what could exist. (See Appendix A for a listing of the members.) They provided wonderful insights and suggestions by breaking from old perspectives and suggesting innovative alternatives. They viewed mathematics and science education in new lights.

Over half of the Working Group gave additional time to collect data during the site visits. These included Stephen Adams, Jeffrey Anderson, Pat Barry, Carmen Baxter, Conni Blomberg, Marva Bredendick, Sallie Brown, Dave Caruso, Greg Coffman, David DeBruin, Mike Endress, Liz Freeman, Becky Guerrero, David Guerrero, Karleen Haberichter, Mary Henry, Judy Heine, Pat Kenner, Steve Kreklow, Jim Kurtz, Darlene Liston, Dan Lotesto, Hazel Luckett, Connie Manke, Ed Mooney, Mary Morris, Mike Mahoney, Vince O'Connor, Cyntha Pattison, Cynthia Pierson, Judith Pokrop, Bill Rawles, Jerry Schnoll, Fred Schroedl, Katrina Simmons, Karen Villwock, Ella Washington, Charles Wickenhauser, Catherine Washabaugh, Jim Wojtech, and Blaine Wiesniewski.

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Preparing for the site visits meant coordination, reorganized schedules, and flexibility on the part of the site visit schools. Principals, assistant principals, learning coordinators, and implementors more than met the challenge. Their welcome mats and coffee were appreciated by all. Interviewed teachers enthusiastically painted pictures of mathematics and science instruction and were gracious, often giving up planning or break time. Some of our most poignant observations and comments were from the students who eagerly provided their ideas of what instruction is and could be.

Without the input of members of the community and parents, our landscape would have been incomplete. Representatives from business, industry, post-secondary education, community and government agencies, and parents (see Appendix C) provided another outlook. This broad sharing of views made the self-study truly a collaborative effort between the University of Wisconsin-Milwaukee, the Milwaukee Public Schools, and the Milwaukee community. The overall support from Milwaukee's mayor, John Norquist, and assistance from his staff, particulary Joanne Anton, helped obtain this valuable community component.

The University of Wisconsin-Milwaukee (UWM) helped facilitate this work. Dr. Gail Schneider, Interim Dean of the School of Education, communicated full support of this effort with encouragement and use of time and facilities. In the UWM Center for Mathematics and Science Education Research (CMSER), Dr. Larry Enochs, Director, sowed seeds of innovation through his extensive background and theoretical frameworks; Tracy Posnanski, Assistant to the Director, cultivated those seeds with his cheerful flexibility especially as deadline pressures increased, and Bill Rawles compiled data and contributed insightful comments and reflections on the text.

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Finally, a thank you goes to MPS staff, Carol Frankiewicz and Pat Haller, who provided the day to day assistance we needed to get the job done, and to Carmen Baxter, Science Curriculum Specialist, who added insights and perspective. Vince O'Connor, Mathematics Curriculum Specialist, and Cynthia Ellwood, Director of Curriculum and Instruction, were the frame that held our landscape painting in place. Howard Fuller, Superintendent, continually provided the heart and inspiration to seek the best education for our students.

CHAPTER 1
BACKGROUND

Science and math will be used in daily life activities and in knowing the environment. You need science and math in your career for solving problems.

--MPS High School Student

I like my teacher; she makes science fun. She makes me learn 'cause we do hands-on things and research. It makes me learn.

--MPS Middle School Student

You need mathematics and science for college. That's the best part of school because you can learn a lot, for example, how to clean up the earth.

--MPS Elementary School Student

These quotes from students in the Milwaukee Public Schools (MPS) reflect the seeds of reform that MPS change agents have been nurturing over the last several years. To provide a panoramic view of mathematics and science education in MPS, a study was conducted in 1993-94 with funding from the National Science Foundation's Urban Systemic Initiative. The landscape was the school district. The artists who created the painting were MPS students, teachers, and principals, and representatives from the broader Milwaukee community. This report is the result of that study; it is a landscape portrait of mathematics and science education in the Milwaukee Public Schools.

NSF URBAN SYSTEMIC INITIATIVE

The Urban Systemic Initiative (USI) is a new venture of the National Science Foundation (NSF). Its aim is to enable large cities to make substantial and long-lasting improvements in mathematics and science education for all students. The USI is making awards available to the 25 cities with the largest number of school-age children (ages 5-17) living in economic poverty as determined by the 1990 census. Milwaukee is one of those 25 cities.

The cities are challenged to develop plans for systemic reform to improve student learning in grades K-12 in mathematics, science, and technology. "Systemic reform of science and mathematics education refers to fundamental, comprehensive, and coordinated changes which will result in improved outcomes for all students as well as in the development of broad based community partnerships" (NSF, 1993, p. 2). Cooperation among teachers, administrators, families, business and industry, government agencies, and cultural agencies is needed to bring about systemic reform.

Although the program is aimed at improving mathematics and science education, it is expected that the reform of these subjects will force comprehensive change across the entire curriculum. The NSF has established goals and expectations considered essential to systemic programs. The goals of the USI are:

- To improve the scientific and mathematical literacy of all students in urban communities;
- To provide the mathematics and science fundamentals which will permit all students to participate fully in a technological society; and
- To enable a significantly greater number of these students to pursue careers in mathematics, science, engineering, and technology (p. 3).

The expectations of the USI are that each school district present an implementation plan which demonstrates:

- A broadly shared community vision for mathematics, science, and technology learning outcomes that benefits all children;
- A comprehensive and systematic plan that addresses mathematics, science, and technology learning from kindergarten through twelfth grade;
- A redirection of school district resources that incorporates the USI implementation plan within the regular school budget; and
- A new science and mathematics education paradigm that becomes part of the existing system rather than an appendage to it and that is institutionalized over the life of the initiative (p. 3).

MILWAUKEE PUBLIC SCHOOLS

In 1993, MPS served approximately 100 000 students. The student population consisted of approximately 75% minority students—50 percent African American, 11 percent Hispanic, one percent Native American, 11 percent Asian, 24 percent Caucasian, and one percent other. Sixty-five percent of the students received free lunch and the high school dropout rate was 15.4 percent. The district employed a total of 9246 full time staff positions of which 6339 were teachers. The district had 155 schools in this school year—111 elementary schools, 21 middle schools, 15 high schools, and 8 alternative schools (MPS, 1994a).

The district has pursued an aggressive reform agenda in recent years affecting all aspects of the system including academic standards, strategies for teaching and learning, approaches to staff development, assessment, shared decision making, and school-based management and budgeting. Two critical reform agendas espouse the vision of the school district: the "K-12 Teaching and Learning Goals" and "School-To-Work."

MPS K–12 TEACHING AND LEARNING GOALS

The K–12 Teaching and Learning Goals (see figure 1-1) center on rigorous standards for all children (Ellwood, Jasna, & Fuller, 1991). The goals were established in 1991 through a process involving over 1000 teachers, principals, parents, business people, community activist, post-secondary representatives, and students. These ten goals aim to offer all children an equitable, multicultural education, and to teach all children to think deeply, critically, and creatively.

The district is working to meet these goals by rethinking and restructuring the decision-making processes, the curriculum, the delivery of instruction, and the methods of assessment used in all K–12 classrooms. In addition, the goals attempt to capitalize on school-level innovation and mobilize all segments of the broader Milwaukee community on behalf of children. Administrators, teachers, and staff in the MPS school district recognize that not everything children learn is learned in school—experiences at home and in the community make a significant contribution. The teaching and learning goals are based on the philosophy that:

- Curriculum is the sum-total of what is taught and learned in schools throughout the system;
- The curriculum must be student-centered;
- The curriculum must promote equity;
- The curriculum must promote deep thinking for all students; and
- Curriculum development must be an ongoing process in which all members of the MPS family participate.

Figure 1-1 MPS K-12 Teaching and Learning Goals

K-12 Teaching and Learning Goals

1. Students will project anti-racist, anti-biased attitudes through their participation in a multi-lingual, multi-ethnic, culturally diverse curriculum.
2. Students will participate and gain knowledge in all the arts (visual arts, dance, theater, literature, music), developing personal vehicles for self expression reinforced in an integrated curriculum.
3. Students will demonstrate positive attitudes toward life, living, and learning through an understanding and respect of self and others.
4. Students will make responsible decisions, solve problems, and think critically.
5. Students will demonstrate responsible citizenship and an understanding of global interdependence.
6. Students will use technological resources capably, actively, and responsibly.
7. Students will think logically and abstractly, applying mathematical and scientific principles of inquiry to solve problems, create new solutions, and communicate new ideas and relationships to real world experiences.
8. Students will communicate knowledge, ideas, thoughts, feelings, concepts, opinions, and needs effectively and creatively using varied modes of expression.
9. Students will learn strategies to cope with the challenges of daily living and will establish practices which promote health, fitness, and safety.
10. Students will set short and long-term goals, will develop an awareness of career opportunities, and will be motivated to actualize their potential.

(Ellwood, Jasna, & Fuller, 1991, p. 4)

SCHOOL TO WORK

In January 1993, Dr. Howard Fuller, Superintendent of the Milwaukee Public Schools, formed the School to Work Task Force to address national and local concerns regarding the effectiveness of secondary education in MPS. The charge given to the Task Force was to develop recommendations for restructuring schools to improve student achievement, to link students to the world of work, and to focus the district's efforts to improve education and effective use of resources.

The School To Work vision has emerged as the guide to a learning process that creates a workable and productive relationship among K–12 schools, post-secondary schools, workplaces, and the community (MPS, 1993a, 1993b, 1994b). The concept of School To Work "means that educational decisions are guided by a significant expected final outcome of the whole educational process—success in the workplace" (MPS, 1993a, p. 2). The MPS plan aims to prepare all students for post-secondary education, whether they choose it immediately upon graduation or later, and to prepare all students to enter the world of work. A major goal of School To Work is to provide students with educational experiences in which they learn and apply ideas and concepts in realistic situations that reflect the complexity of real-life problem solving. Adoption of School To Work in Milwaukee intends to change "the way school is done."

A set of principles serve as the guide for developing and implementing the policies, practices, and programs of School To Work (MPS, 1994b, p. 3). Milwaukee's School To Work principles are:

- Prepare all students to successfully pursue post-secondary education and employment.
- All levels of education—kindergarten through college—should embrace School To Work in a manner appropriate to the learning level.
- The educational process should include experiences in the community and workplace as well as in the classroom.
- Useful knowledge and skills are best learned in an integrated curriculum in which students and teachers work cooperatively.
- Students learn best when they see what they are learning is connected to what they aspire to be in "real life."
- Gender, race, ethnicity and handicapping conditions should not limit student career options.
- Goals and valued results should be explicit and reward should follow effort and achievement.
- Accurate information and careful guidance must be available to parents and students so that reasoned, judicious choices can be made.
- Training in cooperative, integrated education techniques consistent with School To Work objectives should be ongoing for all instructors—school based or community/workplace based.
- Assessment of student performance in the classroom, workplace, or community should be broadly based, at all levels, and continuous.

MPS Mathematics and Science Self-Study

The Milwaukee Public Schools, in consultation with the University of Wisconsin-Milwaukee (UWM), received a planning grant for the 1993-94 school year from the National Science Foundation's Urban Systemic Initiative. The planning grant allowed MPS and UWM to join in a collaborative effort to conduct the MPS Mathematics and Science Self-Study. Guided by the K-12 Goals and the School To Work principles, the purpose of the study was to examine the current status of the K–12 mathematics and science programs throughout the district. The information gained from the study provided input into the development of a systemic implementation plan to improve mathematics and science learning for all students.

SYNOPSIS

A core planning team was formed to supervise the study. The Core Planning Team was comprised of the co-principal investigators of the study and the district mathematics and science curriculum specialists. The co-principal investigators for the study were Dr. Howard Fuller, Superintendent of the Milwaukee Public Schools, Dr. Cynthia Ellwood, Director of Curriculum and Instruction for the Milwaukee Public Schools, and Dr. DeAnn Huinker, Associate Director of the Center for Mathematics and Science Education Research at the University of Wisconsin-Milwaukee. The other members of the Core Planning Team were Mr. Vince O'Connor, the MPS Mathematics Curriculum Specialist, and Ms. Carmen Baxter, the MPS Science Curriculum Specialist. Two additional members joined the Core Planning Team as the study progressed, Ms. Gretchen Pearson and Ms. Lynn Doyle, research associates from the Center for Mathematics and Science Education Research at the University of Wisconsin-Milwaukee. Dr. DeAnn Huinker and the two research associates served as the lead researchers for this study.

A working group was formed to give direction and input for the study, to serve as a forum for discussion, to participate in data collection, and to provide guidance in the development of a plan for systemic reform. The Working Group was comprised of 60 representatives from MPS (teachers and administrators), Milwaukee (business/industry, cultural agencies, city and county government, parents), and post-secondary institutions. A listing of the Working Group members is given in Appendix A. The Core Planning Team members were also members of the Working Group.

The Working Group met for several intensive, all day planning sessions in community centers including the Italian Community Center, the Zoofari Conference Center, and the Milwaukee County Museum. Additional meetings were scheduled as needed to write mathematics and science program standards, plan for site visits, develop data collection instrumentation and guides, synthesize findings, and make recommendations.

In Fall 1993, the primary task of the Working Group was to build a vision for mathematics and science learning in MPS with broad community consensus. The vision emerged through the development of program standards for mathematics and science education. In December of 1993 and January of 1994, the Working Group developed a plan for assessing the current status of mathematics and science education in MPS. The collection of data was to involve (1) site visits to 40 schools to conduct classroom observations and interviews with students, teachers, and principals; (2) surveys of elementary, middle, and high school mathematics and science teachers; (3) community and parent focus groups; and (4) collection of existing documents. Data collection was conducted during Spring 1994.

A forum was held at the MPS Central Office with several hundred stakeholders in the study and interested community members on 7 February 1994. This forum stimulated excitement for systemic reform in the broader Milwaukee community and set the tone for data collection. The key speakers at the forum were Mayor John Norquist, Superintendent Howard Fuller, Dr. Cynthia Ellwood the Director of MPS Curriculum and Instruction, Dr. DeAnn Huinker from the University of Wisconsin-Milwaukee, and Dr. Joseph Danek from the National Science Foundation. The forum provided opportunities for the participants to make verbal and/or written suggestions for improving mathematics and science learning. The initial accomplishments of the Working Group were also presented, and the plan for data collection was outlined.

MATHEMATICS AND SCIENCE PROGRAM STANDARDS

Throughout the self-study, the Working Group sought formal and informal input from community members in social agencies, business, industry, government, and education. Combining this input with the MPS K–12 Teaching and Learning Goals and the School To Work Initiative, the Working Group developed a set of Mathematics and Science Program Standards for MPS. The standards are broad statements in seven focus areas; (1) Equity and Access, (2) Curriculum, (3) Assessment, (4) Collaboration, (5) Governance, (6) Staffing and Other Resources, and (7) Staff Development.

Equity and Access. Quality educational programs must be made available to all students, not just a few. As equity and access are increased, the need for student support systems changes. Measure of school and program success must include a focus on the opportunities which are available, on the degree to which those opportunities are being taken, and on the ultimate success of the participants. Disaggregated data are essential to this analysis. The program standards for equity and access are:

1. All schools provide varied curricular opportunities that are accessible to all students.
2. All schools provide a support network for each student to achieve the highest possible success.
3. Students take an active part in the decision making process in their schools, both at the classroom level and school-wide.
4. Graduation, promotion, and admission requirements at all levels reflect the importance of mathematics and science for success in a technological society.
5. Students of all gender, ethnic, and socio-economic backgrounds enroll in advanced mathematics and science courses.
6. Students of all gender, ethnic, and socio-economic backgrounds succeed in advanced mathematics and science courses.

Curriculum. The mathematics and science curricula are under constant review and development, ensuring that educational opportunities throughout the city are meeting current and future needs at all levels, pre-school through adult. Through integration, relevance, and involvement in heterogeneous groups, the mathematics and science curricula must enable students to make a successful school-to-work transition. Curriculum includes all phases of teaching and learning, that is, the content goals, instructional approaches, materials of instruction, grouping strategies, course offerings, student outcomes, and so on. All curricula must work together to address district goals as articulated in the K–12 Teaching and Learning document. The program standards for curriculum are:

1. All students regularly participate in hands-on investigations, including student initiated independent research, to develop the knowledge, discipline, and skills inherent in science and mathematics.
2. Mathematics and science concepts are connected and used throughout the school day and across the curriculum.
3. Students of varying abilities work together and have access to the full program.
4. Curriculum is connected with students' lives and with what is happening in the wider world.
5. Students communicate mathematical and scientific knowledge, ideas, thoughts, feelings, concepts, opinions, and needs effectively and creatively using varied modes of expression.

6. The science and mathematics curricula provide opportunities for students to use multiple intelligences (e.g., creative, analytic, kinesthetic, etc.).
7. Students develop logical and abstract thinking by applying mathematical and scientific principles of inquiry to identify alternatives, solve problems, and create new ideas related to life.
8. The district has in place a statement of goals and benchmarks for student learning (skills, knowledge, abilities, and attitudes) which guides teachers, parents, and administrators in planning and assessing programs at each level (elementary, middle, and high school).
9. The district has a systematic procedure for the ongoing evaluation and refinement of its curriculum in mathematics and science.
10. The mathematics and science curricula at every level involves students in the active, appropriate, capable, ethical, and responsible use of technological resources.
11. The student's prior knowledge and experiences are built upon in planning and implementing mathematics and science programs at all levels.
12. The mathematics and science curriculum integrates the development of social and group interaction skills.
13. Students are recognized and rewarded for accomplishments in mathematics and science.

Assessment. Assessment plays a dual role in mathematics and science instruction. On the one hand, assessment must occur as an ongoing component of instruction to provide feedback to the students, teachers, and parents, and so, becomes the guide to instructional planning. On the other hand, assessment must also inform the larger community about the success of schools and programs in meeting the needs of students. In that role, assessment can point out needs and serve to stimulate change. In both roles, assessment must be consistent with current goals and instructional practice. The program standards for assessment are:

1. Assessment reflects curriculum goals and instructional practices.
2. A variety of assessments is used at the classroom, school, and district levels.
3. Assessments measure higher order thinking skills which includes use of processes, concepts, problem solving, and application.
4. Assessment involves the application of mathematics and science tools and resources.
5. Assessment reflects change and growth over time, recognizing the developmental continuum of the learning process, including social, cognitive, and affective domains.
6. Students engage in regular self-assessments which focus on the quality of the educational program and on the student's own responsibilities for learning.
7. School and program assessments include an array of evidence (demographic data, scores, surveys, and student work products) which reflect both quality of opportunities and achievements.

Collaboration. The involvement of the greater community in planning, supporting, and participating in the mathematics and science education process is essential to the success of the community. Family, business and industry, government, education (alternative, higher, technical), cultural agencies (zoo, museum, library) must be joined in the goals of educating the youth of this community to prepare them for the opportunities and challenges of an increasingly technological society. The program standards for collaboration are:

1. Interactive communication among schools, parents, employers/employees, agencies, and other community resources is easy and reciprocal.
2. There is an effective system in place enabling all schools, industry, cultural agencies, business, and other community resources to connect with each other.
3. Curriculum is developed and evaluated collaboratively with all segments of the Community.
4. The Community and schools demonstrate flexibility in dealing with parental, family, school, and work needs.
5. School/community collaborations are based on mutual benefit.
6. Families and parents are accepted, accommodated, and respected at school.
7. Parents are provided the training and resources to support/reinforce their children's learning at school and at home.
8. Mathematics and science teachers (K–adult) participate in regularly scheduled discussions which enable multi-level groups to focus on program development and perceived needs.
9. The development of new mathematics and science projects is guided by established goals and identified needs and is coordinated through a broadly-based advisory commission.
10. Staff collaborate to apply for and receive grants associated with mathematics and science education.

Governance. The policies and procedures of the school district with regard to the ongoing development, implementation, and assessment of mathematics and science programs are crucial to the acceptance and success of those programs. Of concern are the extent to which the mathematics and science leadership includes all segments of the community in decision making and the extent to which the district's policies and practices promote systemic development (broad coordination and collaboration) and avoid fragmentation or unnecessary duplication of effort. The program standards for governance are:

1. A broadly based advisory group provides stimulus for the development, implementation, assessment, and dissemination of mathematics and science learning opportunities, K–Adult.
2. New initiatives are considered in relation to established goals, current programs, and identified needs.
3. Collective bargaining teams and program planners are engaged in dialogue which informs and improves both processes.
4. The budget development process is sensitive to both physical and human resource needs (e.g., planning time, mandatory staff development, teacher involvement in decision making, extended year contracts, student release).
5. School and program assessments include qualitative and quantitative measures aligned with district goals and meaningful benchmarks.

Staffing and Other Resources. The importance that is placed on an instructional program is reflected in the resources that are devoted to achieving the goals of that program. Resources include staff, materials of instruction, facilities, equipment and supplies, time, and dollars. Staff includes both regular classroom teachers and a variety of support personnel, both paid and volunteer. Certain intangible elements, such as scheduling practices and accessibility, are also important to this focus as they impact the use and effectiveness of staff and other resources. The program standards for staffing and other resources are:

1. Adequate time for planning and collaboration in the teaching of mathematics and science occurs on an ongoing basis at all levels.
2. Class sizes are limited to provide an effective learning environment.
3. Support personnel (implementor, teaching assistants, resource specialists, mentors, etc.) are available on a regular basis.
4. The mathematics and science curricula are designed, planned, and implemented with an adult-to-child ratio that leads to safe and effective learning environments at all levels.
5. Educational staff work together as a professional community to develop and teach an integrated curriculum.
6. Educational staff teaching science and mathematics have adequate experience and educational background.
7. Up-to-date technological resources are used by students and teachers to enhance learning in mathematics and science.
8. Technology is used to extend learning opportunities beyond the walls of the classroom/school (e.g., telecommunication, distance learning).
9. The district is committed to the investigation of new technologies and to the acquisition and use of those technologies to expand opportunities in mathematics and science.
10. Adequate materials, supplies, and facilities are available at all schools to effectively support curriculum.

Staff Development. The success of the mathematics and science programs is dependent on the involvement of dedicated, well prepared, and knowledgeable staff, both in the teaching ranks and among the many administrative and support staff, including parents and other community volunteers, who play important roles in the teaching and learning process. Mathematics and science are dynamic fields of learning which require continual renewal on the part of educational staff. The program standards for staff development are:

1. All staff members demonstrate the belief that all students can achieve in mathematics and science at high levels.
2. Staff members are enthusiastic toward mathematics and science and model appropriate problem solving behaviors.
3. Educational staff are provided adequate time and support to develop and share skills, ideas, and strategies in implementing curriculum and assessing program effectiveness.
4. Collaborative efforts engage school and community resources to plan and provide staff development (e.g., training, mentoring and modeling, demonstration programs).
5. Systematic planning and evaluation ensure that staff development efforts target identified needs and are effective in reaching agreed upon goals.
6. All staff participate in ongoing staff development in the areas of mathematics and science.
7. Teachers participate in ongoing staff development activities to enhance multicultural understandings which facilitate work with students, families, colleagues, and community.
8. Educational staff are recognized and rewarded for innovative contributions to mathematics and science education.

SUMMARY

The NSF Urban Systemic Initiative supports comprehensive change by making substantial awards directly to school districts which focus on improving mathematics and science education. To appropriately plan for this initiative, MPS needed a picture of the current status of its mathematics and science programs. This report summarizes the processes and results of the MPS Mathematics and Science Self-Study which provided that picture.

The first step was to form two groups: the Core Planning Team which supervised the study and the Working Group which provided direction, input, and grass roots assistance. Throughout the study, these groups looked to the reform efforts already underway in the district, specifically, the MPS K-12 Teaching and Learning Goals and the School To Work Principles. Both reflect educational ideologies that foster creativity, critical thinking, and student-centered problem solving through involvement of the entire Milwaukee community. Using ongoing community input combined with these current reform efforts, the Working Group developed program standards in seven focus areas for mathematics and science education. The next step was to design the study and instrumentation for data collection.

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CHAPTER 2
DESIGN OF THE STUDY

The Mathematics and Science Self-Study sought to answer the question, "What are the strengths and weaknesses of mathematics and science education in the Milwaukee Public Schools (MPS)?" To create a landscape picture of mathematics and science education, the research needed to seek patterns of similarities and differences across the entire MPS terrain. To accomplish this, a research design was developed which incorporated both qualitative and quantitative data. Data collection methods were triangulated across multiple sites with the input from numerous and varied informants.

The four major components of the research design were (a) interviews, (b) classroom observations, (c) district-wide surveys of teachers, and (d) community and parent focus groups. During site visits, students, teachers, and principals told interviewers their stories, and observers recorded what was happening in MPS mathematics and science classrooms. A survey across the entire school district ensured the representation of teachers who were not included in the site visits. To broaden the perspective, focus groups were held with community members and parents. The following is a depiction of each of the research design components.

SITE VISITS

Site visits were conducted at 40 (27 percent) of the 157 MPS schools: 22 elementary schools, 12 middle schools, and six high schools. Criteria for site selection included; (a) diversity of geographic location, (b) feeder patterns to middle and high schools, (c) diversity of representation according to level and type (specialty and non-specialty schools), and (d) proximity for site visit scheduling.

Data was collected by site visit teams. Each team was comprised of three individuals, in most cases two educators and one community member. The team members varied from site to site. Of the 60 members of the Working Group, approximately 35 participated in the site visits. Additional site visitors were selected from within MPS and the community. This varied team composition provided multiple perspectives of each site visit and helped build constituencies for future planning and implementation for systemic change.

To manage the logistics of the visits, a team leader was designated for each team. Site visit teams spent one half day at each site collecting data through observations and interviews. Teams collected data through the following activities: (a) an interview with a group of six teachers, (b) interviews with two groups of students (six students per group), (c) an interview with the principal, and (d) observations of six classes, three mathematics and three science. Teams met following each site visit to debrief. This involved checking the accuracy of their data and writing a summary of their coordinated impression of mathematics and science education in each school.

Data collection instruments were developed by the lead researchers in collaboration with members of the Working Group. Directions and instruments were compiled into a Site Visit Guide (see Appendix B). Site visit teams received a two hour training session in the use of the instruments and guides through observing video recordings of classrooms and role playing of interviews. Approximately two-thirds of the site visitors had prior experience in classroom observations and/or interviewing.

INTERVIEWS

Interviews were conducted during the site visits to MPS elementary, middle, and high schools. The students and teachers shared their thoughts and ideas with interviewers in a group setting (generally three to six individuals per group); the principals related their thoughts and reactions individually.

Data Sources. Fifty-five groups of students were interviewed for a total of 260 students who contributed to the landscape. It was only possible to schedule one student group interview in several of the schools. Of these 260 students, 136 were from elementary schools, 80 were from middle schools, and 32 students were from high schools. The grade level for 12 students was not recorded. Of the 260 students interviewed, 50 percent were females and 50 percent were males. Fifty-three percent of the students were African American, 30 percent were Caucasian, seven percent were Hispanic, seven percent were Asian, one percent was Native American, and two percent were from other ethnic groups.

Forty-two groups of teachers were interviewed. A total of 188 teachers provided their views; 91 were elementary school teachers, 63 were middle school teachers, and 34 were high school teachers. Twenty-nine percent of the teachers were males and 71 percent were females. Seventy percent of the teachers were Caucasian, 21 percent were African American, five percent were Hispanic, and five percent were from other ethnic groups.

Twenty-six principals enhanced the landscape by providing the administrative perspective. Sixteen were elementary school principals, six were principals of middle schools, and four were principals of high schools. Thirty-eight percent of the principals were male and 62 percent were female. Fifty percent of the principals were African American, 46 percent were Caucasian, and four percent were Hispanic.

Data Collection and Analysis. The interview guides (see Appendix B, pp. 140-145) consisted predominately of open-ended questions using six a priori categories identified by the Working Group. These were content, instruction, equity, climate, and resources and technology. Interviews were recorded on audiotape. Some interviewers also took notes which were included as data.

Interviews held with students, teachers, and principals were approximately thirty-five to forty-five minutes long. In some sites, either the principal and/or a group of students or teachers was unavailable which accounts for the discrepancy between the numbers interviewed and the number of sites visited.

Summarizing data from the interviews involved several stages. The audiotapes from the interviews were transcribed and/or summarized. Next, several readings of all interview data were made by the lead researchers. This provided an overview of the sites investigated. Data were then re-read and summarized for each question from the interview guides.

CLASSROOM OBSERVATIONS

Observations of mathematics classes and science classes were conducted during the site visits to elementary, middle, and high schools. The classroom observations provided detail to the evolving sketch of mathematics and science learning in MPS.

Data Sources. Site visitors observed a total of 54 mathematics classes and 44 science classes in 21 elementary schools. The distribution of the observations among the various grade levels is shown in table 2-1.

Table 2-1 Elementary School Observations

Class	Number of Mathematics Observations	Number of Science Observations
Kindergarten	5	2
Grade 1	7	3
Grade 2	8	7
Grade 3	7	7
Grade 3-4	2	1
Grade 4	9	10
Grade 4-5	0	1
Grade 5	8	6
Grade 6	2	1
Unknown	6	6
Total Observations	54	44

At the middle school level, 27 observations of mathematics classes and 32 observations of science classes were made at 12 middle schools. The distribution of the various grade levels is shown in table 2-2.

Table 2-2 Middle School Observations

Class	Number of Mathematics Observations	Number of Science Observations
Grade 6	7	8
Grade 7	8	6
Grade 8	7	9
Combined (6-7, 7-8, or 6-7-8)	4	3
Unknown	1	6
Total Observations	27	32

A total of 33 classroom observations were made at the six high schools visited. Eighteen were of mathematics classes and 15 were of science classes. The distribution of the observations among the various mathematics classes is shown in table 2-3.

Table 2-3 High School Observations

Mathematics Class	Number of Observations	Science Class	Number of Observations
Algebra	9	Physical Science	4
Applied Math	2	Biology	3
Geometry	6	Chemistry	3
Advanced Placement Calculus	1	Physics	4
		Advanced Placement Biology	1
Total Observations	18	Total Observations	15

Data Collection and Analysis. Observations of mathematics and science usually occurred for an entire class period. Observers made written notes using a classroom observation guide (see Appendix B, pp. 132-135). The guide focused on six areas: (a) materials, tools, and technology, (b) climate, (c) instruction, (d) teacher focus, (e) student focus, and (f) equity. For each classroom observation, the observers responded to the questions on the guide and provided additional information through narratives and overall impression ratings.

Several readings of the completed observation forms were made by the lead researchers. The forms were then separated into elementary, middle, and high school levels and then further separated by content area. Matrices were used to summarize the data for each level by subject area and to look for emerging themes.

SURVEYS

The purpose of the surveys was to determine perceptions of elementary, middle, and high school teachers across MPS regarding (a) adequacy of factors affecting mathematics and science teaching, such as resources, time, and class size, (b) instructional and assessment practices in mathematics and science, and (c) attitudes regarding teaching mathematics and science.

Teachers surveyed differed across content areas and levels of instruction. To accommodate their varied needs, three different survey instruments were utilized: (a) elementary school mathematics and science, (b) middle school and high school mathematics, and (c) middle school and high school science. The survey instruments were developed by the lead researchers in collaboration with other members of the Working Group. Copies of the survey instruments are included in Appendix C.

ELEMENTARY SCHOOL

One version of the survey was given to elementary school teachers in MPS. The elementary school survey included questions regarding the teaching of both mathematics and science.

Data Sources. The elementary survey was distributed to a random sample of 475 elementary teachers in MPS. Of these, 232 teachers (49 percent) returned surveys. Most of the respondents, 85 percent, were female and the other 14 percent were male. Ninety-one percent of the teachers were Caucasian, three percent were African-American, three percent were Hispanic, one percent was Asian, and one percent was from other ethnic groups. The mean number of years of teaching for these elementary teachers was 14 (SD=10) with a range from 1 to 43 years.

Data Collection and Analysis. MPS was responsible for the distribution and collection of the elementary survey, including the identification of the random sample of teachers. The surveys were distributed and returned using MPS interdepartmental mail.

The UWM Center for Mathematics and Science Education Research and the UWM School of Education Research Department compiled and analyzed the results of the elementary survey. Scaled responses were analyzed using the SPSS software program. Open-ended responses were coded and summarized according to themes.

MIDDLE SCHOOL AND HIGH SCHOOL

Two versions of the surveys were given to middle and high school teachers in MPS. One survey was given to mathematics teachers and another survey was given to science teachers.

Data Sources. The middle and high school mathematics survey was distributed to all certified mathematics teachers which included both middle and high school teachers. The mathematics survey was distributed to 298 teachers of which 124 (42 percent) were returned. Of those returning the mathematics survey, 82 percent taught at the high school level and 18 percent taught at the middle school level. Fifty-one percent of the mathematics teachers were female and 49 percent were male; 88 percent were Caucasian, six percent were African-American, two percent were Asian, one percent was Native American, and four percent were from other ethnic groups. The mean number of years of teaching for middle and high school mathematics teachers was 17 (SD=10) with a range from 1 to 40 years.

The middle and high school science survey was distributed to all certified science teachers which included both middle and high school teachers. The science survey was distributed to 194 teachers with 75 (39 percent) being returned. Of those returning the science survey, 69 percent taught at the high school level and 31 percent taught at the middle school level. Thirty-five percent of the science teachers were female and 61 percent were male; 90 percent were Caucasian, seven percent were African-American, and three percent were Asian. The mean number of years of teaching for middle and high school science teachers was 20 (SD=10) with a range from 1 to 35 years.

Data Collection and Analysis. MPS was responsible for the distribution and collection of the surveys, as well as the identification of the teachers to be surveyed. The surveys were distributed and returned using MPS interdepartmental mail.

The UWM Center for Mathematics and Science Education Research and the UWM School of Education Research Department compiled and analyzed the results of the surveys. Scaled responses were analyzed using the SPSS software program. Open-ended responses were coded and summarized according to themes.

FOCUS GROUPS

To obtain the Milwaukee community's impressions of mathematics and science programs in MPS and to invite suggestions for improvement, four focus groups were held. Three of these were held with a broad representation of community members and parents and the fourth with MPS parents. A listing of the participants for all four focus groups is given in Appendix D.

COMMUNITY FOCUS GROUPS

The three community focus groups were held at a community center in Milwaukee. An experienced consultant was hired to facilitate the discussion of the focus groups. After a brief welcome and introductions, the groups were provided with background information including the goals and expectations of the Urban Systemic Initiative, the MPS K-12 Goals, and an overview of School To Work.

Data Sources. Of the 91 people invited, 27 individuals participated in the community focus groups. Participants represented business and industry, cultural agencies, parents of MPS children, parent organizations, community organizations, universities and colleges, city government, the state department of education, and the state department of natural resources.

Data Collection and Analysis. Participants chose the most convenient time, early morning, lunch, or early evening. Each focus group discussion lasted two hours. The facilitator provided the focus groups with a purpose and structure which allowed for flexibility in questioning. The same structured questions were used for all of the focus groups although different paths were taken by each group as the discussions progressed. The questions are listed in Appendix E.

Sessions were not audio recorded since it was felt this might interfere with the spontaneity and openness of the sessions. Three recorders took extensive field notes containing numerous quotations and comments made during each of the focus groups.

A meeting was held with the consultant and the lead researchers. The purpose of this meeting was to summarize observations and provide an overview of themes which emerged from the focus groups. The field notes taking during the focus groups were then analyzed for recurring themes and patterns and synthesized for perspectives on the current situation, key points and examples, and suggestions for improving mathematics and science education in MPS.

PARENT FOCUS GROUP

A focus group was held with parents of MPS students to concentrate on the important role parents play in their children's education. The parent focus group was held at a community center in Milwaukee. A consultant was hired to facilitate the parent focus group discussion. This consultant was a MPS parent and former teacher with experience working with MPS families. After a brief welcome and introductions, the parents were provided with background information including the goals and expectations of the Urban Systemic Initiative.

Data Sources. Of the 42 parents invited, nine parents participated in the parent focus group. They represented four high school students, three middle school students, and six elementary students in MPS. Several parents also had grown children who had attended MPS.

Data Collection and Analysis. The focus group discussion lasted two hours. The facilitator used the questions listed in Appendix E to guide the discussion, but allowed for flexibility in questioning and responding. The session was not audio recorded since it was felt this might interfere with the spontaneity and openness of the discussion. The facilitator took field notes throughout the discussion.

The consultant and lead researchers met to debrief after the parent focus group for the purpose of summarizing observations and emergent themes. The field notes were then analyzed for recurring themes and patterns and synthesized for perspectives on the current situation, key points and examples, and suggestions for improving mathematics and science education in MPS.

SUMMARY

To investigate the strengths and weaknesses of mathematics and science education in the Milwaukee Public Schools, data was collected through multiple methods and incorporated the perspectives of many. The design consisted of four major components: (a) interviews with students, teachers, and principals, (b) classroom observations of mathematics and science, (c) a district-wide survey of teachers, and (d) focus group discussions with community representatives and parents.

Data sources included students, teachers, principals, parents, and a wide representation from the Milwaukee community. Data collection was accomplished by members of the Working Group and other volunteers. Instrumentation utilized for data collection was developed by the lead researchers in collaboration with members of the Working Group. The Center for Mathematics/Science Education Research at the University of Wisconsin-Milwaukee assisted in collating and analyzing the data. Through thematic data analysis, a panoramic view of mathematics and science education in the Milwaukee Public Schools was created.

CHAPTER 3
INTERVIEW RESULTS

Some of the richest data for the landscape of mathematics and science education in the Milwaukee Public Schools (MPS) came from personal interviews with students, teachers, and principals. Together they painted a picture of mathematics and science education with each group adding its unique hue and style. When blended, these three perspectives created an impression of an educational program with not only strengths, but also some need for systemic reform.

The intervi[illegible]e conducted during 40 site visits to elementary, middle, and high schools in MPS. The students and teachers told their stories to interviewers in a group setting; the principals related their stories individually. Interviews were recorded on audiotape and later transcribed and/or summarized. Interviewer notes were also included.

The three sets of interview summaries—students, teachers, and principals—are organized around the questions from the interview guides (see Appendix B). Each question is presented with a summary and illustrative examples of comments from the students, teachers, and principals.

STUDENT GROUP INTERVIEWS

A total of 55 groups of students were interviewed. Altogether 260 students contributed to the landscape; 136 were from elementary schools, 80 from middle schools, and 32 students were from high schools. The grade level for 12 students was not recorded. Of the 260 students interviewed, 50 percent were females and 50 percent were males. Fifty-three percent of the students were African American, 30 percent were Caucasian, seven percent were Hispanic, seven percent were Asian, one percent were Native American, and two percent were from other ethnic groups.

The interview questions are stated below. Each interview question is followed by a summary and representative student comments. Because the interviews were conducted in small groups, each bullet is a compilation of comments from several students.

MATH CLASS

I am going to show you something and then I'm going to ask you to tell me what came to your mind when you saw that. Ready? (Wait a moment, then show the card with "math class" written on it.) What did you think of when I showed you the card with math class written on it?

Students frequently gave single word responses. The word heard most frequently was "boring." When students thought of math class, they thought of problems, board work, and worksheets. They often listed content areas, such as, addition, subtraction, multiplication, and division. Only a few students said it was interesting or described it as an interesting or exciting challenge.

Elementary School Comments

- Sort of boring, but I still listen because it's educational. Studying. Falling asleep. It comes easily. It is boring, but I want to pass. The teacher explains things for twenty minutes which is too long. Things should be explain d to those who don't understand, not everyone.
- Don't like it; there are too many hard questions. I hate it. It is confusing when plus and minus are mixed up. There is not enough time to finish the work.
- Multiplication and division. My math book. It is fun. It is hard work. Division with the dot. It is interesting. Learning. I think of how to do it.
- We count, play with shapes and money. We do math on a board, measure shapes and lines. We do times tables and value places.
- Interviewer notes: The students thought of addition, subtraction, times tables, division, and work in their math books.

Middle School Comments

- Math is complicated but it puts my brain to work.
- Interviewer notes: The students identified mathematical topics: addition, subtraction, geometry, numbers, algebra, rule of numbers, roots, and angles. Some said that they loved math—it was their favorite subject; it was challenging, easy to do, and fun to do. Others said it was boring.

High School Comments

- Boring. Problems. Math is hard, but it gets easier when we get good instructions. Lots of homework and tests.
- Interviewer notes: Students thought of numbers, particular teac' ers, and algebra. Some said it was fun because they could talk during class.

SCIENCE CLASS

I am going to show you something else, and then I'm going to again ask you to tell me what comes to your mind when you see this word. What did you think of when I showed the card with science class written on it?

"Experiments" was the word that was used by most students when asked what they thought of when they saw the words, "science class." The responses for this item were more positive than those for math in the previous question. They included such words as, fun, explosions, learning, and testing things out. Many students wanted to have science more frequently than they did. Most said they had science class twice a week; others three times. Rarely did any elementary student report having science more often than this.

Elementary School Comments

- The science teacher teaches you about animals, stuff under water, stuff underground like ants. We color and make wave bottles. We get to see what dissolves like sugar and hot cocoa. We went in a submarine and had flashlights, and we learned about fish and salt and fresh water. Science class is fun; we draw; we make pictures; we play with ice and water and test it out. We learn about bones and what food has too much sugar in it.
- It is stupid; I don't like it 'cause I can't touch other animals during show and tell. Some of the pages in the textbook are good, and some are bad. I like to learn about things. I need more time to finish my work.

- Interviewer notes: The students mentioned dissecting, projects, a science book, fun, hard work, learning new things, water, how to change dirty water into clean water, volcanoes, and animals.
- Interviewer notes: Students said it was fun. They have experiments, dissect things, work with magnets, explosions, and catching animals. A few said it was boring.
- Interviewer notes: The children's first response was that they did not have science, but then they said they did make kool-aid where they used scales, spoons, and cups. They also worked with cartoons.

Middle School Comments

- Chemicals, hands-on things, research. It makes me learn. I like my teacher; she makes science fun. I like the summer course at UWM.
- Interviewer notes: The students named several areas of science including animal studies, DNA, and astronomy. They felt they were finding out how things work in a lab setting. "In the lab, you work with test tubes and do experiments."

High School Comments

- Interviewer notes: The students mentioned dissecting, biology, labs, physics—which they said this was stupid, and chemistry—which they said was good.
- Interviewer notes: The students responded by stating a specific teacher's name, a lot of work, study of life, dissection, and the word of the day activity.

IDEAL MATH CLASS

I would like to pretend that you are in control of your math class. You can decide what is taught and how it is taught. You are still in the class, but you make the plans for this ideal math class.

If students had control of their mathematics classes, they would "play games." But, by this, most did not mean they wanted to simply play in school, but rather, they wanted mathematics presented through stimulating and interesting challenges. They described how they love math when, on special days, their teachers "play" math games with them. Others recalled certain teachers who were their favorites or were good teachers because they made math fun.

According to these students, teachers should be helping students individually and not doing whole group instruction. They said that teachers went too fast and just wanted to get "through the material" rather than taking pride in individual student learning. They described ideal classrooms as communities of learners in which students collaborated in small groups and did self teaching with the teacher as facilitator. Instruction would be practical and would involve the community of work outside of the school through projects and guest speakers.

This question contained a series of five prompts. Students' comments are listed below for each of the specific prompts.

If you could describe your ideal math class, what would you be doing?

Elementary School Comments

- I would play math games. This would make it fun. Students should learn to play the game. If they are able to do ten problems right, then they are able to play. But they are able to quit when they want.

- We would be counting candy, and then when we are done and have the answers, we could eat it. We do problems with puzzles and then get candy when we are done. We also do value places with candy or toys for a reward.
- Easy math. Give more time, not so many problems, and don't mix plus and take away.
- Sitting down, write down page, and then let them go. Explain for five minutes; get a book that explains what to do.
- Interviewer notes: Students would be in groups and work on sheets and math books that could be written in. Children could also work on the board.

Middle School Comments

- We would like to play games with math problems. We could do this with music, use a sense of humor, and math jokes. Math should be taught by explaining it slow and take time to go over details.
- Interviewer notes: In an ideal math class the students noted that the work would be more advanced. More hands on experiences would be included. This would also include more games.

High School Comments

- Apply math to every day life. Explain in ways everyone could understand. Students help other students. Take it slower and involve everyone.
- Students would help other students. If one student gets their work done fast, they would help slower students. Interacting with other students by working in groups. In physics, kids help each other.
- Students would work in groups to help other students who need help. Teach mnemonic devices. Do brain teaser problems. Assign no homework.

What would your teacher be doing in your ideal math class?

Elementary School Comments

- Asking questions like, "Do you understand, or am I talking too loud?" Teachers should be helping kids who do not understand.
- The teachers would sit at their own desk and do something else. Teachers should not interrupt; mostly students are teaching themselves.
- Showing us how to make hard things like a radio or a building.
- Teachers should be helping other children.

Middle School Comments

- Different levels all in one class, also pre-algebra and math. The teacher should help others. Sitting in with groups.
- The teacher would get prepared. Replace the text book with teaching her own way so students could understand and use more hands-on stuff.

High School Comments

- Teachers would help students individually and make it fun. They would take the students on trips to learn to scale buildings. Make sure everyone participates. Ask them if they need help, make sure everyone knows what they are doing. Agree with everyone else, make learning fun.

- Teachers should give life examples. They should walk around helping, giving hints, supervising. Explain things to students. Teach students to interact with the class. Breakdown the work and use lots of examples to help with problems.

What would you study or learn about in your ideal math class?

Elementary School Comments

- Should study about telling time.
- No pluses or minuses because they are too easy. Instead do multiplication and division.

Middle School Comments

- Making patterns and working with maps.
- Interviewer notes: Students noted that they would focus on different areas of math including geometry and algebra. Basic and advanced math would be also studied.

High School Comments

- Designs. How to make scale models of buildings to help in designing airplanes. Basic math along with life math. Work with formulas to be able to use computers. Make it based on real life stuff.
- Learn more useful math applications and more general life things. Learn some short cuts. Relate to what people are interested in by using projects and examples.

What kinds of activities would you be doing in your ideal math class?

Elementary School

- Jumping while counting. We could have high school students help us with hard math problems.
- Interviewer notes: Students wanted to do times tables and fractions. Also students would work on the chalkboard.

Middle School Comments

- We would be doing critical thinking, math games, and stories with prizes.
- Interviewer notes: Students wanted more field trips so they experience math in the real world rather than just from a book.

High School Comments

- Use visual aids and hands on. Ask kids in the class what interests them. Take students on field trips more often, maybe to MSOE. Bring in career speakers. Do more word problems, reports, and use objects. Slow down and use more specific examples. Do more one on one. Bring people in to talk about careers.
- We would take trips and see how math is used in different jobs. We could get speakers about math and math careers.

How does your ideal math class differ from what typically happens in your math class?

Elementary School Comments

- Now we have to sit quietly and do our math problems. We want to jump and move around more.

- Class now has too many problems. Teacher laughs behind students backs, and teachers talk out in the hall and disrupt students.

Middle School Comments

- They could take assignments out of the book, I suppose, but also make up some of the problems. Take everything a lot slower. Do not do everything the same. They should change their teaching and relate problems to what you are doing.
- Classes would not be boring; there would be more advanced classes.

High School Comments

- Now they work out of book instead of creating stuff. They just do what they have to do, but do not explain application. Teachers in trig help everybody. Teachers do not know how to take pride in students' progress. Teachers should combine and review work.
- My teacher does not ask questions. Groups are too crowded. Groups do not work at times because friends just want to visit. Teachers just talk; they should slow down. Some teachers are just interested in wanting to get through the material. Students need time to learn it. Teachers need to walk around and help. Some teachers get off the subject. More field trips.

IDEAL SCIENCE CLASS

This time I would like you to pretend that you are in control of you science class. You can decide what is taught and how it is taught. You are still in the class, but you make the plans for this ideal science class.

As with the question regarding ideal mathematics classes, students want to do hands-on learning in science. They want to learn through practical experience especially through experimentation. If given control of their classes they would set up experiments and take field trips. These were not elaborate field trips involving long bus rides, but rather could simply involve going outside more or taking walks to examine what was around the school.

Elementary students want science taught more frequently. Most students could not specify when or how often they had science adding that they just did it when there was extra time. A few said that was once a week; most said it was two or three times per week. Students were more specific if there was a science teacher in their school. However, in those cases, science instruction fell to the science teacher with little incorporation by the classroom teacher according to the students interviewed. Again, students said that teachers should present material more slowly making sure that each student is able to learn.

This question contained a series of five prompts. Students' comments are listed below for each of the specific prompts.

If you could describe your ideal science class, what would you be doing?

Elementary School Comments

- To make the class more interesting, it should be taught in a way that makes it fun for the students. There are too many kids in the classroom.
- Experience. Lots of experiments.
- I like experiments like making a volcano, cleaning water, using dirt, beakers, food coloring cups, pie tin, baking soda.

- We'd make all kinds of new things like cut out your body. While we were sitting down and working we might get a sticker. We'd make books, color, make a journal, or write about insects, water, and stuff.
- We would make mummies and do something else besides teeth. Our teacher wouldn't treat us like we were in kindergarten.
- We would work with animals like frogs. We would work with clay to make houses.

Middle School Comments

- I'd like to do more experiments, work with the microscopes, and dissect animals. Learning from the book is boring, and there should be no science labs. The classroom is the science room.
- Interviewer notes: Students feel that participating in more field trips is important. Also, hands on activities would be included.

High School Comments

- More labs should be included, for instance, one a week. Notes taken during class should be cut down. Relating what we learn in class to how we're going to use it on the job would be helpful. Physics should have more labs, and there should be oral practical labs.
- There should be hands-on experiments, more dissections, more discussion, and not so many things going on at once. Do more experiments and show how they relate to real life. More experiments to see how chemistry works. Also, there should be lab projects, more field trips, and more hands on stuff.

What would your teacher be doing in your ideal science class?

Elementary School Comments

- Our teacher could get books about experiments, and we could pick out which ones we wanted to do. Teachers would help with research and get the materials organized so the students can work.
- The teacher would help students with their work.
- The teachers would help with projects and give instructions. They would give out chemicals for experiments and tell us what to mix together.

Middle School Comments

- My teacher wouldn't change anything about what she was doing.
- The teachers would help with projects and give instructions. They would give out chemicals for experiments and tell us what to mix together.
- Interviewer notes: The students wanted the teachers to teach more math and science because those were their favorite subjects. Students liked attending fairs, buying their own supplies, and picking topics they wanted to learn about.

High School Comments

- The teacher would help the kids understand, make sure they do things right, show examples, and do the experiments themselves before the students do them.
- The teacher would not talk about his/her family. He/she would bring the equipment in, help students learn, and also be safe.
- The teacher would be active in the classroom by directing students, working with students, and participating with the students.

What would you study or learn about in your ideal science class?

Elementary School Comments

- We would learn about spiders and mummies.
- We would learn about sounds.
- We would learn about the weather and electronics.

Middle School Comments

- We would learn about space, animals, elements, and matter.
- We'd learn about lots of different things like, how machines work, how remote controls work, how light comes from a switch, and how a T.V. gets its signal without an antenna.

High School Comments

- We would study about the earth and the environment. We would learn more about how chemistry and physics affects our life, the sky, and more about the things around us and how they affect us.
- We should have more chemical experiences, more hands on experience, like building and launching rockets, and more dissecting, and looking into real life.

What kinds of activities would you be doing your ideal science class?

Elementary School Comments

- We would use computers, VCR's, do things with live animals, play games that you would learn a lot from, and have a science show with projects.
- We would do hands on activities.

Middle School Comments

- We would do experiments and dissect animals.

High School Comments

- We would do experiments with objects from every day. More labs and more science field trips should be done.
- DNA experiments should be conducted, and more dissections.

How does your ideal science class differ from what typically happens in your science class?

Elementary School Comments

- Now we use worksheets. We don't do many experiments. We would like to do more experiments. All we do in science is activities with cards and work out of the science book.
- Interviewer notes: Students were confused about what would be different.

Middle School Comments

- Our teacher would be more active in the classroom instead of just sitting.
- We always have to take notes and watch stupid movies. We read the chapter and then answer questions. The experiments that are done are kindergarten ones.

- Interviewer notes: Students wanted to participate more in the planning of what they study. Also, more hands on activities would be included.

High School Comments

- Now teachers are the ones who mostly talk; they should ask for more opinions from the students.
- We do not interact; we just learn the formulas and subjects.
- There should be more field trips; we haven't had one in four years.

Individual Work or Group Work

In math or science class, if you could choose, would you rather work in groups or alone? Why?

Although more students preferred to work in groups, there were a large number who wanted to work individually. Most often the students who preferred working individually were those students who were achieving. One middle school group in particular felt that they were being held back by having to work collaboratively and having to help other students.

Elementary School Comments

- Groups, because groups go faster and you can get help and give help to others.
- It all depends on the subject, for instance, science should be worked on alone while math should be worked on in groups. Sometimes cheating occurs in groups so then people should work in pairs, not big groups.
- I like working with a group and by myself. Because you want to work with all your friends, when you work with all your friends it's easier because they can help you. You also have more people and they can help you understand.
- Other people disturb me. I can't get my work done because other people ask me things. Other kids can confuse you. Some kids mess up and also talk so then their group doesn't get a sticker. But, in groups there will be somebody to help you and help you get all the answers where you might not have working alone.
- Interviewer notes: Students liked working in groups and alone. The students responded that they get help in groups but working alone makes it easier to concentrate and it is also quieter.

Middle School Comments

- Working in groups is more fun and you can learn from others. You can also get more done, share, learn faster, learn to work together, and get everyone's opinion. The only bad thing about working in groups is that sometimes people get off the subject. That's why groups should be limited to two or three people.
- Interviewer notes: Most of the students like working in groups to share their ideas. They like working alone when students in their group did not share the work.

High School Comments

- There are advantages to both. Working alone is less disruptive, but group work is more supportive.
- Math should be done alone to enable students to solve the problems by themselves. Science is a more interactive subject and should be done in groups. It makes science easier to understand.

WHY STUDY MATH AND SCIENCE

A lot of kids wonder why they have to study math and science in school. How will it help you with anything outside of school? Can you give me some examples?

Students saw the practical need for mathematics instruction primarily for daily life skills rather than job skills. For example, most students thought mathematics would help them count their money, cash payroll checks, and write checks to buy things.

Overall, students had more difficulty expressing the value of science education. Almost all responses reflected a use in the future; students did not relate their mathematics and science education to their current lives.

Elementary School Comments

- You need these subjects for college. That's the best part of school because you can learn a lot, for example, how to clean up the earth. If you grow up and have children you want to be able to help them with their science and math.
- You need science and math to get a good education. You also need them to learn how to use money, dividing things, dividing dirt, raking your yard, making a garden for seeds, figuring out how fast you go when you rake your yard, or how to count money so people don't rip you off.
- Almost every day in your life you need to use math somehow. For instance, getting a discount in the shopping mall. I want to be a marine biologist so I need science. On the other hand, a lawyer would need math for his profession.
- It will help in college. You will be able to answer your own kids questions.
- Interviewer notes: Some children said they did use math when using money. They felt that science was not needed. Overall, they had mixed responses.

Middle School Comments

- You need to know math in order to "get big money." You have to use basic math in order to "get a job." You don't really need science as much as you need math. Different people need different things.
- Interviewer notes: The students felt math and science were important in getting a job. They gave the following examples of how math is used: purchasing of items—knowing whether or not you get the correct change, and working in a shoe store—knowing how to arrange boxes.

High School Comments

- Science and math will be used in daily life activities and in knowing the environment. Science and math will be used in your college career and for solving problems, using formulas, and converting temperatures. You can use science and math to help your own children learn when you have a family.
- Math will help you get a better job, and after you have the job it will help you handle the money you receive. Science can also help you get a better job. Science helps in living your life: like just understanding weather changes.

MATERIALS, TOOLS, AND TECHNOLOGY

What kinds of special things-things like materials, tools, toys, equipment, and machines-do you use in your math and science classes?

Do you ever use calculators or computers in math or science class? How often do you get to use them? or Would you like to use them? Why? What types of things do (would) you use them for?

The most frequently used classroom materials and equipment are paper, pencils, chalkboards, and overhead projectors. When students elaborated on special equipment used, it usually related to special projects they had done especially in science classes. This use of special equipment more often appeared to be the exception rather than the rule.

When asked specifically about calculators, elementary student informants painted a picture of classrooms where calculators are used for specific unit instruction rather than daily use. On the other hand, high school students used calculators on a daily basis. Use of computers varied on a school by school basis depending a great deal on the resources of the school. Computer usage in elementary schools was higher in classrooms which had multiple computers. Students tended to describe use of computers as an isolated activity most often associated with computer labs rather than integrated into overall classroom learning.

Elementary School Comments

- Sometimes calculators are used, but not science equipment.
- In science class we use blocks, beakers, measuring cups, plastic cups, paper cups, water, cubes, rulers, papers, pencils, chalkboards, calculators, and computers. We very seldom use calculators to check answers, maybe about three times a year. We use the computer for circus math.
- In science and math we use computers and calculators, we also used sheets of paper and rocks. Some teachers would be upset if we used calculators.

Middle School Comments

- Interviewer notes: The students reported using a variety of materials, such as colored counters, straws, calculators, and computers. The students felt that they used calculators about the right amount of time.
- Interviewer notes: The students reported using compasses, protractors, algebra lab gear, geoboards, and calculators. Students said that there are no computers in the classrooms, but that there is a computer room for course study only, computers are not used in math and science class. Science classes use more equipment than math. There are no animals in the lab except fish.

High School Comments

- More science equipment should be brought in.
- Interviewer notes: Students did report using computers to study math and science. Some students stated, "Everyone is required to have a scientific calculator in Algebra; the students are not allowed to share." Students also reported using telescopes and other science equipment.

WHO IS GOOD IN MATH

Think of someone in you class who is good in math. Why did you pick that person?

Students perceive someone who is good in math as one who gets good grades, does their homework, and works hard. Good students are often quick. Few students expanded their responses beyond traditional measures of academic achievement. Several high school students saw the good student as one who solved problems and was more of a critical thinker.

Elementary School Comments

- I'm good at math because we took a math test and I got a 100 percent. John because he knows all the answers and he has all stars. Our teachers because they finished school. Mary knows how to read a lot of big words, and she knows math and blurts out answers.

- They know how to do division, do problems right the first time, and do times tables quickly.
- Because he is my best friend. When he helps me with my math, I get an A. She's fast and gets the right answers. He helps me to learn. He does his work real fast.
- A person good in math works fast, knows all the answers, and gets good scores on papers.

Middle School Comments

- Interviewer notes: The students responded that individuals who are selected for special activities are good in math. They also felt that students that get the right answers and can do it quickly are good in math.
- Interviewer notes: The students responded that students good in math "back up" their answers, always give the right answers, ask questions to make sure they know the answers, are enthusiastic about participating, and always do their homework.

High School Comments

- The good math student participates in class. They set goals for themselves..
- Interviewer notes: The students responded that good students have a good understanding of math, never give up on a problem, think logically, work harder, and work things out. The good student is also more helpful than the teacher, always answers the teacher's questions, catches on quickly, helps others, and solves brain teasers.

WHO IS GOOD IN SCIENCE

Think of someone in your class who is 'good' in science. Why did you pick that person?

Student responses for being good in science were similar to the responses for being good in mathematics. Students perceived someone who is good in science as one who gets good grades and works hard, as well as understands, remembers everything, and is able to help other students.

Elementary School Comments

- The good student listens and understands, is fast and right, can be fast and wrong, and gets work done.
- A good student works quickly.
- She learns a lot of stuff. He is good in science because he can make a volcano. He helps me finish earlier.
- She is good because she gets a reward or treat. He is good because he does his work. There are a lot of kids in my class that are good at Science because they sit down, be quiet, and raise their hand politely.

Middle School Comments

- A good student works out experiments and works to get answers or conclusions. They are good at figuring out questions. They are leaders and they enjoy science and like to figure out answers.
- Interviewer notes: Many of the students identified students as good in science because they could help others when they have problems.

High School Comments

- He is a good student because he knows and understands. People who keep up or finish quickly are good at science. Good students are intelligent, make it more fun, remember everything, know more than other people, will major in science, and don't mess around a lot.
- The good student works on their own and puts in extra effort. They do outside readings.

WHO HELPS YOU

Sometimes people find math or science difficult. Tell us what you do when math or science is hard for you. Does anyone at home ever help you with your math or science work?

When students have difficulty with their mathematics or science work, they most frequently turn to a family member for help. Students said their mothers and older siblings help them; fathers were rarely mentioned. The students also ask friends, but with less frequency. Although several students stressed the need for students to not be afraid to ask questions of their teachers, one group of middle school age students said it is difficult to get help from teachers because of limited time. Often, students who are bussed arrive too late in the morning for help, and, according to these students, their teachers were unavailable at lunch and left immediately at the end of the school day.

Elementary Schools Comments

- My brother helps me. My older cousin because she gives me all the answers. My sister and my mom help me. Our niece helps.
- My mom, brother, and friends help me.
- You can't be afraid to ask questions to say "I don't get it." My sister and my mom help me.

Middle Schools Comments

- Interviewer notes: The students stated that they ask for help at school because they don't get help at home—the parents have not used the skills and don't remember how to do the work.
- Interviewer notes: Some students ask an older sister or other family member to help them. Some students look in the book for a related problem to help them figure out the problem they are working on. One student's father helps when he knows the answer.

High School Comments

- I ask the person next to me in class for help. Ask a family member at home for help. Ask the teacher questions in class or stay after class for extra help. Ask a friend.
- Interviewer notes: Some students suggested that when problems are hard students should brainstorm and consider all the options. Another student commented, that if he/she finds something interesting he/she tries to persevere and figure it out, if it is not interesting they "just forget it."

TEACHERS' ATTITUDES

Do you think your teachers like math or science? How can you tell?

A great deal of variability occurred in the students' responses to this question. By and large, students felt their teachers liked mathematics and science because they had enthusiasm and wanted students to learn. But, these students also perceived that their teachers like mathematics better than science. They based this on the fact that their teachers teach mathematics every day, whereas science is taught infrequently.

Elementary School Comments

- Yes I think my teachers like math and science. The teachers talk to each other and do things before the students come to class. The teachers learned it and now they want to teach it to us. The teachers smile a lot.
- The teachers help students with assignments. They must enjoy it because they teach math everyday.
- No. My teacher is mean. The teachers want students to get answers wrong. The teacher doesn't know math herself, she has to look in the book for answers.
- Yes, the teachers enjoy math and science as much as we do. Bob likes science and important history facts. The teachers make learning games. The teachers may like math and science, but hate when they have to keep explaining things. Teaching to Bob is like a big game, nice and funny, but we are still learning.
- Yes the teachers like math and science because they make it fun.

Middle School Comments

- Interviewer notes: The students felt the teachers liked math because they teach that subject.
- Interviewer notes: The students thought the teachers liked what they teach because they were eager for the students to learn it and they work hard to help the students understand.

High School Comments

- My math teacher likes math, but my science teacher is burnt out so he/she doesn't like it. It is necessary to like the subject you teach in order to teach it. All my teachers like it. My teachers like it because they chose that profession. They like it because they spend all their spare time talking about it and learning more about science. It would be hard to teach if you didn't like it.
- The teachers like teaching. You can tell 'cause they have enthusiasm and are helpful and interested in students. They are like your friend or your "dad in school."

OTHER STUDENT COMMENTS

Is there anything else you'd like to tell us about your math or science classes?

Elementary School Comments

- If we didn't have math and science, our principal would feel sad and unhappy that kids couldn't learn math and science. The school would have to get tore down.
- Teachers should be nice! We should have science every day. I like to learn about everything. Studying dinosaurs is fun.

Middle School Comments

- My teacher always has a smile on her face.

- We wish we had equipment so our teachers didn't have to skip chapters because they don't have microscopes.
- Our teacher lets us do experiments instead of using books all the time.
- Math and science can be boring if the teachers just give the students worksheets or if it is not challenging.
- My teacher was a college professor and has all of these degrees. He says class is so rowdy, but he sticks with it anyway.

High School Comments

- The classes should be smaller so that there would be more individual help. I think they should only have 15 to 20 students in our classes.
- I really enjoy my classes. My teachers are always willing to help. The class depends on how interesting the teacher makes it.

STUDENT QUESTIONS

Is there anything you would like to ask us?

Elementary School Questions

- Why did you come here?
- Do you have any children? They might make friends with us some day.
- What are you going to do with the tape?

High School Questions

- What kind of math and science did you have? Did they have the books? What is this grant you're working on all about? Where would the money go?

TEACHER GROUP INTERVIEWS

Forty-two groups of teachers were interviewed for a total of 188 teachers. Ninety-one were elementary school teachers, 63 were middle school teachers, and 34 were high school teachers. Twenty-nine percent of the teachers were males and 71 percent were females. Seventy percent of the teachers were Caucasian, 21 percent were African American, five percent were Hispanic, and five percent were from other ethnic groups.

The interview questions are stated below. Each interview question is followed by a summary and an illustrative list of teacher comments. Because the interviews were conducted in small groups, each bullet is a compilation of comments from several teachers.

GOALS

Let's begin by talking about your goals for teaching mathematics or science. I'd like a few of you to talk about one or two of your goals, and then have the rest of you comment on how your goals are similar or different or describe additional goals.

The comments of teachers indicated that they strove toward goals for more practical, hands-on instruction in classrooms. They wanted to teach mathematics and science using a problem solving approach which was more applicable to everyday life.

Although several teachers viewed their goals as transmission of curriculum content, most strove for broader goals of critical thinking and problem solving for students. Computer literacy was also mentioned frequently.

- Our philosophy is to stress the science and math specialty of the school. But the District places emphasis on reading and writing and computation and math—not problem solving, so the message to teachers is science isn't as important. The school district stresses tracking and rote memorization. The kids need problem solving. We need to teach how to get the information.
- To increase the interest level of kids by making them aware that math and science are a part of their everyday life.
- Our goals for math include: counting, shapes, adding, subtracting, fractions, sizes, patterning, and money. For science our goals include: bodies, animals, food groups, and the environment.
- My goal is to get the youngsters to handle math and problem solving situations—when they have a problem, knowing how they can go about attacking it.
- Our goal is problem solving and meeting the five Chapter I areas. This involves problem solving where the children can explain what they do when they solve a problem and are able to use different strategies. In that same line, I decided I wanted to focus in on relationships to involve critical thinking and problem solving skills. For the fourth grade, team problem solving is also our goal.
- To become more comfortable with computers and prepared for high school. We want students to see the connection between math, science, and the real-world.
- To get computers in the classroom, implement more science programs and science themes such as nutrition, college, and the environment.

NEEDED RESOURCES

What do you feel is the most important resource needed to truly make a positive change in your mathematics or science program?

Time and materials are what the teachers cited most often. Time is particularly needed for planning and staff development. Teachers feel they need more manipulative type materials especially for science. They would like science rooms, equipment, computers, and materials. They also felt that they need more support, such as, from administrators and staff development programs. This was most evident when teachers discussed integrating their curriculum.

- We need inservice within schools and money for subs so that staff development could occur at the school site during the day.
- The most important resources needed are more hands-on experiences and more science manipulatives. Science is not integrated into the curriculum well enough. We need inservice time.
- We had a lot of help from the Central office and we no longer have that. There is not that help of a supervisor. You have to figure out your own methods. I finally figured out that every method is good. They are all wonderful. Different children can learn under different methods. The problem is that I cannot separate the children. Sometimes manipulatives are mixed together in the classroom.
- We don't have a science room. We don't have very much science equipment and computers. Over the years, I have seen a decline in the use of materials. We don't have that kind of money.
- Sufficient manipulatives for each child to have their hands on something. I think we need a sufficient amount of manipulatives.

- We need more "things" and more places in which to store them. We also need proper space in which to use them. We should have one science kit set for each school.
- Materials now are shared and not easily used. In order to makc a lot of this meaningful and time this all correctly, we may be correlating this with a language arts units. All of a sudden you realize all your needed materials will be unavailable. Trying to do a holistic integrated approach complicates this even more.
- With poor materials, we then digress to the old books.

BARRIERS TO EFFECTIVE INSTRUCTION

A lot of things can get in the way of effective mathematics and science instruction. What are the biggest barriers to effective mathematics and science instruction?

What factors or conditions make it possible or difficult for each of you to regularly engage your students in hands-on investigations or in small group work?

Teachers found an insufficient amount of time was their greatest barrier to effective mathematics and science instruction. They wanted more time for planning, teaching, integrating, collaborating with other teachers, and for their own professional development. A lack of adequate materials was also a serious barrier to effective instruction. Teachers feel there should be enough materials for each student to handle their own manipulatives during classes. Other barriers discussed included teacher attitudes, lack of familiarity with content, assessment, parent apathy, and large class size. Teachers said that many of them and their colleagues needed to be open to change and less apprehensive regarding hands-on instructional methods. They needed to know their content better and present it in a more practical manner. It was also mentioned that parents needed to be more involved and needed to understand that use of methods which stress problem solving are more accurately measured through performance and authentic assessment methods.

- We need materials, planning time, equipment, and training time. The self esteem and interest of the kids is there; it's just that extra effort of both the teachers and the students is needed to get a unit completed. This is both time consuming and frustrating.
- Barriers to effective instruction are poor materials and lack of planning time.
- Class sizes are too large, and we have no teacher aides.
- Emphasis is placed on standardized tests over performance tests. Teachers are reluctant and apprehensive of hands-on methods—we need more staff development. Some teachers have a lack of familiarity with content.
- Performance is not accurately measured. Social expectations differ from current reality, especially as perpetuated by decision and policy makers.
- Parents' negative attitudes is a barrier, for example on conference day when the parents say "I was never good at Math."
- This school is very large yet there are far too many kids. They are packed to the gills. It was built for 500 kids and they have more than 800.

TECHNOLOGY

What are the strengths or needs of your school related to the use of technology for teaching mathematics or science?

Comments covered a vast range. Some teachers were quite satisfied with the technological equipment in their schools. Others felt they had sufficient calculators, but needed more computers and advanced technology, while others felt they were inadequately supplied in all areas. Teachers, particularly resource teachers, mentioned the need to improve their own skills in using technology.

- We have a computer lab. There is a good mix of reading and science programs—not just word processing. We do integrate technology, but we could be doing more.
- There is literally no technology here; we have very limited computers, both in numbers and usage.
- We have lots of computers and manipulatives. We need money for the newest technological advances, packages, and so on.
- In the sixth and seventh grades, it is set up that every kid has a calculator. In the first grade, they have them, but they have to share. The eighth graders have nice graphics calculators.
- In the eighth grade, teachers are comfortable using calculators, but the other ones (K–7) aren't used to it yet. We want to make sure the kids get the basic idea of math and use the calculators for the problem solving.
- We have lots of calculators. Interactive videodisc players were just shipped in last week. One of the drawbacks I find is that they have to be used by someone who is actively into teaching science, but with our new curriculum and lack of space and time, they may never be used adequately.
- We have a limited number of computers, opportunities to explore other materials, and to share with other teachers.
- There is a computer program and we have calculators, but we need many more computers and labs.

ASSESSMENT STRATEGIES

Let's talk about monitoring students' progress and understanding in mathematics and science. What kinds of assessment strategies do you use in your classrooms?

The most frequently mentioned innovative assessment procedure was portfolios. Teachers ranged in their feeling about portfolio assessment from feeling very comfortable to apprehensive. Although use of portfolios was more common in other areas of the curriculum, their use in mathematics and science assessment appeared to be increasing. In many situations, portfolios were being initiated and used in combination with other assessment measures, many of which continued to be more traditionally based, such as tests and checklists. Observation was also seen as a valuable assessment strategy.

- We use a combination of grades, observation, and are beginning to use portfolios. We are already beginning to use video portfolios.
- We use some testing, observations, projects, reports, and portfolios.
- The assessment strategies we use are individual observation, science and math journals, and we are learning how to do portfolios.

- Our assessment strategies include checklists, observation, and oral and written work.
- We use more performance assessment level now, with math particularly. I don't think that testing is necessary at the first grade level. We see if students can make the generalizations that they have discovered. It's more performance oriented. Teachers make up the tests on their own. It's not coming from the book anymore.
- Well, I use a math journal, students record different things in there. I use a portfolio in writing and reading, but not in science. I think some teachers do, and they look at them every six weeks.
- We use portfolios as part of Chapter 1. I do them with another teacher who gets involved with performance assessments. I don't even have a grade book; I pull the portfolios to justify my collaboration on the grading.
- We have assessments on the computers of math and science concepts. My math evaluation is all done on performance assessments, a lot of them being pictorial things put into portfolios. In math problem solving, they must show the five steps and explain them. My assessments are mostly written with some board performance and spot checks.

PERFORMANCE GAP

Why do you think there is a performance gap between White students and minorities in mathematics and science?

According to most of the teachers interviewed, low socioeconomic status was cited as the primary reason for the performance gap between White and Black students. Teachers mentioned that students from low socioeconomic environments do not have the exposure and educational opportunities that higher socioeconomic level students do. It was also noted that parents are sometimes unable or do not understand the need for early educational experiences for their children. Several teachers also mentioned discrimination in assessment, different learning styles, poor teacher-student communication, and low expectations as possible causes for this achievement gap along racial lines, but low socioeconomic status was the strongest perception identified by these teachers.

- Exposure. All parents don't take their kids places. Most Black parents don't take their kids exploring things on weekends. They just don't do it, maybe they don't have the money to do it. I'm amazed what students have never been exposed to.
- I think it's the status of poverty of the children rather than if they are Black or White. Parents don't know what they should be doing for their children before they get to school. Statisticians have found that more children are raised from single families. Being if they are White, Jewish, or Black, they just don't have the money. What single parent would have the money to take their child out? They don't even go out to their yard and discover what is out there. They would rather watch T.V. There is no conversation going on, especially with the young parents. Even if we sent home materials for them to work with, they don't know how to use them. I often ask myself, "What kind of homes do these children go home to?"
- Socio-economics. It relates to the education level of mothers.
- For all minority students, we must change assessment strategies to better assess students in ways they are able to relate.
- The ITBS is 15 years old. There is discrimination in standardized testing.

- Black students learn differently. They learn by doing; they're more mobile and physical.
- Students are influenced by their home, uneducated parents, low socio-economic backgrounds, and lack of teacher-student communication. Teachers need more multicultural education.
- Minority kids don't see what their life in school has to do with real life. The "cultural expectations" support minority kids not attempting to succeed.

STAFF DEVELOPMENT

What, if anything, could be done differently with respect to your staff development that could improve your ability to implement your mathematics and science programs more effectively?

The MPS teachers interviewed said they want more staff development specifically in hands-on instruction for using manipulatives in problem solving. Several complained that, although the amount of staff development has been adequate, the quality and appropriateness was not. They said they were often required to attend programs which were not matched to their needs. They do not want lectures, but practical instruction that will enable them to use these methods effectively in their classrooms. The teachers also expressed a need for further professional development in computer skills. Some admitted that they do not use computers or calculators in their teaching because they do not understand them well enough themselves.

- Need to address teacher reluctance and apprehension for hands-on learning.
- We need more staff development and inservices, not more meetings and lectures, but more time for collective planning.
- I think when they brought this in, what two years ago, many of the teachers didn't have enough training. I try to talk to some of them about it, but they are often reluctant about using them.
- We didn't do much with the materials because time is the most important thing. Your trying to get everything in and you don't do all of it. I tried to get everything from the book, but it is difficult and we need staff development for manipulatives.
- One goal of the computer lab is to help teachers try to meet their goals, a sort of resource for them.
- We need additional equipment, inservice time, computer purchases, material purchases, and laser disk inservice.
- Teachers don't know how to work all of the calculators. It's new to them. They need training so they can use them in their classrooms.

OPPORTUNITIES FOR TEACHERS TO INTERACT

What opportunities are there for you as a mathematics or science teacher to discuss or share ideas and resources with teachers of similar or other curricular areas?

Most teachers reported that they do not have a formal structure built into their workday for collaboration and cooperative planning with other staff members. Whatever efforts are made are left to the discretion of individual staff members. Several faculties as a whole reported trying to encourage their members to devote extra time beyond their working day toward this effort, but again, this is at the discretion of each teacher. According to teachers, few or no opportunities for sharing and collaboration on a district wide basis exist.

- We take initiatives on our own. There is no opportunity otherwise.

- It's very rare. We are trying to get teachers to come to school early to working together on planning themes and integrated learning experiences.
- We always make an effort but it's difficult to execute because of time and class coverage interference.

INTEGRATION OF SUBJECTS

It's often difficult to integrate mathematics and science with other subject areas. What successes have you had in doing so?

Many teachers interviewed felt that they should be integrating their instruction with other curricular areas and with other grade levels, but they were not. They reported being unable to do this because they had inadequate time to plan cooperatively. They also felt the structure of the school and schedule was not conducive to integration. For example, groups were not organized around instruction, but rather isolated to grade level classrooms; materials were not readily available to foster flexible integrated instruction.

- Some integration is being done through the math and science resource teacher. Integration is a goal that needs much more work.
- Science is not integrated into the curriculum well enough. We need inservice and time for discussion between grade levels and different subjects.
- I can do anything I like. I can go with another teacher and team teach or just skip it. It's up to the initiative of teachers, but we don't have enough time to plan for any of that, and we don't have many groups at the same level.
- We used to integrate reading, but not science or math. I think it's encouraged. Our club program is certainly integrating between all the grades. We have many clubs that meet four times a semester and are mixed with all grades. We have bowling, drama, illustrations, and so on
- In order to make a lot of this instruction meaningful, we need to time everything correctly. We may be correlating instruction with a language arts unit, and all of a sudden you realize all your needed materials will be unavailable. That's what happens when you're trying to do a holistic integrated approach.

FAMILY INVOLVEMENT

Could you describe the level of family involvement in your school?

Perceptions of family involvement varied from school to school ranging from very strong to poor. Those with poor family involvement cited several primary causes including, (a) parent's lack of time primarily due to work, (b) parent's unawareness of the importance, (c) transportation problems, and (d) poor parental attitudes. Teachers felt that their schools should be doing more to foster family participation and better communication.

- Participation fluctuates. We have many working parents, and because we are a city-wide school, we have transportation problems.
- Our level of family involvement is average.
- I think parental involvement is the one resource we don't have.
- Not enough. Our PTA consists of two or three people. Some parents respond to conference day, but it is not consistent, and that is what we need. Parents come once a year.

- You need that parent to take that kid to an outing. So many of our kids just don't have experiences with going to the zoo or outside to view plants. It's amazing that parents just don't have the time to educate them. Both parents work. Parents don't know the importance. We have so many young parents, and they don't know what to do.
- Single families don't have the time. They have negative attitudes. The textbooks should have experiments that are easy to do at home with stuff everybody has. That's how our math homework is, but that's how it should also be in science.
- Our parent involvement is very strong, but we still always need to develop ways of reaching out to those parents that are unable to participate or communicate with teachers regularly.
- Efforts to increase our level of family involvement have been unsuccessful. Some parents work with children on homework and come to open houses. Not much more though.

COMMUNITY SUPPORT

Could you describe the level of support from business and industry, cultural agencies, and other community organizations for mathematics and science in your school?

Teachers frequently did not know if they had a business partner and often referred to past business relationships. Of those that knew their current business partner, most described benefits that were in the form of tangible rewards. A few teachers described business relationships which were collaborative where members of the business participated in the school itself.

- We have an active SBM [site-based-management] group. The community is generous at times, but our local community is not vested in the children. We had a business partner, but we're not even sure who that is right now.
- Target is our business sponsor. This just meets general sponsorship needs and is not specifically for math and science.
- We work with the Catholic home. We used to get tutors from the YMCA, but we haven't got that kind of support from business. We do get support in that they offer the kids rewards, For example, Wendy's and The Chancery give prizes for the kids. The YMCA, before it went out of business downtown, used to support us with tutoring, swimming, and basketball, or whatever. They offered student rewards, and it worked great, but we don't have that anymore.
- We have two business partners, one is the local vocational college and the other a small, local business which helped with our career days. They also do in school visits and sponsor workshops and field trips.

PRINCIPAL INTERVIEWS

Twenty-six principals enhanced the landscape picture of mathematics and science in MPS by providing the administrative perspective. Sixteen were elementary school principals, six were principals of middle schools, and four were principals of high schools. Thirty-eight percent of the principals were male and 62 percent were female. Fifty percent of the principals were African American, 46 percent were Caucasian, and four percent were Hispanic.

The interview questions are stated below. Each interview question is followed by a summary and illustrative principal comments. Because the interviews were conducted individually, each bullet is a response from a specific principal.

RATINGS OF MATHEMATICS PROGRAMS

On a scale from 1 to 10, with one being low and ten being high, how would you rate your mathematics program and explain why?

Ratings for the mathematics programs ranged from 5 to 8. The mean rating was 7.2. The frequencies for the various ratings are listed in table 3-1.

Table 3-1 Ratings of School Mathematics Programs

Rating	Frequency
5.0	1
5.5	0
6.0	5
6.5	2
7.0	3
7.5	5
8.0	6
8.5	3
No Response	2

Principals told interviewers that their teaching staffs consisted of dedicated professionals who cared about the learning of MPS students. They felt their mathematics programs were stronger than their science programs and attributed this to teachers feeling more comfortable with the subject matter and instructional methods traditionally used in teaching mathematics. They added that, for both mathematics and science, teachers were too dependent on paper and pencil tasks and textbooks, and that they needed to use more hands-on methods in their teaching strategies. According to most principals, teachers needed more familiarity with how to use manipulative materials in mathematics instruction, but a few indicated that the teaching of mathematics is changing within some schools. This is reflected in the following comments.

- We have a strength in how math is taught because there is an emphasis on kids understanding concepts We use tons of manipulatives and reinforcements. Journals also help our program. We use a strong, consistent developmental sequence to mathematics instruction.
- I am not entirely pleased with our mathematics program. We need to motivate the teachers and students to break from textbooks. The teachers need more hands on training.
- We have some teachers that are too textbook driven. Hopefully, some of the staff development workshops will have them get out of that problem.
- Some teachers have reached out to the knowledge base for current information, but are uncomfortable with the new manipulative methods. There is more reluctance in intermediate and secondary level teachers.
- Teachers have to be less afraid of mathematics and know that mistakes will occur.

RATINGS OF SCIENCE PROGRAMS

On a scale from 1 to 10, with one being low and ten being high, how would you rate your science program and explain why?

Ratings of the science programs ranged from 3 to 10. The mean rating was 6.2. The frequencies for the various ratings are listed in table 3-2.

Table 3-2 Ratings of School Science Programs

Rating	Frequency
3.0	2
3.5	0
4.0	3
4.5	1
5.0	3
5.5	2
6.0	2
6.5	1
7.0	2
7.5	2
8.0	2
8.5	0
9.0	2
9.5	1
10.0	1
No Response	3

According to these principals, teachers need more contact time in science instruction, especially at the elementary level. Elementary science is taught inconsistently and infrequently compared to most other major subjects. Principals targeted four key areas for improvement: (a) Teachers need a stronger knowledge base in science content; (b) Teachers need to develop implementation skills using hands-on approaches; (c) Teachers need to recognize the importance of science instruction and provide more time for it; and (d) Schools need to make science materials and equipment more available. A few principals commented that the way to improve science instruction is to change the way it is assessed because assessment drives instructional methodology.

- I would rate our science program about a 4, because I think science does not get the attention mathematics does. The teachers know that math is something they have to teach every day, whereas science is inconsistently taught. Many teachers don't think they are skilled at science so they shy away from it. They don't have enough time in the school day, so they put science at the bottom of the list. I think science is not getting the attention that it should at the elementary level.
- Teachers are more comfortable with math because they have more knowledge about how it is supplemented and how to individualize it.
- Teachers do not do enough science instruction. They find it threatening. Better science materials and equipment needs to be more readily available to them.
- Teachers hesitate to use hands-on materials and this is most evident in the teaching of science.
- Our science program is somewhat higher compare to other schools because we use a model called Search. It focuses on sense making for kids. Students learn to work in groups, develop questions, and problem solve. We also use an authentic

assessment model which is ability based assessment. Since assessment drives teaching behavior, this is the primary motive to change teachers.

- I rated the science program low [rating of 4] because the focal point of this school is reading and language arts. We don't emphasize mathematics and science
- The teachers rely too heavily on the science lab and therefore their own teaching methods are inconsistent.

TEACHER COMFORT LEVELS

In your judgment, how comfortable are teachers with the mathematics and science programs that they are implementing and why?

Principals do not think teachers are comfortable with new methodology particularly in science, and therefore, continue to be textbook driven. They stated that there are too many who continue to use traditional methods, and added that teachers understand what needs to be done, but do not implement this in their classrooms. Several principals used new staff members and recent university graduates as catalysts for changing those teachers amenable to it, but they lamented that changing instruction is too slow.

- Several teachers are experts and the others are dependent on those. Some of the teachers in this school are still wishing for strict textbook methods which tell them what to do step by step.
- We have university students come in and our teachers have said how they learn so much from them as far as new ideas and demonstrations
- New, recent graduates are another help. We got a new person on the staff; this is her second year out of the University, and she is bringing in the "hands-on" experience our school needs. Little by little other teachers who work with her on a team are changing.
- Teachers are not comfortable with math and science. They are reluctant to give up the textbooks and move to more innovative, supplementary types of teaching methods and materials. The newer teachers out of college are more comfortable.
- There is a big leap from learning the mechanical aspects of instruction to actually implementing it .

SUPPORT SYSTEMS

What support systems are available in your school to help teachers implement their mathematics and science programs?

Only a few principals mentioned innovative support activities that showed a commitment to supporting new methodology. The support methods for teachers that principals mentioned most frequently were inservice programs and seminars. Other support activities were scheduled meeting times, informal meetings, resource personnel, and mathematics and/or science labs. Reasons cited for inadequate support were lack of time and resources due to district level policies.

- They are encouraged to share amongst themselves.
- We have mathematics and science technology resource personnel on staff who are supportive to teachers.
- Teachers participate in inservices and serve on committees.

- Our mathematics and science labs focus on providing the teachers with all the materials they need. We also have a block of time in the school schedule devoted to meeting and discussing implementation of programs.
- The school district implemented a new science series for elementary schools. The district was supposed to provide materials kits designed for hands-on science instruction. The teachers said the program cannot be implemented without these kits, but the kits never arrived.
- Our teachers meet once a month with the resource person to share and discuss problems. On occasion, this is done across grade levels.
- There is more district level support. There is on-going staff development through many of the district level initiatives. The math and science curriculum specialists from the central office push our district and support teachers towards a different type of instruction, more hands-on. At this school, the teachers network with one another and support is done that way. Our learning coordinator tries to support them too on an informal basis.
- The university needs to take a whole new approach for how teachers are being prepared. There should be a middle school certification for teachers so that we don't put people with high school or elementary (K–8) certification in middle schools because there simply wasn't a place for them at their certification level.
- There are many support programs, most based on income of students, such as, Chapter 1, but we don't get that kind of support.
- We have poor support systems at the school level.

OPPORTUNITIES FOR TEACHERS TO INTERACT

What opportunities do teachers have for sharing ideas and resources related to mathematics and science instruction?

Are there any opportunities for teachers of different grade levels to get together to work on program development or address areas of concern or need?

To encourage teachers to integrate their curricula, several principals said they provided opportunities for common planning time and scheduled meetings for sharing ideas, but most were through informal methods initiated by teachers. The most frequently mentioned barrier to sharing was lack of time.

- Sharing is limited due to teachers lack of common planning time. They really don't have the time to do those things. I would love to see the day when teachers could have some time in the day to help each other and have common planning.
- Some ways that we have teachers share is through our resource personnel. These individuals facilitate having our teachers bank time, develop assessments, and collaborate on curriculum.
- Our teachers meet according to grade level committees. They also share through committees which work with me. We also share during our inservice and seminars.
- Our structure for sharing is informal. Teachers network whenever they can. They have opportunities during inservice programs.
- At the high school level, you might have several different grade levels in a particular math class, so you have that integration already. The only one we don't have set up like that is our ninth grade. We have a certain math class just for them. Teachers also have informal networks with other schools. But, the only formal contact we have had is with our middle school down the street. We have had

inservices with both of the schools to inform teachers what classes they should recommend for students.

- I think the most informal conversation that teachers have is in the morning. I require teachers to stand outside their classrooms in the morning and a lot of time the teachers will be sharing. Because my teachers are grouped in a certain spot in the building, they are also able to converse with each other, not only before school, but during class time and lunch time. We require teachers to have monthly department meetings and sometimes more often. I do have what is called an academic committee which is made up of department chairpersons and others in the building.

USE OF MANIPULATIVES AND MATERIALS

To what extent do classroom activities include the use of mathematics manipulatives or science materials to enhance understanding? Why do you think this is the case?

Principals reported that classroom activities usually do not include hands-on instruction. They noted that the majority of teachers use traditional methods. Principals mentioned that staff members need to change their attitudes, beliefs, and motivation in order to affect a change in the classrooms. Many also cited examples of how their schools and the school district are moving in that direction. One principal was concerned that the school district has over-emphasized hands-on instruction.

- We need to motivate teachers. They are not happy with not having textbooks, and they need hands-on training. Many are still using traditional methods and do not want to change or adapt.
- Changing beliefs and changing assessments will help change teaching behavior. Teachers helping other teachers is also an excellent avenue for us to change the way teachers teach. This is badly needed.
- Obviously hands-on instruction is the wave of the future in education. Clinton even mentioned this in his state of the nation, so I believe we are attempting to address this. It's what the systemic initiative is dealing with, to see how the academic skills of the urban population are going to be enhanced and make them more employable. Its what the School To Work Program is all about. The school within a school type phenomena has picked up with the more hands-on type of instruction. I think in this building, the staff members are doing everything in their power with the resources that they have to go in that direction. There is momentum and it will grow if support comes from the central office. We need to get the curriculum end of it pulled together so that people are clear as to why this is being requested. I think it will continue to grow. There is a solid core headed in that direction from this school.
- Our school has headed toward more hands-on instruction through our relationship with our business partner. They are strong in implementing hands-on experiences for children. Primary teachers use them more than intermediate ones.
- Large class size is a negative to hands-on instruction. The students need individual attention.
- When you start to say what kids should and should not learn, this will cause problems in the curriculum. I think all areas of learning are important and to discredit one is a great shame. I think we've gone overboard with the manipulatives, which are important, but I think boys and girls need to know certain mathematical facts and skills.

CALCULATORS AND COMPUTERS

Could you talk about the availability and use of calculators and computers for mathematics and science instruction?

Principals varied in their views on the adequacy of the technological equipment in their schools. Some reported it as very inadequate, and others noted it was excellent. Most said they had a sufficient number of calculators. They felt a greater problem was that teachers did not have the technological skills to teach computer skills to their students.

- In this school we have adequate resources. There is a calculator for every student and a computer in every classroom. We have a variety from Apples to Macs to IBMs. There are CD-ROMs in our mathematics and science labs.
- My primary people have an Apple computer in each classroom. We have a computer lab with 20 Tandys and 15 Apples. We are one of the poorest schools with the lowest funding. My problem is the staff is not highly computer literate.
- We have a computer network with four IBM's in each classroom; our computer lab has Apples. We need to buy more calculators because our supply seems to have "walked away."
- Through Equity 2000, all seventh and eighth graders have a calculator to take home with them, but we don't have them for all our lower grades. The teachers don't have computers in the classroom; they schedule time, one day per week, in the computer lab.
- The school is well stocked with calculators. I've just added a computer lab that is strictly for teacher and student use. We also have a computer lab in the basement of the graphics department. We are constantly purchasing computers; there are certainly computers throughout the building. We have calculators stocked in the bookstore, and we have around 300 stocked on reserve in the math department.
- Some of our teachers are not that skilled in computer use. Some of them are taking training. I think only about a third of my staff has a computer at home.
- I would describe our technology resources as typical or above average. We have a fair number of computers, many calculators, and expanded our media resource center. We hope to tie our media resource center to our library.
- In our middle school, it is my understanding that there are not enough calculators to allow the students to take them home. There is some confusion on district policy. A bigger problem though is computers. Our Apple IIs are very old. We obtained them from PTA pizza sales money. Others were loaned from a local college because one of our teachers knows one of the deans there. That is not the way this district should be providing adequate technological resources for its students. It's frustrating for my faculty because they hear that other schools have them.

STAFF DEVELOPMENT

Have mathematics or science been the focus of any staff development so far this year?

Responses varied considerably for this question. Those principals responding negatively often had provided more general staff development programs, such as instructional methodology. Several related the benefits of these programs to mathematics and/or science. Principals also expressed frustration with their inability to reach more teachers with less financial resources.

- We haven't focused specifically on mathematics and science. Much of our focus has been on trying to get teachers to think about reforming the way they teach and starting to think about hands-on instruction.
- Math or science has not directly been our focus, but indirectly I would say it has because we are restructuring our content teaching. We started out with restructuring our Social Studies and English departments because we felt it was the easiest. We have touched on, but we have not gotten into the science department at this point.
- We have university students come in and our teachers have said how they learn so much from them. The students bring new ideas and demonstrations with different techniques.
- Teachers are encouraged to work amongst themselves. We have extensive inservices to make them more comfortable with using manipulatives.
- We are a math–science specialty school, so, yes, our focus has been on those subject areas for our staff development. We are also concentrating on the School To Work initiative.
- I had some money to send one teacher to a workshop out of state. It was excellent for her, but then we didn't have a way to continue in a supportive role for the rest of the staff. This teacher had a one shot deal which was very costly to us, and then there was no follow up or cohesiveness because of lack of funding. That is so often the case.

AREAS FOR INSTRUCTIONAL IMPROVEMENT

What are the most important things you see your staff needing to work on in the areas of mathematics or science?

Hands-on instructional methods was the most frequently cited need followed by improved technological skills. Other areas of concern were developmental and grade level expectations, improved attendance, at risk student needs, and integrated curriculum. Middle school principals felt that teachers needed to improve instruction of algebra especially in light of new graduation requirements in the school district.

- The teachers need to learn more about hands-on instructional methods. This is particularly true for science.
- The staff needs to better understand grade level expectations and the skills that each student needs at each developmental level.
- Computers. Some of the teachers are receiving training, but many more need training because they are not that skillful in computers.
- I think our greatest needs are for ninth grade teachers to concentrate on at risk students and improving attendance.
- Teaming and being able to teach integrated math and science. I think this is the most important area for teachers—for them to feel comfortable enough to work along with another teacher.

FAMILY INVOLVEMENT

Could you describe the level of family involvement in your school?

A few principals reported that their schools have large numbers of parents who are extremely involved in school activities, but this was the exception. Most principals expressed dissatisfaction with their parent participation citing parents' lack of time, job commitments, and attitudes as barriers. Specialty and non-specialty school principals were split; half reported adequate or high parent participation, the other half did not. Many schools were attempting innovative programs and activities with varied success rates. One principal found great success with the parent coordinator at the school.

- Our parent involvement is tremendous. At PTO meetings we average 50 parents. We have a parent coordinator position which has improved things considerably. This person holds meetings to promote parent involvement
- Not very good. This is an area we are working on. Our Open House is very sparsely attended; we have a student body of 800, but less than 10 parents showed up. We have open meetings on Saturdays which are poorly attended.
- I would say our parent involvement is average or somewhat below. Our parent support consists of just getting the child to school and help with homework. Most parents don't have the time because of their jobs.
- We have a high level of parent involvement. They work on the school council, curriculum committee, and with Chapter 1.
- Very little. About half of our school is bused so distance may be a problem. The year 1994–95 is designated as the year of the parent to promote involvement.
- Some are extremely involved. They run the realm of levels of involvement. We have many opportunities for them to be involved, such as special enrichment days. We encourage home support of learning.
- In high school, you will find there are a number of ways that parents are involved, for example, athletics. We have parent night for all sports. We also have other programs, such as a renaissance program where we have a pancake breakfast. We sponsor parent workshops, monthly meetings for parents of special education students, and others for band parents. We have parent volunteers in our school during the day and a Booster Club.
- I think a lot of parents are wondering how they can help. I think the only way parents can help is providing the right kind of atmosphere for the child to study. As far as the content itself, I think there are very few parents who are able to help their children. Most of them are out of touch with it, except at the grade school level. But at the high school level, I think it is difficult for most parents to help their children.
- We are trying to make our school an extended family learning center where we have a lighted school house. I find that when you ask parents to come, they will come. But trying to get parents to come in on their own and volunteer, they won't. We get a very good turn out on parent-teacher conference days and at Open House, but during the rest of the year, we get the same set of parents every time. So, there is a definite need to get their involvement.

Community Support

Could you describe the level of support from business and industry, cultural agencies, and other community organizations for mathematics and science in your school?

Frequently, principals reflected on better days when business partners first began and there was more enthusiasm. Now, many of them do not have business partners. Those with community participation described involvement which was sporadic and/ r related to one specific activity. Most frequently, participation involved providing a small portion of the school's resources. Several school principals, however, were experiencing successful business partnerships and provided some interesting examples.

- We don't have any business partners now. This school had them in the past, but the interest fell off. We need to pursue this more.
- Formerly we GE Associates was our partner, but now we don't have one. They set up our science lab for us. Now all we have is a group of grandparents who volunteer.
- My support is from First Star Bank. Our first set of calculators were purchased by this bank. They also contribute some resources, such as paper, which might be used by the science department.
- Coopers and Lybrand, an accounting firm, are our business partner. They tutor students in math. They are instrumental in terms of arranging our career day. There were achievement initiatives that they assisted with that also dealt with math. MATC, which is another business partner, is involved in the career day. MATC had offered students use of their math lab, but it became too difficult to schedule. So, they are always trying to assist us especially with this School To Work program.
- For math and science we haven't had too much. Most of ours have been for reading and arts. The only one I can think of that works on a specific area is the YMCA. They tutor the kids in any subject area. We have some business partnerships, but they are not geared towards math and science. We have an environmental club and we have the community awareness club. The kids get to go to the symphony, and I guess math and science can fit into music. We focus on art more. With science, I can't think of anything.
- Our business partner is Advanced Learning Systems, a software company. They helped us with a reading program and provided technical support in reading materials.
- Wepco and Harley are our partners and they help with school projects, run fund raisers, help with field trips, and mentor math and science.
- We have one or two businesses that help us. We also have a resource person at UWM, but many of the helpers are scared of our school community.
- We have two partners. The Boys and Girls Club which funds memberships for our kids and provides boots, socks, mittens, and so on. The Kiwanis Club runs the adopt a classroom program in which 22 members are paired with a teacher and classroom.

IMPACT ON STUDENTS

What evidence have you seen that the mathematics and science instruction is having an effect on students?

The most frequent response by principals was school test scores. Almost every principal alluded to them in one manner or another. If favorable, this was the primary way principals evaluated the effect of mathematics and science instruction on their students. If the scores were unfavorable, many principals commented how educators need alternative assessments. Other ways principals judged the effect of instruction on students were student enthusiasm, interest, and number participating in other activities, such as clubs. One principal elaborated on the increased number of students enrolled in advanced mathematics classes since algebra was now a district requirement for all students.

- Students enjoy the science labs; they ask questions and are really involved. Same with math, and our test scores aren't bad.

- Our average GPA is 2.89 and we have 90% attendance. Our students are above the city standard and are doing well in math and further education.
- It's dependent upon the child. Our test scores are not showing it, but some students are real interested and enthusiastic. It's frustrating.
- The number of students that sign up for extra activities related to science and math have increased. They love the science lab.
- Definitely there is an effect. I see it when I look at my ACT scores and compare the number of kids taking advanced classes each year. With my minority students, this number is increasing, and I am proud to say that. Right now I think we have two sections of calculus. We have several sections of physics. The school system is becoming a system of minority students, and when you have an increase in those classes it is a good sign. With that and my ACT scores in the math area above the city average and one point below the state, we are making progress.
- Math has the highest attendance of all classes, and I don't know where science fits into that, but certainly we will explore and find that out.
- Aside from classroom observations, which are impressive, I will wait for test results to make an educational level statement.
- We have some students who are very interested in math and science. Sometimes our students of the week write that their favorite subject is math or science. We tested the children in math and they did improve somewhat.
- More of our kids are continuing their education and pursuing careers.
- Our school continues to rank in the top three. We were involved in the future cities and that was only three students but it was an opportunity for them. Now we didn't get any top awards, but it still is a small indication that something is going on there.

Performance Gap

Why do you think there is a performance gap between White students and minority students in mathematics and science?

Most principals attributed the problem to parents and families, highlighting economic and social status as causes. Others blamed it on low teacher and community expectations and said students then responded accordingly. Barriers included low socio-economic status and/or lack of stimulation. One principal linked the problem to the community and lack of reinforcement in the workplace which in turn lowered motivation.

- I don't think that gap is just in math and science; it's in other areas as well. I think that economics play a part in it. Our Caucasian students aren't doing any better then the Black kids coming in. It just happens that we have more Black kids in the city. I have found that the Black kids that come from parents who have a value in education do well. These parents get their kids involved in education. They do just as well as the White kids. We have more children who come from poor, deprived backgrounds; they come with a lot of social and personal baggage that are barriers to achievement.
- It's due to the social aspect of kids lives. They are stronger in math than in reading or science because of environmental influences. Society labels kids; the expectations for Black students is lower than of White students. White kids have more support at home. Kids bring a lot with them to school that hinders learning. Some kids are raising themselves.

- I can list a number of reasons, but ability would not be one. A lot of it has to do with instruction. I have noticed that there are teachers with different expectations for different children. It's been very interesting this year with our Equity 2000 program placing all children in Algebra to see how the thinking of some the instructors has changed. Inservices have helped staff members open their eyes to say that these kids can achieve, and they can learn this math. Our failure rate for Algebra is around 30%. Our failure rate for ninth graders last year was higher than that. So, it tells you something when teachers change to believe that these kids can learn. Once you get the children believing that they can learn, they will learn it. That is just one way. The gap also exists because of lack of parental involvement and coaching with some children. I think some children have a need to achieve and others don't because they don't have that kind of exposure.
- Some of it is due to cultural influences. The expectations of staff are not high enough.
- There may be a gap between White students and Black students, but the gap is not as great in math as it is in reading.
- Value differences. What's happening in the home contributes to the achievement gap—students go to empty houses instead of to educational homes.
- I think it's due to the lack of socio-economic opportunities. It becomes an issue of the importance of education. It involves the whole motivational or hope aspect, like the School To Work program. The kids will see through this very quickly if we expose them to a lot of career options, and they don't personally believe that those careers will mean anything to them. Again, that whole motivational belief system needs to be increased. I don't think a person like Fuller, as dynamic as he can be, or people within the school saying to students that this is wonderful and you need to believe this and you need to try, will work. There needs to be more of that in the community, and the business community needs to help put some teeth behind it. Universities need to accept these students if indeed they did achieve at a certain level. It shouldn't become isolated within a school district. We need to expand out to have these kids believe that it is going to lead to a future that they want.

ASSESSMENT STRATEGIES

Do you have any initiatives going on at the moment in the area of using alternative assessments in mathematics and science? If so, please describe.

As a group, the principals were excited to talk about alternative assessments. Many had initiatives beginning in their schools. Most principals described their progress toward alternative assessment as "in the early stages" with development of performance assessment measures, particularly portfolios. Several other innovative methods were mentioned, such as, videotaping, recording observations, and other informal assessment.

- We use portfolios in everything. We try new ways to assess our kids as the year goes by.
- The teachers are now keeping "dump portfolios." The students get a sense of where they started at the beginning of sixth grade, for example, and at the end of sixth grade. Then they have pieces in there where they can see themselves as what kind of learners they are.
- The lower grades use math portfolios. I believe in authentic assessment, so we are doing math videotaping for parents home viewing.

- We use an authentic assessment model which is ability based assessment. Since assessment drives teaching behavior, this is the primary motive to change teachers.
- The assessments we have done this year were strictly with instruction versus analysis of grades and attendance. That's how we determined that attendance was higher in math. We've done a lot of observing. We also used more inform. assessment by teachers and administrators.
- We use a writing component to see if critical thinking skills are being taught. Certainly the essay portion on the math exam is one way to see that. Naturally that follows one of our school board goals. That is, all kids will be able to think critically and solve problems.
- We use portfolios. We are currently designing assessment tests for specific grade levels and use informal testing.
- Teachers are into portfolio assessment. They are becoming more comfortable with performance assessments.

STAFF ENTHUSIASM

How would you characterize your staff's enthusiasm toward mathematics and science?

Overall, almost all principals expressed pride in their staffs, some more strongly than others. They said that their staffs were dedicated with the interest of children at heart. A few principals commented that the faculties needed more enthusiasm and motivation to change.

- In this middle school, those that are teaching mathematics are very enthusiastic. A lot of teachers feel very uncomfortable with math, such as social studies teachers. I think that math has always been a subject that has frightened a number of teachers. I think it is changing somewhat because of the integrating efforts.
- Good. This is a school focused on low achievement, so there is no choice but to be enthusiastic to promote growth.
- These teachers see math as a real challenge for them. They know that it is important for students to do math, and they try really hard to make sure the children meet the expectations by the time they leave our school. That is the one area teachers really work hard on.
- It's heartwarming to see so many of them spending money for the students out of their own pockets.
- The enthusiasm of my staff is not as high as it could be. We need more math development and computer usage. Our new science teacher should also promote some enthusiasm.
- I think they want to do more in science, but they feel that they don't have the knowledge, materials, or time to do it. The teachers want to focus on one topic and bring in all the subjects with that one thing. Then the children would get more meaning from that. They will see the relationship between all the subjects better. We do have some teachers who are interested in doing that.

OTHER

Is there anything else that you would like to tell us about your mathematics and science programs?

- I just wish I had more resources for the teachers to use, or training for the teachers. The large class size is negative, students need more individual attention. Class size should be around 20 and 25. Twenty would be good for first grade, 27 at the highest for the other grades. We have over 30 sometimes.
- We just need more time to improve. We can't just have one person be the driving force. We are trying to introduce new techniques. Our staff is excellent, and if we can get the money, we can clear some of these hurdles out of the way.

SUMMARY

Students, teachers, and principals from elementary, middle and high schools were interviewed to provide multiple perspectives on mathematics and science education in MPS. Together, they described not only what mathematics and science education currently is, but also what it could be. Their ideal scene depicts students and teachers learning together solving real life problems. Instruction is integrated across disciplines and incorporates technology in a purposeful manner. Schools are the hub of learning for the community where teachers and students interact with parents, business, industry, agencies, and other organizations. But students, teachers, and principals agree that the ideal is not the reality in MPS. The following is a summary of the views from students, teachers, and principals on mathematics and science education.

STUDENT INTERVIEWS

- Students want practical experiences using "everyday things."
- Field trips can help make instruction more real even if the trip is only a walk through the neighborhood.
- Lessons should be more creative. Learning should be fun through more use of games and experiments.
- More computers in classrooms are needed. Students want to be able to use calculators more often.
- Mathematics and science classes are boring and dull because there are too many worksheets, too much use of chalkboards and overhead projectors, and too few experiments.
- In elementary schools, science is taught inconsistently and infrequently.
- Teachers talk too much; students talk too little.

TEACHER INTERVIEWS

- Teachers believe curriculum should stress critical thinking and problem solving.
- Instructional methods should be practical with extensive use of manipulatives.
- Curriculum should be integrated across subject areas.
- There should be more progressive teaching methods and less traditional teaching.

- Staff development needs are greatest in practical instructional methods, integrated curriculum, and use of technology.
- The greatest barrier to effective teaching is insufficient time and inflexible scheduling. Other barriers include inadequate administrative support, materials, supplies, facilities, and equipment, including computers and calculators.
- A large discrepancy exists between schools in their level of parent involvement.
- Instruction is fragmented due to excessive interruptions and non-teaching expectations.

PRINCIPAL INTERVIEWS

- Principals believe instruction should emphasize problem solving skills using extensive hands-on activities.
- The curriculum should be integrated across disciplines.
- More collaboration should occur among staff.
- Principals perceive the quality of the teaching staff as good, but staff development is needed especially to increase content knowledge.
- Barriers to effective instruction include time constraints, few resources, materials and supplies, and reduced central office support for principals.
- Successful business partnerships are few for most MPS schools.
- Parent involvement is a critical need for most schools.
- Class size is too large.

CHAPTER 4
CLASSROOM OBSERVATION RESULTS

Although the outline of mathematics and science education in the Milwaukee Public Schools (MPS) has been sketched, the canvas still has large unpainted areas. Observations of mathematics and science classrooms at elementary, middle, and high school levels enhanced the scene. The observations took place during site visits to 40 schools in MPS.

Using a Classroom Observation guide (see Appendix B), observers focused on six areas: (a) materials, tools, and technology, (b) climate, (c) instruction, (d) teacher focus, (e) student focus, and (f) equity. The observers also provided additional information through field notes which included comments, narratives, and overall impression ratings. Completed observation forms were analyzed according to these categories.

Summaries of the classroom observations are given for each level—elementary, middle, and high school—by subject area. The two major organizing themes for the summaries are learning environment and instruction. Illustrative examples of observer comments are provided to support the summaries.

ELEMENTARY SCHOOL MATHEMATICS

A total of 54 classroom observations of mathematics were made at 21 elementary schools. The distribution among the various grade levels is shown in table 4-1.

Table 4-1 Elementary School Mathematics Observations

Class	Number of Observations
Kindergarten	5
Grade 1	7
Grade 2	8
Grade 3	7
Grades 3-4	2
Grade 4	9
Grade 5	8
Grade 6	2
Unknown	6

LEARNING ENVIRONMENT

Student Grouping Arrangements. The classroom observations revealed that 33 percent of the elementary school mathematics classes had students sitting in rows and 67 percent had students sitting in either pairs or small groups. In 47 percent of the observations, students had opportunities to work in pairs or small groups during the observed mathematics lessons. Observers reported that the classrooms were crowded in 27 percent of the observations.

Equity. The ethnicity/race distribution of the students in the observed classes reflected the diversity of the students in the school. Within each class, observations were made of the diversity of student seating arrangement and pair or group membership. In six percent of the classes, student grouping arrangements were segregated by gender. Observers commented that this occurred by student choice and not by teacher direction, as the students were allowed to choose their own group members.

In general, student-teacher interaction was equitable with teachers interacting with all students regardless of ethnicity/race or gender. A few exceptions did exist.

- In a fourth grade class, the boys were called on five times and girls just once.
- In a fifth grade class, the teacher only called on the students who raised their hands. The students who raised their hands were boys. Throughout the class period, the same students were called upon to answer—all boys and no girls.

Materials, Tools, and Technology. Although there was some variety in the materials and tools utilized across all observations, in 41 percent of observations students only used paper and pencil. Teachers used overhead projectors (15 percent of the observations), chalkboards (20 percent of the observations), or both (four percent of the observations), as well as a variety of other materials. In one class, the students also used the overhead projector to present their solutions to their class members.

In 52 percent of the elementary school mathematics observations, students used some type of hands-on materials. For example, students used counters, place value blocks, tape measures, tangrams, geoboards, square tiles, square pieces of paper, candy, scales, miniature clocks, and coins. In six percent of the classes, students were observed using calculators. A computer was used in one class.

INSTRUCTION

Instructional Format. The instructional formats in the observed elementary school mathematics classes varied. Some classes (33 percent) were very traditional and teacher-centered—the teacher delivered the information and the students listened passively. In other classes (17 percent), the atmosphere was very student-centered with students actively engaged in figuring things out for themselves and with teachers guiding and questioning. The remaining classes (50 percent) fell somewhere in between these two extremes.

Thirty-three percent of the observed lessons could be characterized as very traditional. The teacher did most of the talking in a lecture format and the students listened passively followed by individual student work. The following are illustrated examples as stated by observers.

- In a fifth grade class, the teacher lectured to the students at the beginning of the lesson and then directed the students to complete some pages from their textbook. The students worked individually on the exercises from the textbook.
- In a second grade class, the students started by solving the math problems the teacher had written on the board—adding and subtracting four-digit numbers. Students explained the procedures for solving the computation problems. Then students recited poems and chants about the seasons and multiplication facts.
- In a third grade class, the teacher presented information and led a discussion on metric measures of distance and area. The teacher used the chalkboard for drawing illustrations and a meter stick for making comparisons. Then the students worked independently on a worksheet in which they were to choose the appropriate type of measurement for different circumstances.

- In a fifth grade class, the teacher walked from the back of her desk to the front of her desk as she lectured. She never changed the tone of her voice. The teacher did almost all of the talking. Very little opportunity existed for students to respond and no opportunity for student interaction.
- In a second grade class, everything was done by reciting backwards and forwards in unison. Students counted by twos forward and backward and then the multiplication facts with two as a factor and then those with three as a factor. Students also recited the days of the week and months of the year.

Many of the classes (50 percent) had some components that could be characterized as traditional and other aspects that were student-centered. The students in many of these classes were given materials or tools to use but the materials were used in a very teacher-directed manner, and students usually worked independently.

- A second grade class was set up as three groups with an adult supervising each group. One adult monitored students working at the computer on addition computation exercises. Another adult monitored a reading group. The teacher worked with the third group on measurement. The observer noted that the teacher and not the students did the weighing. Even with this smaller group working on measurement, each individual student had a worksheet to complete, and there was not much student to student interaction.
- A fourth grade class investigated the number of teeth that fourth graders have. The observer noted that it was a great activity but that the teacher maintained a role of distant director and did not take advantage of time during pair work to engage students. The class also made a class graph of the teeth, and each student was required to make an individual graph as well. Other than counting teeth, the students did not interact except for off task behavior.
- In a fifth grade class, each student was given a cup of candies. They were asked to count the number of candies in their set and to record this as the denominator of a fraction. The teacher than told each student to count the number of orange candies in their set and record this as the numerator. This was then repeated for the other colors with the teacher directing each step of counting and recording. The students did get to handle the candies, but no thinking or reasoning was required by the students. They worked independently and just needed to follow the teacher's directions and respond to her closed-ended questions which only required a one word response.
- A fourth grade class was studying multiplication. The students used manipulatives to model various multiplication facts, such as "9 x 6." The class discussed how to use the materials to show each problem. The students worked individually. The class ended with the students taking a three minute timed test on multiplication.

Seventeen percent of the observed classes were student-centered. These lessons placed the teacher in the role of facilitator and emphasized thinking and reasoning by the students. The students often worked in small groups or pairs and used hands-on materials to assist them in making sense of mathematics.

- In a fourth grade class, the students worked in pairs and used square tiles in their investigation of division. The teacher often asked students for different approaches to solving the problems.
- A first grade class had almost total engagement of the students throughout the lesson. The students were to purchase items to decorate a kit. The students planned what items to use and then counted money to purchase their items. The lesson was very meaningful as the students had a purpose for counting.

- A fifth grade class used geoboards to investigate polygons. The students did most of the talking throughout the lesson. The teacher was a facilitator as the students worked in small collaborative groups.
- In a third grade class, the students were using square tiles to explore area and perimeter. The students drew diagrams on graph paper and took turns demonstrating at the overhead. The observer noted, "The students were so excited and engaged. They couldn't wait for a turn at the overhead." The emphasis throughout the lesson was on discovering all different possible solutions.
- A first grade class was studying fractions. They were to each bring in one half of something from home. Some of the items included one half of a sandwich, cookie, cracker, apple, and paper. The students reported what happened to them at home when they were working with their parent to find one half of something. The class also cut fruit which the teacher had brought to school into fractional parts, such as a banana into thirds, an apple into eighths, and an orange into fourths.

Student Interaction. In 54 percent of the elementary school mathematics classes, the students worked independently. In some of the classes the students sat in groups or pairs, but they did not interact during the lesson.

- In a sixth grade class, there was no student interaction other than glances now and then among the students.
- In a second grade class, the students listened and watched the teacher and responded by writing on individual chalkboards and holding them up for the teacher to see. Then the students were given a worksheet to work on individually.
- In a third grade class, there was no interaction among the students except for a boy throwing paper wads at the person in front of him—six times.
- In a first grade class, the students worked at tables that sat six students. However the students worked individually on an assigned worksheet.

Thirty-nine percent of the classes had planned opportunities for the students to interact with each other in small groups or pairs. In seven percent of the classes, the students were told that if they wanted to they could work with and help each other.

- In a fifth grade class, the students were to discuss answers and then put their ideas on a group recording sheet.
- In fourth grade class, each pair was to reach a common solution on some division problems. The students were using materials to act out the problems.
- In a first grade class, the students worked in groups as they talked to each other about what items to purchase and jointly counted money.

Real-World Connections. The presence of real-life connections in the observed elementary school mathematics lessons varied, but were generally weak or non-existent. In 54 percent of the lessons, no real-life connections were evident.

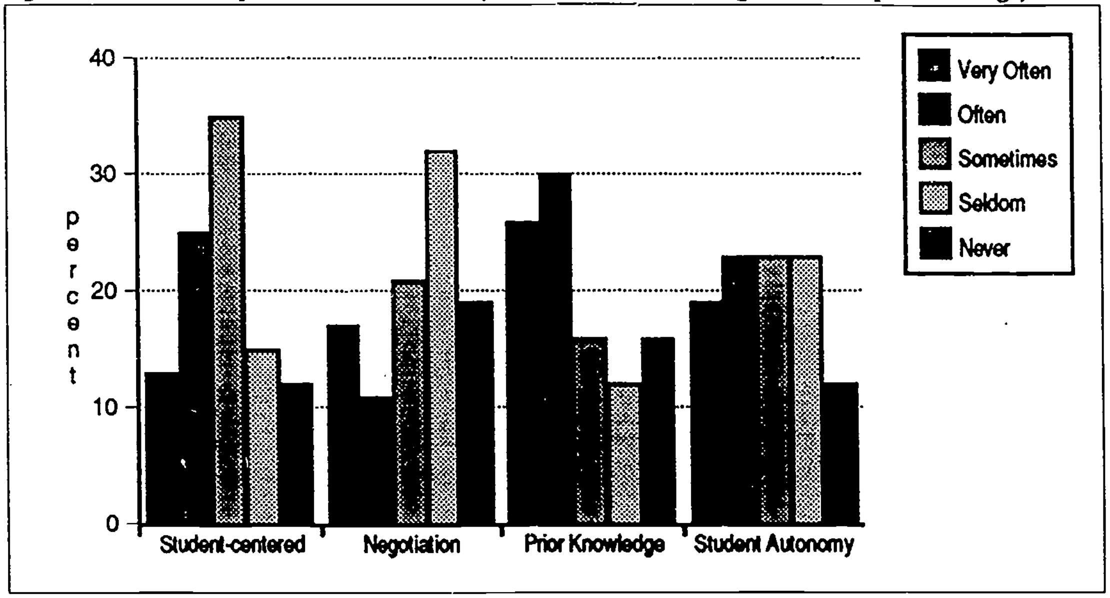
In 30 percent of the lessons, the teachers referred to a real-world situation as an example or to provide some reason for studying specific mathematics content. For example, the teacher mentioned pizza, candy bars, and recipes when studying fractions in a third grade classroom, and a fifth grade teacher referred to real objects to give examples of metric measures.

In seven percent of the classes, the real-world connection provided the context for mathematics learning. For example, students purchased items to decorate a kit in a first grade classroom and prepared food in a different first grade classroom—doubling the recipe and measuring ingredients.

GENERAL IMPRESSION RATINGS

The observers rated their perception of each elementary mathematics class on four dimensions: (a) student-centeredness, (b) negotiation among students to make sense of the ideas examined, (c) efforts to help students build upon prior knowledge, and (d) student autonomy. Figure 4-1 shows how the observers rated the elementary mathematics classes in terms of the four dimensions. The percents given are based on the reported ratings. The actual frequencies are listed in table 4-2.

Figure 4-1 General Impressions of Elementary Mathematics Classes (percent of reported ratings)



The observers rated about half of the observations as often or very often building on students' prior knowledge. About one third of the classes were characterized as student-centered. In many of the observations, students had few or no opportunities to negotiate meaning or work together to investigate problems. Approximately the same number of classrooms promoted student autonomy as those that did not.

Table 4-2 General Impressions of Elementary Mathematics Classes

	Very Often	Often	Sometimes	Seldom	Never	Not reported
The lesson was student-centered.	7	13	18	8	6	2
Students interacted with each other to make sense of ideas and to helping each other investigate.	9	6	11	17	10	1
Teacher helped students build upon prior knowledge and experiences.	13	15	8	6	8	4
Students were given responsibility and control over their learning and encouraged to think independently.	10	12	12	12	6	2

ELEMENTARY SCHOOL SCIENCE

A total of 44 classroom observations of science were made at 21 elementary schools. The distribution of the various grade level observations is shown in table 4-3.

Table 4-3 Elementary School Science Observations

Class	Number of Observations
Kindergarten	2
Grade 1	3
Grade 2	7
Grade 3	7
Grades 3-4	1
Grade 4	10
Grades 4-5	1
Grade 5	6
Grade 6	1
Unknown	6

LEARNING ENVIRONMENT

Student grouping arrangements. The classroom observations of science at the elementary school level revealed that 70 percent of the desks or tables were arranged in groups or pairs. Twenty-five percent of the children were seated in individual rows. (Five percent of the observations did not indicate seating arrangements.) Of the students sitting in individual rows, one class of students was observed moving desks during the lesson so the students could work with partners.

Overcrowded classrooms. Almost one third (32 percent) of the observers indicated that elementary school science classes were overcrowded with little room to work or move about the classroom. Some observers also commented that rooms were equipped with desks or tables that were old, worn out, or inadequate for science activities.

- One fifth grade class used old industrial arts workshop tables.
- An observer of a third grade class noticed, "... many little bodies crowded into too small of a space. The six tables and 25 chairs filled the room, which was formerly a reading clinic room."
- Another observer said, "Thirty-one 8-year-olds doing an experiment is close to impossible to manage... and these were manageable students—just too many of them."

Equity. Of the 44 classrooms observed, 34 were arranged equitably by gender and ethnicity/race. Equity issues in terms of seating arrangements were not addressed by nine of the observers. In the one exceptional case, the boys and girls sat on opposite sides of the room.

Teacher-student interactions, for the most part, were equitable. A few exceptions did exist (nine percent). Two teachers called more frequently on the "better" students or only those who raised their hands. One teacher called only on the boys while constantly reprimanding the girls harshly. Another teacher frequently called on students who were the most disruptive and had the most trouble paying attention.

Student-student interactions, when students were allowed to interact, were found to be equitable. In two classes, students were rude to each other, but no particular gender or racial/ethnic group pattern was observed.

Materials, tools, and technology. Computers were observed in half the classrooms, but were not used during any of the observations. Calculators were used in one class. Use of manipulatives, science materials, and equipment was reported in 57 percent of the elementary school science classes. The remaining 43 percent of the children observed used other materials as described below or no materials.

- The children in four classes worked with paper or worksheets and pencils.
- One class was observed using old elementary science textbooks even though the district had adopted a new science program the previous year which had no student texts.
- Nine classes of children had nothing in their hands.
- Five classes were using art supplies

INSTRUCTION

Instructional format. For those elementary school science classrooms in which the instructional format was reported, the instruction varied from traditional and teacher-centered to student-centered. Seven percent of the observers did not comment on classroom instructional format.

Forty-five percent of the science lessons were traditional. The teacher did most of the talking and, in a few cases, demonstrated an activity while the students listened and watched passively. During these classes, the students read aloud or worked on a worksheet, but always individually with no collaboration among the students.

- One observer noted while watching a third grade class, "How frustrating for these third graders. The teacher had all the fun doing a demo, and the kids were amazingly well behaved and quiet as they only watched."
- Another class was very controlled. The teacher was "entertaining," and the kids were the "viewing audience."
- Another teacher stood in front of the class, posed questions she thought were important and guided the children's answers to what she wanted. The observer noted, "This was like I remembered science class—actually quite boring."
- Journals were used for drawing observations in a fifth grade class. The students had to listen to the dictation of the teacher and write what she said.

Fourteen percent of the classes had a combination of teacher-centered and student-centered instructional activities. In these classes, the teachers would give directions, demonstrate, or explain something to the students. The students were then allowed to work in pairs or small groups and were usually given materials to use. In some of these classes, whole group discussions occurred with lively interactions between teacher and students and between students and students. In one of the classes, the teacher did most of the talking during the first part of the class. Then during the second part of the activity, the students talked more as the teacher facilitated the activity.

Thirty-four percent of the classes were student-centered with students sharing, collaborating, guiding and directing each other, problem solving, and generally being responsible for their own learning. Teachers were seen as coaches and resources for the students.

- In one combination class of first and second grade students, the teacher acted as the facilitator for each group. She asked questions that required further investigations. She encouraged group problem solving with the types of questions she asked.

- In another class (no grade reported), the students were helping each other to understand buoyancy and the relationship between solids and liquids. Positive support was provided by the teacher to encourage students to explore and develop independent thought processes.
- A fourth grade lesson was the first in a new unit on rocks. The groups of students were given the opportunity to identify the questions they wanted to answer during the unit.

Student interaction. Although most elementary school science classrooms had students sitting in groups or pairs (70 percent of the observed classes), these arrangements did not ensure that cooperative learning or student-to-student interactions were actually taking place. Those students sitting in rows (30 percent of the observed classes) displayed little to no student-to-student interaction and only some teacher interaction. This interaction consisted mostly of teacher questions and individual student answers or student questions with the teacher giving answers.

Of the 31 classes arranged in groups or pairs, only fifteen (34 percent of the total observed classes) exhibited true cooperative learning, verbal sharing, collaboration, and problem solving within the groups.

- One observer of a second grade class noted, "The students are doing most of the talking amongst themselves. They try to solve problems first. Only if stumped do they involve the teacher. Each child had a role to play in the lesson."
- Some first grade students were working in small groups with excellent interaction. Most of the talking was done by the students. They were engaged in cooperative activities.

In the other classes (36 percent of the total observed classes), students worked individually with materials or showed a minimum of collaboration with their peers, even though they were grouped with other students. One observer of a second grade class commented "The children seem to work independently in groups . . . yes, this is what I meant to say." The students were physically seated in groups, but never worked jointly on a task or discussed their individual work with each other.

Real-world connections. The presence of real-life connections varied in the observed elementary school science classes. No real-life connections were observed in 37 percent of the classes. (Two percent of the observers did not report on this item.)

In 50 percent of the observed science classes, the teacher made some kind of verbal reference to a real-world example to connect a science concept with the lives of the children. This was accomplished by the teacher making suggestions, or asking the children for examples that represented the concept.

- The teacher of a fifth grade class made connections to density by talking about salad dressings, foods, and liquids familiar to the students.
- A third grade teacher used probing throughout the whole class discussion and questioning about germs and diseases related to their own experiences.
- A kindergarten teacher used the analogy, "On the outside of the seed is a shell; on a person, it is the skin."

In the remaining 11 percent of the science classes, the teachers used real-world connections to provide a meaningful context for students to engage in hands-on investigations. These contexts helped students connect the concepts with their lives.

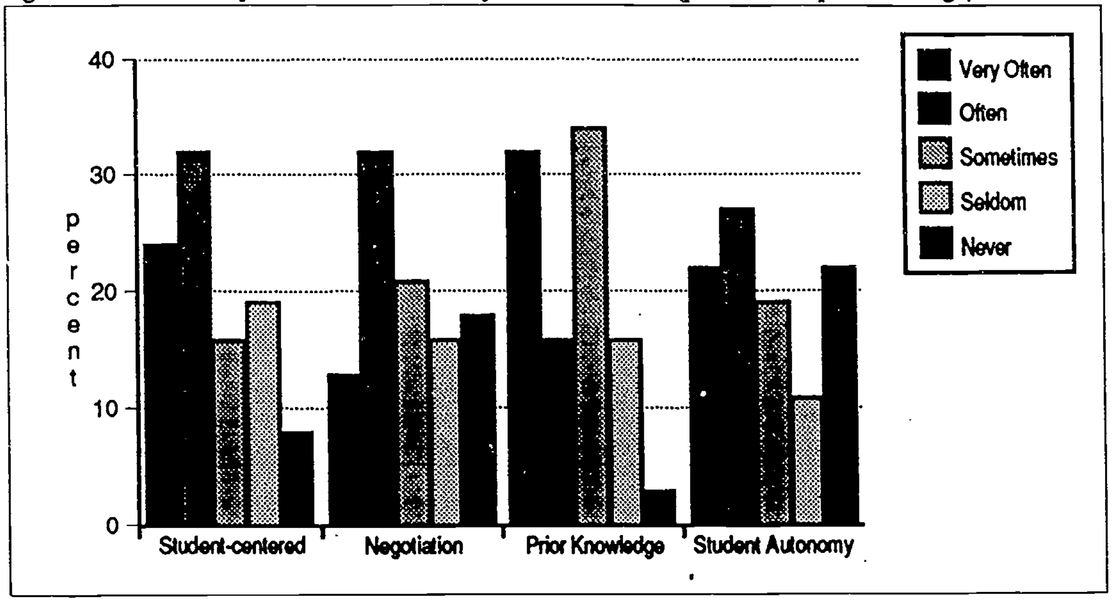
- Some third graders were given a number of objects that had reflective qualities and were told to examine them, describe them, and tell how they could be used.
- Some fourth graders were summarizing two weeks of research into rocks. The students brought in their own rocks and talked about them.

- During a second grade lesson about the benefits of brushing teeth and effects of sugar and vinegar on eggshells, the teacher had the students count their partner's teeth. They discussed the names of teeth they have.
- The teacher kept referring to the fourth grade students as "scientists."

GENERAL IMPRESSION RATINGS

Figure 4-2 shows how the observers rated the elementary school science classes in terms of four dimensions: (a) student-centeredness, (b) negotiation among students to make sense of the ideas examined, (d) efforts to help students build upon prior knowledge, and (d) student autonomy. The percents given are based on the reported ratings. The actual frequencies are listed in table 4-4.

Figure 4-2 General Impressions of Elementary Science Classes (percent of reported ratings)



The observers reported that more classrooms were student-centered than were not student-centered and that more classes had opportunities for students to negotiate or make sense of the ideas being studied by interacting with other students than did not have these experiences. However, in 18 percent of the classes observed, there were no opportunities for students to negotiate meaning, and in 22 percent of the classes there was no student autonomy.

Table 4-4 General Impressions of Elementary Science Classes

	Very Often	Often	Sometimes	Seldom	Never	Not reported
The lesson was student-centered.	9	12	6	7	3	7
Students interacted with each other to make sense of ideas and to helping each other investigate.	5	12	8	6	7	6
Teacher helped students build upon prior knowledge and experiences.	12	6	13	6	1	6
Students were given responsibility and control over their learning and encouraged to think independently.	8	10	7	4	8	7

MIDDLE SCHOOL MATHEMATICS

Twenty-seven observations of mathematics classes were made in 12 different middle schools. The distribution of the various grade levels is shown in table 4-5.

Table 4-5 Middle School Mathematics Observations

Class	Number of Observations
Grade 6	7
Grade 7	8
Grade 8	7
Combined (6-7, 7-8, or 6-7-8)	4
Unknown	1

LEARNING ENVIRONMENT

Student Grouping Arrangements. The classroom observations revealed that 64 percent of the middle school mathematics classes had students sitting in rows and 36 percent in groups or pairs. Group seating did not ensure that students interacted and worked on group tasks. Twenty-nine percent of the observed classes did provide students with opportunities to work in pairs or small groups at various times during the mathematics lessons.

Interruptions. Several observers noted an excessive number of interruptions occurring during their observations. These interruptions created an environment that was not conducive to learning. An observer in an eighth grade class noted, "The class was interrupted by announcements, telephone calls, and students walking into class late." An observer in a sixth grade class commented, "Too many PA [public address] interruptions."

Equity. Three cases of inequity were noted in the middle school mathematics classes. One case was due to scheduling, the other two cases were due to inequitable student seating arrangements within a class. In all other observed classes, (89 percent) the ethnicity/race distribution of the student enrollment and grouping arrangements did reflect the diversity of the students in the school.

- A seventh grade class for academically talented students had 21 Caucasian students, five African American students, one Hispanic student, and four Asian American students. The ethnicity/race distribution of the students in this class did not reflect the diversity of the students in the school.
- In a combination sixth-seventh grade class, the student groups were seated by race/ethnicity.
- In a seventh grade class, the student groups were segregated by gender.

Materials, Tools, and Technology. Teachers used overhead projectors (25 percent of the classes), chalkboards (25 percent of the classes), both (14 percent of the classes), or neither (36 percent of the classes). Students used hands-on materials in 21 percent of the classes. These included geoboards, geometric shapes, protractors, graph paper, and rulers. In 46 percent of the classes, the students just used paper and pencil, including their textbooks and worksheets.

Students were observed using technology in some if the observed classes. Students used calculators in 11 percent of the classes, used computers in seven percent of the classes, and used both computers and calculators in four percent of the classes. Videos were used in two classes (seven percent)—a videotape in one class and a videodisc in the other.

INSTRUCTION

Instructional Format. The instructional formats in the observed middle school mathematics classes varied. Some classes (43 percent) were very traditional and teacher-centered—the teacher delivered the information and the students listened passively for most of the lesson. In other classes (11 percent), the atmosphere was very student-centered with students actively engaged in figuring things out for themselves and with teachers guiding and questioning. The remaining classes (46 percent) fell somewhere in between these two extremes.

Forty-three percent of the observed lessons could be characterized as very traditional. The teacher did most of the talking in a lecture format, and the students listened passively followed by individual student work.

- In an eighth grade class, the teacher lectured and asked only a few short answer questions for which he wanted very specific answers. The observer commented, "The teacher doesn't appear to be too enthused about the group or the activity that he is teaching." The observer noted that the students were not engaged in the lesson and that many students were not listening to the teacher. Some of the students were doodling or working on other subjects as the teacher was talking. The observer also noted, "I noticed that the only students that he [the teacher] paid attention to were those that were actively listening and answering questions. He was not encouraging all of the students to participate in the lesson."
- In a multi-grade class, the teacher reviewed how to solve some computation problems with negative numbers and then the students worked individually on a worksheet of similar problems.
- A sixth grade math class was studying fractions. The teacher reviewed procedures for adding and subtracting fractions. Students worked out computation exercises on the chalkboard. Then all students worked individually to complete a worksheet of fraction computation problems.
- In an eighth grade class, the lesson began with a review. The teacher did not ask for any student responses or questions, but only lectured. Then the teacher demonstrated how to graph a function followed by individual student work on similar exercises.

Forty-six percent of the classes had a combination of traditional and student-centered learning activities. The students in many of these classes were given materials or tools to use but the materials were used in a very teacher-directed manner and students usually worked independently.

- A sixth grade class met in the computer lab. The first part of the lesson was strictly review, mostly through lecture. In the second part of the lesson, the students worked individually on the computers in a computer assisted instruction program. The observer noted that the students seemed to enjoy working at the computers, however, the observer also commented, "I was not sure if the students were actually mastering concepts or guessing."
- In a seventh grade class, the students used graph paper as they investigated area and perimeter of squares, rectangles, and triangles. The students worked independently. The observer noted that some students were engaged, but several seemed passive and some even seemed angry.
- A seventh grade class began with a review of division computation. Then the students used counters for the next part of the lesson. However, the observer was not sure of the purpose of this part of the lesson and noted that the students also seemed confused. Thus the students seemed to be merely repeating what the teacher modeled without understanding.

A small number of observed classes (11 percent) could be characterized as student-centered. These lessons placed the teacher in the role of facilitator and emphasized thinking and reasoning by the students. The students often worked in small groups or pairs and used hands-on materials to assist them in making sense of mathematics.

- In an eighth grade class, the students worked in groups and used tangrams to explore congruency and geometric properties. The students cooperated well in their groups. The teacher encouraged the students while allowing them to discover their solutions. The observer noted, "The class demonstrated a lot of rapport and respect for her [the teacher] as they stayed on task and reacted positively."
- A seventh grade class was studying geometry. During a whole class discussion, the teacher asked many higher-level questions requesting that students explain their thinking and even form conjectures. Some of the questions the teacher asked included, "What's going on here? . . . Give me an example. . . . Why would a mathematician give the same thing two different names? . . . Give me the answer and how do you know. . . . What would be another way?" Evidence of risk taking and openness was evident in this class as one student was not afraid to admit she did not know. The teacher encouraged and assisted the student in thinking it out which resulted in success for the student. At one point in the lesson the teacher stated, "I see the same hands." The teacher made a concerted effort to engage all students—she called on those who did and did not raise their hands.

Student Interaction. Twenty-nine percent of the middle school mathematics classes observed had planned opportunities for the students to interact with each other in small groups or pairs. In seven percent of the observed classes, the students were told that, if they wanted to, they could work with and help each other.

- In a sixth grade class, each small group of students was given a set of directions on cards to create a "silent picture." The students had to cooperate without talking to construct a geometric design.
- In an eighth grade class, the students sat in pairs and were allowed to work together if they wanted. Each student was to complete his or her own set of problems. Some groups were observed talking to each other, some on task and some off task discussions. Some pairs did not talk at all.

In 64 percent of the classes the students worked independently with no student-to-student interaction.

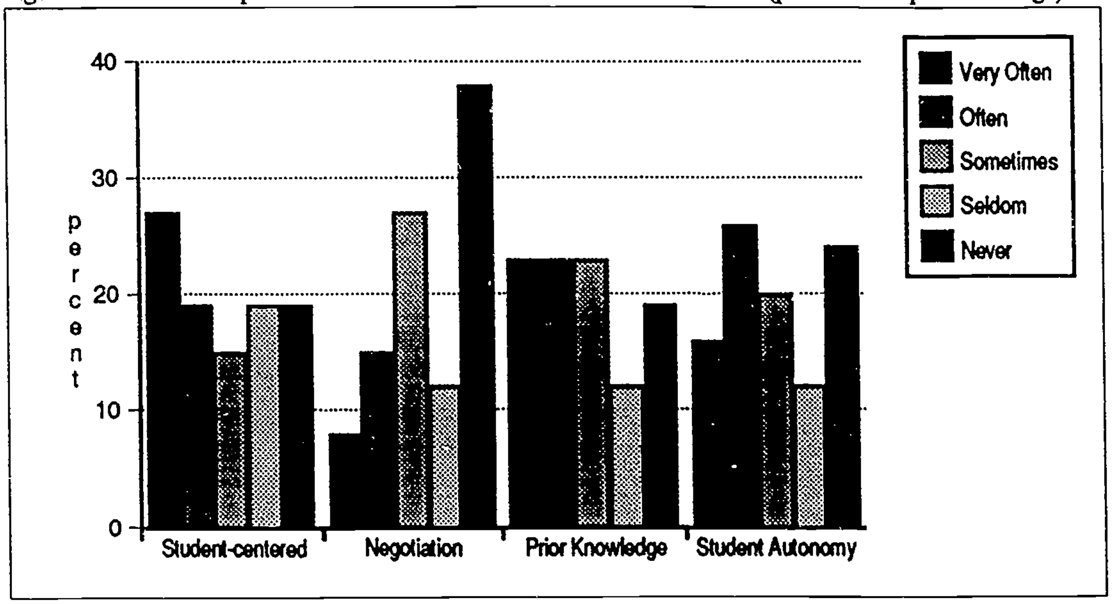
- In a multi-grade class, the students worked independently to complete a worksheet containing 21 computations with negative numbers.
- An eighth grade class was seated in pairs, but the students were not to interact as they worked individually on their assignment.
- In a seventh grade class, a student told the observer that the students were not supposed to help each other.

Real-World Connections. Few real-life connections were observed in middle school mathematics classes. In 75 percent of the lessons, no real-life connections were evident. In the other 25 percent of the lessons, the teachers referred to a real-world situation to provide an example or reason for studying specific mathematics content. For example, a seventh grade teacher showed a picture of a house to illustrate parallel lines; an eighth grade class discussed the fairness of a dart game in their study of probability; data on rental property was used to provide information for writing equations in an eighth grade class; and pizza toppings were used to illustrate combinations in a multi-grade level class.

General Impression Ratings

Figure 4-3 shows how the observers rated their perception of the middle school mathematics classes on four dimensions: (a) student-centeredness, (b) negotiation among students to make sense of the ideas examined, (c) efforts to help students build upon prior knowledge, and (d) student autonomy. The percents given are based on the reported ratings. The actual frequencies are listed in table 4-6.

Figure 4-3 General Impressions of Middle School Mathematics Classes (percent of reported ratings)



Thirty-eight percent of the classrooms were rated as not providing students with any opportunity to negotiate meaning or work together to investigate problems. Only a few classrooms (eight percent) were rated as providing students with lots of these types of experiences. Ratings for the other three dimensions were approximately even with about the same number of classes being rated favorably as negatively.

Table 4-6 General Impressions of Middle School Mathematics Classes

	Very Often	Often	Sometimes	Seldom	Never	Not reported
The lesson was student-centered.	7	5	4	5	5	2
Students interacted with each other to make sense of ideas and to helping each other investigate.	2	4	7	3	10	2
Teacher helped students build upon prior knowledge and experiences.	6	6	6	3	5	2
Students were given responsibility and control over their learning and encouraged to think independently.	4	7	5	3	6	3

MIDDLE SCHOOL SCIENCE

A total of 32 classroom observations of science were maae at 12 middle schools. The distribution of the observations among the various grade levels is shown in table 4-7.

Table 4-7 Middle School Science Observations

Class	Number of Observations
Grade 6	8
Grade 7	6
Grade 8	9
Grades 6-7-8	3
Unknown	6

LEARNING ENVIRONMENT

Student grouping arrangements. Seventy-eight percent of the observed science classes at the middle school level had students seated at tables or desks in groups or pairs. Sixteen percent of the classes had students seated in desks arranged in rows. The seating arrangements were not recorded for two of the observed classes.

Overcrowded classrooms. Forty-four percent of the middle school science observations included descriptions of overcrowded classrooms due to inadequate rooms and/or large numbers of students. Some observers commented that the students and the teachers functioned well in spite of the conditions.

- One sixth grade classroom was originally a home economics room—long and very narrow.
- One observer of a seventh grade class wrote, "If this class is confined to this room, there are big limitations placed on what activities will occur. The room lacks tables, water access, hook-ups for electricity, and storage space."
- Another classroom for eighth graders is much too small for 39 students. They ran out of space to work on their projects so some students were working in the hall and the library.
- A class of eighth graders is in a small room with seven rows—a total of 45 desks. There is little to no space to move between the rows.
- Another observer of a sixth grade class wrote, "Excited, engaged students of science were observed in this classroom. There were no incidents of poor or inappropriate behavior. I was impressed with the quality of instruction, despite the poor science facilities. This requires an extra effort and dedication to students' learning on the part of the teacher who made due with less than should be expected."

Interruptions. One interesting occurrence emerged from 16 percent of the observations of middle school science classes. Observers noted numerous interruptions during single class periods interfering with instruction. These interruptions seemed equally detrimental to lesson delivery whether the lesson was student or teacher-centered. Interruptions included: public address announcements, late students, a father picking up his son's science fair project, other adults entering the room to talk to the teacher or to the students, intra-school phone calls, and others. Observers reported that students were very distracted by these interruptions.

Equity. Observations of seating arrangements revealed that 69 percent of the science classes at the middle school level exhibited diversity in the seating and grouping arrangements of students with regards to both gender and ethnicity/race. Six percent of the observations did not report equity. In the other 29 percent of the observed classes, student grouping arrangements showed evidence of segregation by gender or ethnicity/race, by both gender and ethnicity, or by unspecified segregation.

- In nine percent of the classes, groups or pairs or individuals were segregated by gender.
- In 13 percent of the classes, groups or pairs or individuals were segregated by race.
- In three percent of the classes, groups or pairs or individuals were segregated by both race and gender.

All observers reported that teachers interacted with all students regardless of ethnicity/race or gender, giving groups and individual students equal opportunities to answer questions, ask questions, or discuss activities with the teacher. An observer commented that the teacher "corrected all students equally."

Materials, tools, and technology. Availability and use of tools, technology, materials, and equipment varied widely in the middle school science classes. Seventy-eight percent of the classrooms were well supplied with science materials and equipment, such as microscopes, and with other science related tools, such as plants, rocks, animals, and models. The other 22 percent of the classes had little or no science materials or equipment visible during class time. One observer noted that the room was so small, it was hard to tell where any equipment could be stored. Some other rooms had cabinets and cupboards, so it was assumed that materials were inside. Two other observers wrote about classrooms they visited:

- In a seventh grade class, it was noticed that, "Both teacher and assistant are doing an excellent job in helping the students understand what's going on in their experiments, in spite of the crowded class and limited resources."
- An observer of an eighth grade class wrote, "The small crowded room with no science or math manipulatives observable was depressing. Discussing abstract concepts with no visuals, concrete materials—not even a chalk board—was disturbing."

Sixteen percent of the classes had one or more computers available to the students. Only one class used computers during an observation. One class had calculators visibly available for the students, however, they were not using them at the time. Thirty-one percent of the classes had one or more of the following in their rooms: VCR, TV, videodisc player, and overhead projector. Most of this equipment, however, was not used during the observations.

INSTRUCTION

Instructional format. The instructional formats in the middle school science classes were characterized as teacher-centered, student-centered, or a combination of both. Over half of the teachers (58 percent) exhibited a more traditional approach to teaching, that of teacher-centered lectures, question and answer periods, and students working independently on assignments.

- The topic in a seventh grade class was metric conversions. The teacher lectured, directed, and disciplined the students. The students copied notes from the board into their notebooks, wrote answers individually on the chalkboard, gave rote answers, and displayed little enthusiasm.
- Another observer wrote, "This eighth grade teacher was a director. She called on people to read; she asked the questions; she stated the facts. The topic was minerals and the students read the goals and things to learn from the book. They read about atomic structure. The teacher would pause in the reading to ask factual

questions for clarification. No models, diagrams, or visuals were used to supplement the atomic structure. This was reading in the science content."

- Another class had students who were quiet and well-behaved. They read aloud, taking turns, and they wrote down definitions and listened to the teacher, but they seemed bored and tired.
- Another observer of a sixth grade class described the instructional format as "The old-fashioned way" of teaching. "This pleasant teacher was very much in charge of distributing information. The students recited memorized or written answers. This teacher enjoys what he's doing, but his enthusiasm wasn't transferred to the kids. What he could do with some hands-on training!"

One fourth of the classes were, for the most part, student-centered, allowing the students opportunities for inquiry, interaction, sharing, and creativity. The teachers' roles were that of facilitators, coaches, and guides.

- In one combined sixth, seventh, and eighth grade class, the students were surrounded with an extremely positive learning environment. The students appeared to be very enthused and involved in learning about the digestive system. The use of the students to teach and develop written exercises went over very well The use of audiovisual equipment by the students for a special news break was effective. The teacher's role as facilitator worked well. The students were still aware of her role as the teacher, even though she was in the background for the most part. There was good cooperation among the students to help each other learn the material. The observer noted, "Overall, this lesson was effective and positive. This is what school should be about everyday and everywhere in MPS."
- In a sixth grade class, the teacher was a facilitator—a roving eye-witness, encourager, question answerer. This instructor was comfortable with the excitement and noise level generated by the activity
- During an adaptation of some lessons from the JASON Project, the teacher of a combined sixth, seventh and eighth grade class had students integrate science with art, poetry, music, mathematics, and language arts by working in small groups on presentations to the rest of the class. Each group had a problem to solve.

An even smaller number of classes (13 percent) displayed a mixture of both teacher-centered and student-centered instruction. Two typical examples follow:

- Initially the teacher did most of the talking in this seventh grade class. After the explanation, the students did most of the taking. They first listened to the teacher, then worked in groups on a hands-on problem solving activity, then explained their reasoning to the rest of the group.
- In an eighth grade class, the students initially corrected homework which was followed by a brief question and answer session with the whole group, and finally a hands-on session of rock characteristics.

One sixth grade class could not be placed in any of the above instructional formats. As the observer noted, "In general, the lack of an organized lesson was the outstanding observation. It seemed that the class period was wasted and unproductive. I thought I was in a homebase where students were passing the time with a worksheet while they socialized and waited to eat lunch. This teacher was aware that someone would be visiting on this date."

Student interaction. Sixty-three percent of the middle school science classes provided minimal or no opportunities for the students to interact. When they were allowed to interact, the students only engaged in social discussions. Six percent of the observations did not report on student interaction.

Thirty-one percent of the classes indicated opportunities for the students to answer each others' questions, communicate about the topic, cooperate and collaborate with each other, and brainstorm solutions to problems.

- The cooperative lesson in an eighth grade class showed how the ability of one group to describe rocks well, directly influenced the ability of the second group to match descriptions with particular rocks.
- A lab activity for some sixth graders involved dissecting owl pellets. The pairs of students were actively engaged. Each team made discoveries and could be heard hypothesizing on these. Students were able to share knowledge and the process in which they were involved. The verbal communication between students was task oriented. Some students moved to other groups to see their discoveries. All of this was appropriate behavior. The students were sharing space, tools, and owl pellets. Taking turns was accomplished among the students with no hassles. The teacher smiled and encouraged the students with positive statements.
- One observer noticed an interesting twist to student interactions in a sixth grade class. The students were asked to use a worksheet to do an activity showing how much of a leaf an insect would eat. The teacher distributed the sheets, scissors, and paper. The students then looked to each other for help in ascertaining what the task was and what they were supposed to do.

Real-world connections. No real-life connections were observed in 53 percent of the science classes observed at the middle school level. One lesson involved students looking at a transparency of planaria and copying down information in their notebooks. The observer wrote, "The instructor could have had the class engaged when he caught their interest for a moment upon me. ioning planaria regenerating two or more heads. His lesson was boring. Why not experiment with real worms of all kinds?" Twelve percent of the observations did not report on this area.

In 32 percent of the classes, the teachers referred to real-life examples of science concepts. An example of this kind of connection was from a class studying types of rocks; the teacher reviewed the use of stones as construction material over history. In the remaining three percent of the classes, real-life connections were used as the contexts for providing hands-on experiences to help students connect the lesson with their lives.

- The teacher used a newsroom format with a group of sixth, seventh and eighth graders who were learning about the digestive system.
- The activity was finding the pulse rate of an earthworm for a combined grade group. The students worked in pairs. They had to make calculations and find the average of multiple readings. Then they took their own pulse rates and compared them to the earthworms' rates.

General Impression Ratings

The observers rated their perception of each middle school science class on four dimensions: (a) student-centeredness, (b) negotiation among students, (c) efforts to build upon prior knowledge, and (d) student autonomy. Figure 4-4 shows how the observers rated the classes in terms of the four dimensions. The percents given are based on the reported ratings. The actual frequencies are listed in table 4-8.

Forty-eight percent of the classrooms were rated as only sometimes making connections to prior knowledge. Thirty percent of the classes were rated as never providing opportunities for student autonomy. Ratings on student-centeredness and negotiation were approximately even with about the same number of classes being rated favorably as negatively.

Figure 4-4 General Impressions of Middle School Science Classes (percent of reported ratings)

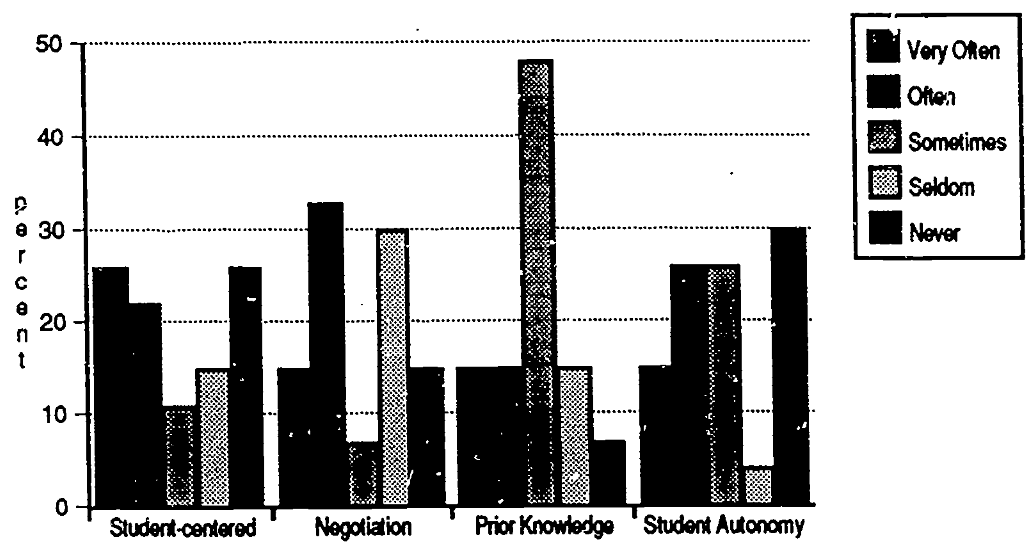


Table 4-8 General Impressions of Middle School Science Classes

	Very Often	Often	Sometimes	Seldom	Never	Not reported
The lesson was student-centered.	7	6	3	4	7	5
Students interacted with each other to make sense of ideas and to helping each other investigate.	4	9	2	8	4	5
Teacher helped students build upon prior knowledge and experiences.	4	4	13	4	2	5
Students were given responsibility and control over their learning and encouraged to think independently.	4	7	7	1	8	5

HIGH SCHOOL MATHEMATICS

A total of 18 observations of mathematics classes were made at six high schools. The distribution of the observations among the various classes is shown in table 4-9.

Table 4-9 High School Mathematics Observations

Class	Number of Observations
Algebra	9
Applied Math	2
Geometry	6
Advanced Placement Calculus	1

LEARNING ENVIRONMENT

Student Grouping Arrangements. The classroom observations revealed that 78 percent of the high school mathematics classrooms had students sitting in rows. Twenty-eight percent of the observations showed that students did have opportunities to work in pairs or small groups at various times during the mathematics lessons.

Equity. Enrollment of students in the observed high school mathematics classes was noted for patterns of diversity in race/ethnicity and gender. Evidence of inequity was observed in two of the advanced mathematics classes. The AP Calculus class had 13 Caucasian students and one African American student. A junior level geometry class had 21 Caucasian students and three African American students. The ethnicity/race distribution of the students in these two advanced classes did not reflect the diversity of the students in the school. In all other classes, the ethnicity/race distribution of the students did reflect the diversity of the students in the school. The observed high school mathematics classes were equitable in terms of gender. Approximately the same number of males and females were observed in all classes.

Observations were also made of the diversity of student seating arrangement and pair or group membership. In 72 percent of the observed classes, students sat with and worked with each other regardless of ethnicity/race or gender. In 28 percent of the classes, patterns of inequity occurred in student groups. It was usually noted that this occurred by student choice and not by teacher direction, as the students were allowed to choose their own group members.

- In 11 percent of the classes, student groups were segregated by race/ethnicity.
- In 17 percent of the classes, student groups were segregated by gender.

Regarding student-student and teacher-student interaction during a lesson, observers noted that, in general, student-student and student-teacher interaction was equitable. Students sat with and worked with each other regardless of ethnicity/race or gender and teachers interacted with all students regardless of ethnicity/race or gender. An observer noted, "The teacher called on students who were and were not volunteering so that almost everyone got involved somewhat in the lesson." A few exceptions did exist.

- In one of the classes with a majority of Caucasian students, an African-American female sat at a table by herself in the front of the room. No interaction was observed between her and the other students. This student watched what the teacher was doing, but did not participate.
- In one advanced mathematics class, the teacher allowed students to call out answers rather than calling on individual students by name. Thus, the teacher interacted mainly with the students who were calling out and, in almost every case, this was a male student—eight of the 14 students in the class were female.

Materials, Tools, and Technology. Little variety occurred in the materials and tools utilized by the teachers and the students during the high school mathematics observations. Teachers used overhead projectors (44 percent of the observations) or chalkboards (39 percent of the observations) or both (17 percent of the observations).

Students used graph paper and rulers in two classes. Other than this, the teachers and students were not observed using any other types of materials besides paper and pencil. Students used paper and pencil only, including textbooks and worksheets, in 56 percent of the classes.

In 33 percent of the classes, students were seen using scientific calculators or graphing calculators. In one class, a computer was used to organize data in a spreadsheet.

INSTRUCTION

Instructional Format. The instructional formats in the observed high school mathematics classes showed little variety. Most classes (83 percent) could be characterized as very traditional and teacher-centered—for the most part, the teacher delivered the information, and the students listened passively.

- In a ninth grade algebra class, most students were passive and not engaged. The teacher has a quiet pleasant manner, but didn't "turn-on" the kids. The teacher did most of the talking. The students who did respond only gave short answers with no explanations. The class did a few examples of solving linear equations together as a whole class, and then students worked independently on an assignment while the teacher circulated around the room.
- In a different ninth grade algebra class, the interaction between the teacher and the students was warm, friendly, and encouraging. The teacher walked the students through some sample problems—setting up equations for some word problems. Little or no discussion occurred as to why the equations were set up in a particular way. Then the students did the other problems on their own.
- In a geometry class, the teacher led a review for 15 minutes, preparing students for the test. The teacher then gave the students a ten item true-false test on geometry vocabulary such as parallel and perpendicular lines and planes.
- A geometry class was mostly a lecture on proofs and how to take notes. Most of the hour was spent listening to the teacher. Some students volunteered answers to the teacher's questions. Homework was assigned near the end of the period.
- A different geometry class seemed to be going through the motions. All the students did what they were supposed to do, but with little to no enthusiasm or interest. The teacher directed the students and did most of the talking. The students answered the questions when the teacher called on them.

In some classes (17 percent), the instructional format was mixed with some components that were traditional and other components that were more student-centered. These classes tended to engage students in more thinking and reasoning and figuring problems out for themselves with teachers guiding and questioning.

- In a ninth grade algebra class, the teacher encouraged responses and participation from all students. He asked the students if they agreed with answers that were given. The class investigated disagreements about any of the solutions. The teacher did a lot of the talking but it was designed to engage students and to get them to respond and explain their thinking.
- In an AP calculus class, the teacher told the students not to rely on memorization of the formulas, but rather to visualize them by sketching and then deriving them. A student asked the teacher, "Do we need that part?" The teacher replied, "Well, let's try it and see?" There was some, but not much student-student interaction during the lesson, and even with the enthusiasm of the teacher, two students were sleeping on and off.

Student Interaction. In 72 percent of the high school mathematics classes, the students worked independently with no opportunities for them to interact with each to discuss mathematics. In 22 percent of the classes, the students were told that they could work with and help each other. In six percent of the classes, the students worked in groups on a joint task that required them to interact and work together.

- In a geometry class, the teacher did most of the talking. The students answered questions when called on. The students did not interact with each other during the lesson except for casual conversation.
- In an algebra class, the students worked mainly by themselves. Some students did ask each other opinions about what to do to solve the problems.
- In another algebra class, the teacher did most of the talking. There was no student interaction.

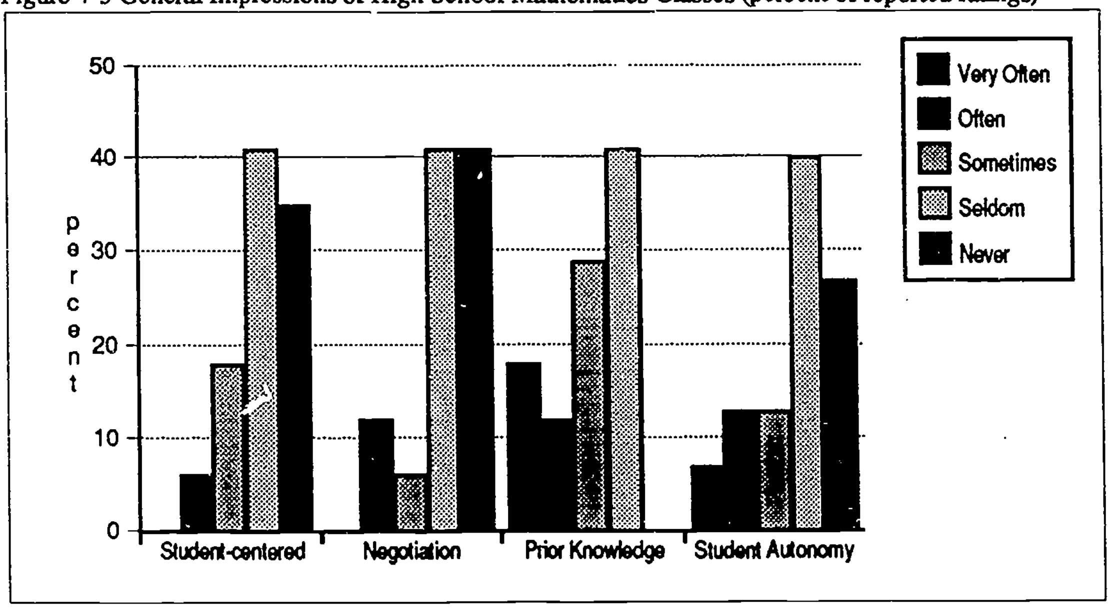
- In a different algebra class, a friendly interchange with mutual respect occurred between the teacher and the students. Then the students worked independently on the text assignment. The teacher told the students that they could work together, but very few did so.

Real-World Connections. Very few connections were made to real-life situations in the high school mathematics classes. In 72 percent of the classes, no real-life connections were evident. In 22 percent of the classes, the teachers merely referred to a real-world situation to provide an example or reason for studying specific mathematics content. For example, reference was made to cheese being in the shape of a rectangular prism in a geometry class and to population centering in a different geometry class. In a calculus class, connections were made to the solar system model and static electricity. The teacher in this class also asked, "Suppose you're an engineer wanting to devise shock absorbers for a car?"

GENERAL IMPRESSION RATINGS

The observers rated their perception of each high school mathematics class on four dimensions: (a) student-centeredness, (b) negotiation among students to make sense of the ideas examined, (c) efforts to help students build upon prior knowledge, and (d) student autonomy. Figure 4-5 shows how the observers rated the classes. The percents given are based on the reported ratings. The actual frequencies are listed in table 4-10.

Figure 4-5 General Impressions of High School Mathematics Classes (percent of reported ratings)



No classes were rated "very often" in providing a student-centered environment or opportunities for student negotiation. In fact, 76 percent of the high school mathematics classes were rated as seldom or never being student-centered, and 82 percent were rated as seldom or never providing opportunities for student negotiation. Although all classes were rated as making connections to prior knowledge, few provided opportunities for student autonomy.

Table 4-10 General Impressions of High School Mathematics Classes

	Very Often	Often	Sometim es	Seldom	Never	Not reported
The lesson was student-centered.	0	1	3	7	6	1
Students interacted with each other to make sense of ideas and to helping each other investigate.	0	2	1	7	7	1
Teacher helped students build upon prior knowledge and experiences.	3	2	5	7	0	1
Students were given responsibility and control over their learning and encouraged to think independently.	1	2	2	6	4	3

HIGH SCHOOL SCIENCE

A total of 15 classroom observations of science were made at five high schools. The distribution of the observations among the various science classes is shown in table 4-11. Most classes met for 45 to 50 minutes per day, a typical period, except for the advanced placement (AP) biology class which met for two hours each day.

Table 4-11 High School Science Observations

Class	Number of Observations
Physical Science	4
Biology	3
Chemistry	3
Physics	4
Advanced Placement Biology	1

LEARNING ENVIRONMENT

Student Grouping Arrangements. The classroom observations revealed that 87 percent of the high school science classrooms had students sitting in rows. In approximately half (54 percent) of the classes, students had opportunities to work in pairs or small groups at various times during the science lessons.

Equity. Patterns of inequity were observed. The ethnicity/race distribution of the students in the more advanced science classes (chemistry, physics, and AP biology) did not reflect the diversity of the students in the school. Sixty-three percent of the observations of advanced science classes revealed a lack of diversity. In the lower-level science classes (physical science and biology), the ethnicity/race distribution of the students did reflect the diversity of the students in the school.

- An advanced placement biology course had 12 students present on the day of the observation. Eleven of these students were Caucasian and one was Hispanic.
- In a chemistry class, 16 of the 25 students were Caucasian, seven were African-American, and two were Hispanic.
- In another chemistry class, 12 of the 21 students were Caucasian, eight were African American, and one was Asian.
- In a physics class, 12 of the 14 students were Caucasian, one was Asian, and one was Hispanic. In another physics class, 16 of the 26 students were Caucasian, seven were African-American, and three were Hispanic.

The classes were equitable in terms of gender. Approximately the same number of males and females were observed in all classes, both lower-level and upper-level. The exception was a physics class in which 15 of the 16 students were female.

In general, student-student and student-teacher interaction was equitable. Students sat with and worked with each other regardless of ethnicity/race or gender, and teachers interacted with all students regardless of ethnicity/race or gender. A few exceptions did exist, such as all Asian students in one class sat and worked together, and in another class, the groups were racially segregated. This occurred by student choice and not by teacher direction, as the students were allowed to choose their own group members.

Materials, Tools, and Technology. During the high school science observations, teachers used overhead projectors (33 percent of the observations) or chalkboards (33 percent of the observations), as well as other materials. Students used hands-on materials in 40 percent of the classes. Students used items such as mirrors, traffic light, food samples, burners, test tubes, acid, zinc, cardboard, markers, grasshoppers, and charts of the periodic table. Students were observed using calculators in two classes (13 percent of the observations). Computers were not used during any of the observations. Students only used paper and pencil, including textbooks and worksheets, in 47 percent of the classes.

INSTRUCTION

Instructional Format. The instructional formats in the observed high school science classes varied greatly. Some classes (27 percent) were very traditional and teacher-centered—the teacher delivered the information and the students listened passively. In other classes (20 percent), the atmosphere was very student-centered with students engaged in figuring things out for themselves and teachers guiding and questioning. The remaining classes (53 percent) fell somewhere in between these two extremes.

Twenty-six percent of the observed lessons could be characterized as very traditional. The teacher did most of the talking in a lecture format, and the students listened passively followed by individual student work.

- An observer of a physics class stated, "I am bored just watching him."
- An observer of a biology class noted, "Student interest drifted after about 15 minutes of lecture."
- A physical science class began with the students taking a quiz on vocabulary and labeling—no higher level thinking was required. After correcting the quiz, the students had to call out their scores for the whole class to hear so that the teacher could record them. Then the students were given a study guide and were to read their book and answer the questions on the sheet. The teacher stood or sat at the front of the room and students were expected to come to him for help or call out their questions.

Many classes (53 percent) had a combination of teacher-centered and student-centered learning activities. The following three examples illustrate these types of classes.

- One physical science class began with a quiz and a review of homework, but then students researched the role of African Americans in science and/or inventions in the resource center as the teacher held individual conferences with the students about their grades.
- A chemistry class began with the teacher lecturing, but then students worked in small groups on a lab. However, the lab was very structured and consisted of

students following directions with no opportunities for them to pose their own questions.

- In a physical science class, the students were studying the properties of mirrors. They were to follow a set of written directions and answer a series of questions. The observer noted that the students were generally passive as they worked individually to answer questions.

Twenty percent of the observed classes were student-centered. These lessons placed the teacher in the role of facilitator.

- In a physics class, the teacher often answered questions by asking questions. He often asked students "why" and encouraged them to look up the needed information rather than answering the questions himself.
- In a different physics class, the students did most of the talking and the teacher was a facilitator. When students asked questions, the teacher was there to help but not to answer the questions. She often asked, "How did you come up with the answer?" The students explained how they arrived at their answers.
- In a biology class, students learned how to test foods for carbohydrates and were to bring in foods to be tested. The observer noted, "The students were to reason out what results should occur in the testing" and "One student was so curious about the tests that he got part of his lunch to see how it would test."

Student Interaction. Fifty-four percent of the high school science classes observed had planned opportunities for the students to interact with each other in small groups or pairs. Thus, in 46 percent of the classes students just worked individually.

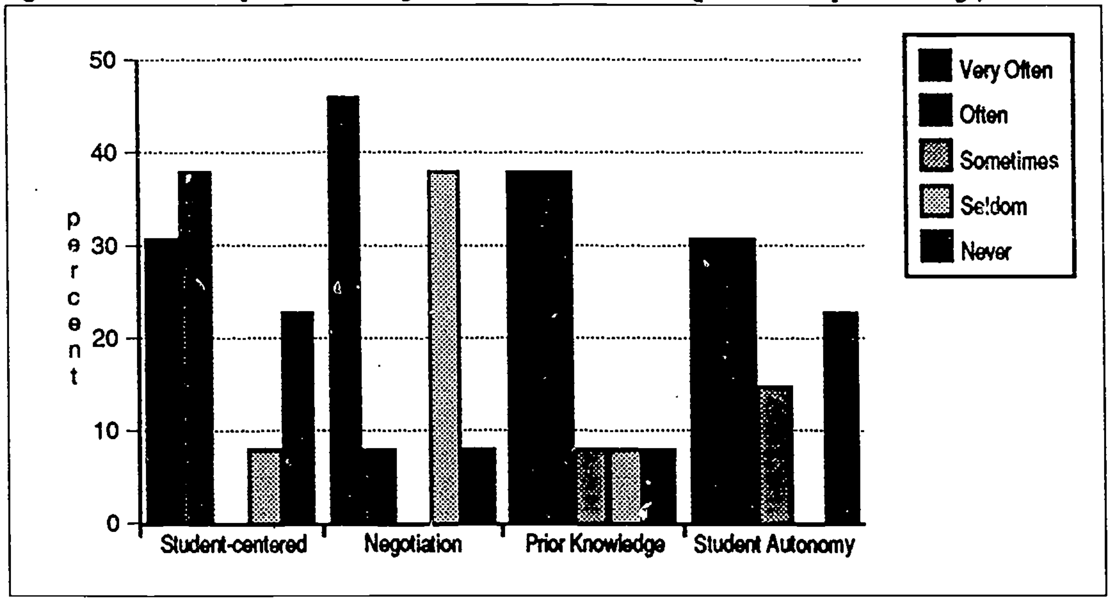
- The teacher allowed the students to work together in a physical science class, but most just socialized and did not actually work cooperatively.
- In a biology class, the students worked individually. Some informal interaction among the students occurred, but generally nonproductive off-task behavior.
- In a different chemistry class, there was some talking to among the students, but only about non-related subjects.
- In a chemistry class, the students interacted very well with each other. Lots of learning communication occurred. The students were involved in cooperative work and seemed to enjoy working together.
- In a biology class, as the students dissected grasshoppers, they showed great team work, attentive work, excitement of experience, and sense of accomplishment.

Real-World Connections. The presence of real-life connections in the observed high school science lessons were generally weak or non-existent. In 47 percent of the lessons, no real-life connections were evident. In 40 percent of the lessons, the teachers merely referred to a real-world example. For example, reference was made to fireworks and car combustion in a chemistry class and a teacher mentioned electricity bills in a physical science class. In a chemistry class, the teacher asked students to think about and discuss "Why is this useful?" In 13 percent of the lessons, the real-life connection became the focus for student investigation. A biology class discussed the carbohydrates in the foods the students eat, made conjectures about the contents, and then tested the foods. An AP biology class discussed and collected data on students' genetic traits.

General Impression Ratings

The observers rated their perception of each high school science class on four dimensions: (a) student-centeredness, (b) negotiation among students, (c) efforts to build upon prior knowledge, and (d) student autonomy. Figure 4-6 shows how the observers rated the classes in terms of the four dimensions. The percents given are based on the reported ratings. The actual frequencies are listed in table 4-12.

Figure 4-6 General Impressions of High School Science Classes (percent of reported ratings)



The observers rated 46 percent of the classes as providing students with opportunities to negotiate meaning and to work with each other to investigate problems, while 46 percent of the classes seldom or never provided these types of experiences. Seventy-six percent of the teachers were observed often or very often helping students build on their prior knowledge and experiences.

Table 4-12 General Impressions of High School Science Classes (frequencies)

	Very Often	Often	Sometimes	Seldom	Never	Not reported
The lesson was student-centered.	4	5	0	1	3	2
Students interacted with each other to make sense of ideas and to helping each other investigate.	6	1	0	5	1	2
Teacher helped students build upon prior knowledge and experiences.	5	5	1	1	1	2
Students were given responsibility and control over their learning and encouraged to think independently.	4	4	2	0	3	2

SUMMARY

Observations of 190 mathematics and science classes were conducted during site visits to MPS elementary, middle, and high schools. These observations helped to answer the question, "What does mathematics and science education currently look like in MPS?" Upon analyzing the data from the classroom observations, some interesting comparisons were made and several consistencies were evident. The following is a summary of some of the major findings from the observations of mathematics and science classes in MPS.

- About half of the observed classes at all levels—elementary, middle, and high school—were characterized as traditional in format with the teacher doing most of the talking and students listening passively or doing individual seat work. The other observed classes either had a combination of teacher-centered and student-centered learning activities or were primarily student-centered.
- A lack of real world connections to the students' learning was evident at all grade levels. Only about five percent of the teachers used real life connections to provide a context for investigating and learning mathematics and science. Another 29 percent of the teachers made, at the minimum, some verbal references to real world situations.
- Computer use was rarely observed at any level.
- Calculator use by students was seldom observed in elementary mathematics classes. More calculator use was observed in middle school mathematics classes. Calculator use by students further increased at the high school level, but only to about one third of the observed classes.
- Race/ethnic inequities, but not gender, were observed in the enrollment of students in advanced mathematics and science classes in high school. The ethnicity/race distribution of the students in these advanced classes did not reflect the diversity of the students in the school as more Caucasian than minority students were present in these classes.
- Elementary school classes exhibited diversity in the seating and grouping arrangements which allowed for interaction between and among students irregardless of race/ethnicity or gender.
- Planned opportunities for student interaction involving collaboration, problem solving, sharing of ideas, and communication about the topic involved only 32 percent of the total number of observed classes. High school science classes had the most opportunities for student interaction, and high school mathematics classes had the least number of opportunities.
- Many classrooms, particularly at the elementary and middle school levels, were overcrowded with either too many students, too small a room, or both.

CHAPTER 5
SURVEY RESULTS

The Milwaukee Public Schools (MPS) Mathematics and Science Self-Study was designed to provide a panoramic view of mathematics and science education. To widen the lens beyond the 40 site visit schools, a survey of elementary, middle, and high school teachers across the entire school district was conducted. The survey results, when combined with classroom observations and interview data, provided the wide-angle panorama needed to portray the perspectives of many.

The teachers surveyed differed across content areas and levels of instruction. To accommodate their varied needs, three different survey instruments were utilized: (a) elementary school mathematics and science, (b) middle school and high school mathematics, and (c) middle school and high school science. Copies of the survey instruments are included in Appendix C.

Findings from elementary school teachers are presented first followed by those from middle and high school teachers. The data analysis is organized under the following categories: instructional practices, assessment practices, informal learning environments, calculators and computers, resources, teachers' perceptions, other factors, professional development, and obstacles to teaching.

ELEMENTARY SCHOOL

The elementary survey contained questions regarding both the teaching of mathematics and the teaching of science. The survey was distributed to a random sample of 475 elementary teachers. Of these, 232 (49 percent) were returned.

PROFILE OF MATHEMATICS AND SCIENCE TEACHERS

The mean number of years of teaching for elementary teachers was 14.0 (SD=10.1) with a range from 1 to 43 years. Most respondents were female (85.4 percent), with 14.2 percent being male. Table 5-1 shows a profile of the elementary teachers. The race/ethnicity of the elementary teachers was mainly Caucasian, with nearly half having earned at least a master's degree.

Table 5-1 Profile of Elementary Teachers Completing Survey

	Percentage	**Highest degree earned**	Percentage
Race/Ethnicity		BS/BA	18.7
African-American	3.2	BS/BA+16	28.9
Asian	1.4	BS/BA+32	7.1
Caucasian	91.0	MS/MA	11.6
Hispanic	3.2	MS/MA+16	15.6
Native American	0.0	MS/MA+32	18.2
Other	1.4	Doctorate	0.0

INSTRUCTIONAL PRACTICES

Figure 5-1 and table 5-2 show that while almost half of the teachers spent five or more hours teaching mathematics each week, only 5.4 percent of the teachers devoted that much time to science. Over half of the elementary teachers taught science for two or fewer hours each week.

Figure 5-1 Amount of Instruction Time Each Week

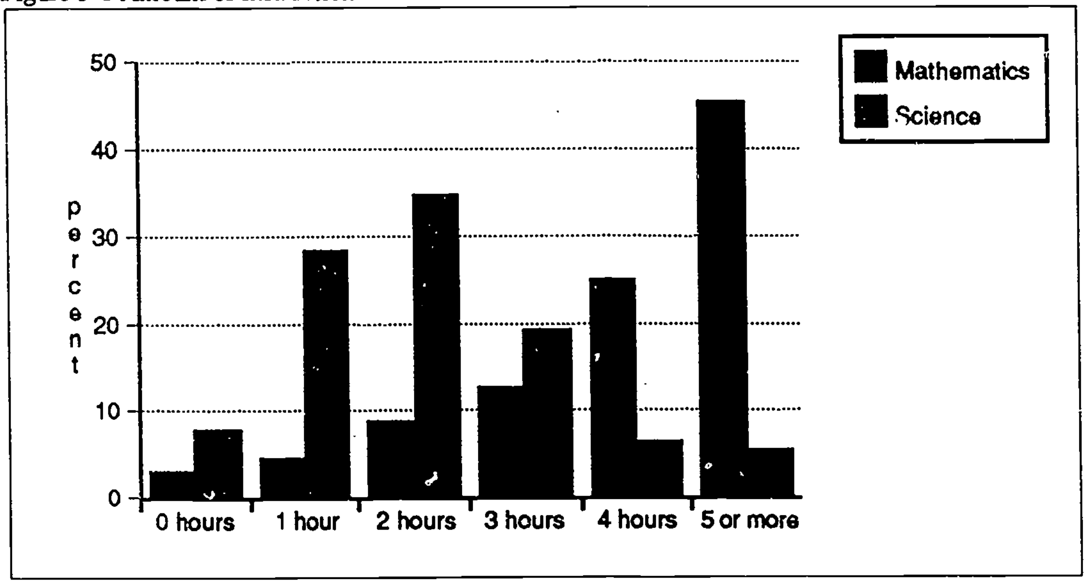


Table 5-2 Amount of Time for Mathematics and Science Each Week

	Mathematics Percentage	Science Percentage
None	3.1	5.4
1 hour	4.4	28.5
2 hours	8.8	34.8
3 hours	12.8	19.5
4 hours	25.2	6.3
5 or more hours	45.6	5.4

Teachers were asked which of the statements listed in table 5-3 best described how mathematics and science were taught in their classrooms. About half of the teachers reported integrating mathematics and science with each other or with other subjects.

Table 5-3 Description of Elementary Mathematics and Science Instruction

	Percentage
Integrated with each other	11.5
Integrated with other subjects	40.4
Taught separately	44.0
Other	4.1

Figure 5-2 and table 5-4 indicate the frequency of use for a variety of instructional methods. On a daily basis, whole group discussion was used from three to five times as often as small group or pair work. A few teachers reported that they never have their students work in small groups or pairs.

Figure 5-2 Small Group Work

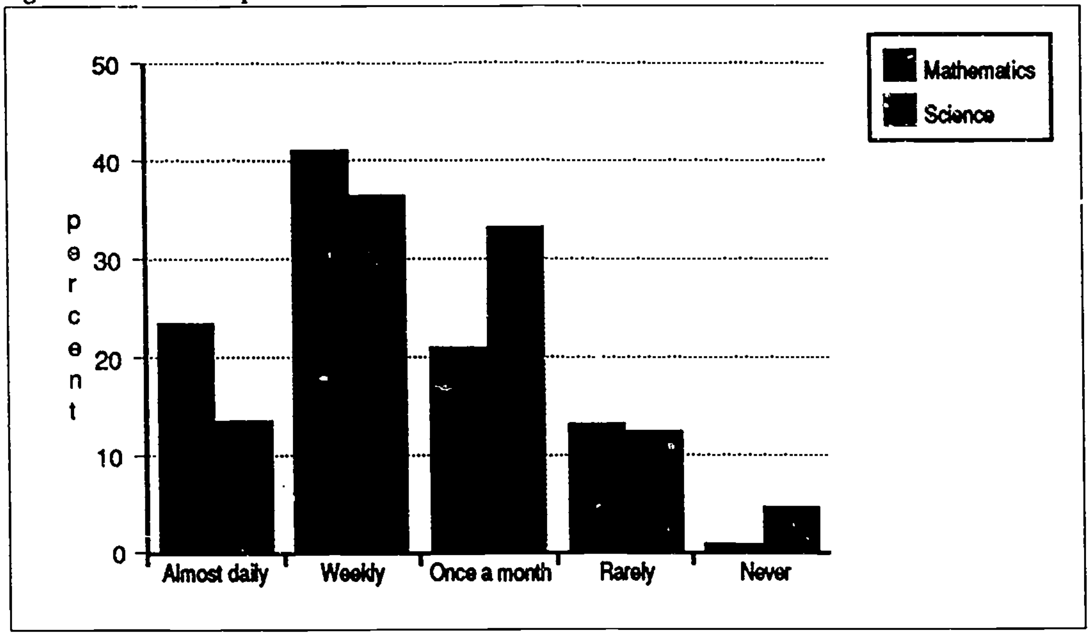


Table 5-4 Frequency of Small and Large Group Activities

	Almost daily Percentage	At least weekly Percentage	At least once a month Percentage	Rarely Percentage	Never Percentage
Small group work					
Mathematics	23.6	41.0	21.2	13.2	0.9
Science	13.4	36.6	33.2	12.4	4.5
Students working in pairs					
Mathematics	25.0	47.0	17.0	9.9	0.5
Science	8.0	38.7	21.2	19.1	3.0
Whole-group discussions					
Mathematics	81.3	10.7	3.3	3.3	1.4
Science	42.0	47.2	8.5	0.9	1.4

Teachers were asked to report on the frequency that the instructional practices listed in table 5-5 occurred in their teaching of mathematics and science. Teachers explain or demonstrate often in both mathematics and science. About 40 percent of the teachers indicated that their students do not use textbooks in either mathematics or science. About one third of the students use worksheets daily in learning mathematics.

Teachers also reported on the use of materials such as manipulatives or equipment and on the occurrence of students doing experiments. Forty percent of the teachers reported infrequent or no use of manipulatives or equipment in science, and about 20 percent of the teachers reported infrequent or no use of manipulatives or equipment in mathematics. About one fourth of the teachers stated that students rarely or never do experiments in science with 40.1 percent of the teachers indicating that students do experiments about once a month.

Table 5-5 Frequency of Instructional Practices in Elementary School

	Almost daily Percentage	At least weekly Percentage	At least once a month Percentage	Rarely Percentage	Never Percentage
Teacher explains/demonstrates					
Mathematics	87.3	10.9	1.4	0.0	0.4
Science	36.6	50.7	10.3	1.4	0.9
Students use textbooks					
Mathematics	32.1	13.4	2.4	10.5	41.6
Science	4.0	13.4	15.4	23.4	43.8
Students use worksheets					
Mathematics	31.6	33.5	10.4	17.9	6.6
Science	3.0	22.0	25.5	32.0	17.5
Students use manipulatives or other equipment					
Mathematics	37.6	40.7	14.9	5.9	0.9
Science	16.8	43.3	26.0	10.1	3.9
Learning center use					
Mathematics	17.8	21.6	14.9	25.0	20.7
Science	11.3	19.6	26.5	30.9	11.8
Students do reference work*					
Science	1.0	18.4	27.9	35.8	16.9
Students do experiments*					
Science	8.2	28.5	40.1	18.4	4.8

*The question was not asked for mathematics.

Table 5-6 summarizes teachers' self-perceptions of their strengths and weaknesses using three different instructional strategies. Each strategy was considered a strength by more than 62 percent of the teachers for both mathematics and science.

Table 5-6 Perceived Strengths and Weaknesses for Selected Instructional Strategies

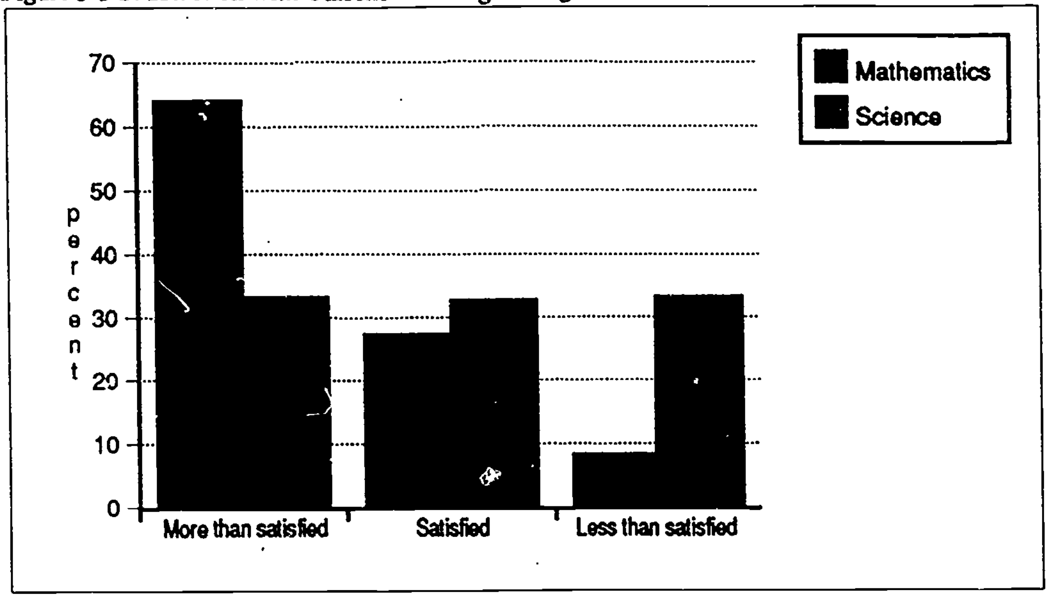
	Strong		Adequate	Weak	
	5 Percentage	4 Percentage	3 Percentage	2 Percentage	1 Percentage
Conducting demonstrations					
Mathematics	36.4	43.2	17.7	2.7	0.0
Science	24.1	40.2	26.6	4.2	2.8
Facilitating hands-on					
Mathematics	36.7	43.9	14.5	4.5	0.5
Science	23.3	39.1	22.8	10.2	2.8
Making connections to life					
Mathematics	31.9	36.6	20.4	5.1	0.9
Science	27.9	40.4	25.5	5.3	1.0

Over half of the mathematics teachers were more than satisfied with their current teaching strategies. The corresponding figure for science teachers was only 33.5 percent as shown in table 5-7 and figure 5-3.

Table 5-7 Satisfaction with Current Teaching Strategies

	More than satisfied		Satisfied	Less than satisfied	
	5 Percentage	4 Percentage	3 Percentage	2 Percentage	1 Percentage
Mathematics	22.7	41.4	27.7	5.9	2.3
Science	9.9	23.6	33.0	20.8	12.7

Figure 5-3 Satisfaction with Current Teaching Strategies



ASSESSMENT PRACTICES

Figure 5-4 and table 5-8 show the assessment practices used by teachers. They were asked to check all that apply. In mathematics and science, observation and performance tasks are the assessment methods used by the most teachers. A third of the elementary teachers also use portfolios in mathematics and about a fourth in science. Journals are used by close to half of the teachers in science and by about a fourth of the teachers in mathematics.

Figure 5-4 Assessment Practices in Elementary School

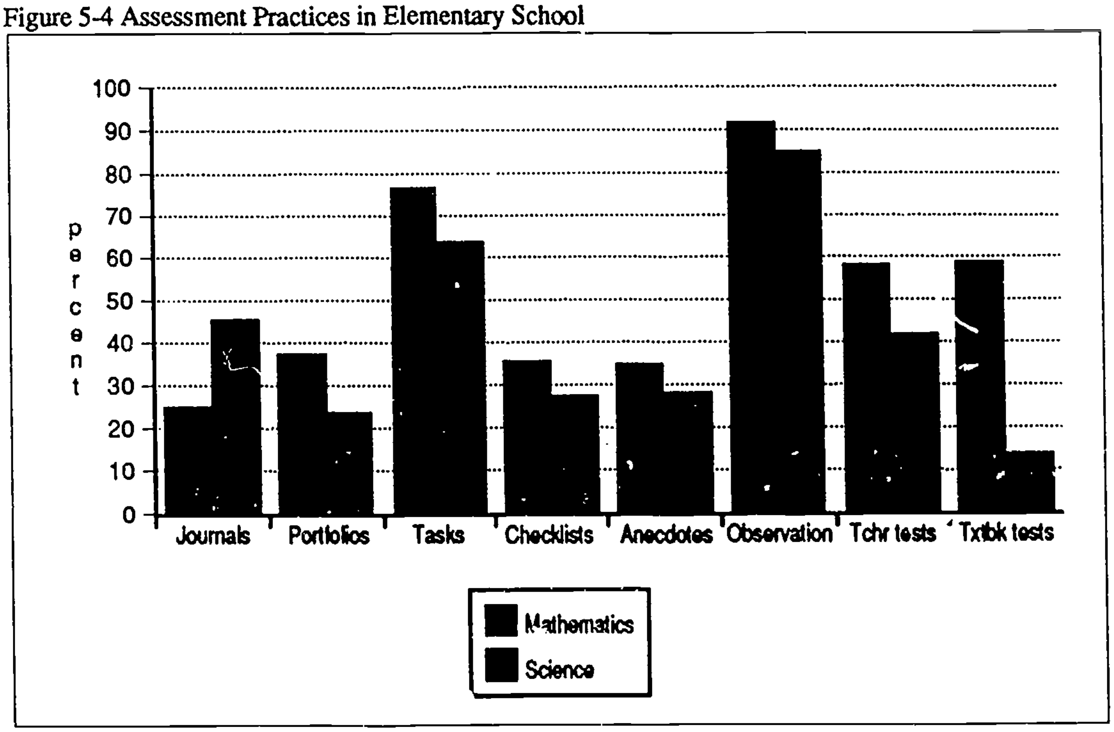


Table 5-8 Assessment Practices in Elementary School

	Mathematics Percentage	Science Percentage
Journals/Learning Logs	25.1	45.8
Portfolios	37.2	23.9
Performance Tasks	76.8	64.0
Checklists	35.7	27.8
Anecdotal Records	35.2	28.2
Observation	91.7	84.7
Teacher-developed tests	57.9	41.7
Textbook tests	58.8	13.6

More than half of the teachers felt strong in their ability to assess student learning as shown in figure 5-5 and table 5-9. Twenty percent of the teachers, however, felt it was a weakness in mathematics and 12.7 percent felt this way about science.

Figure 5-5 Ability to Assess Student Learning

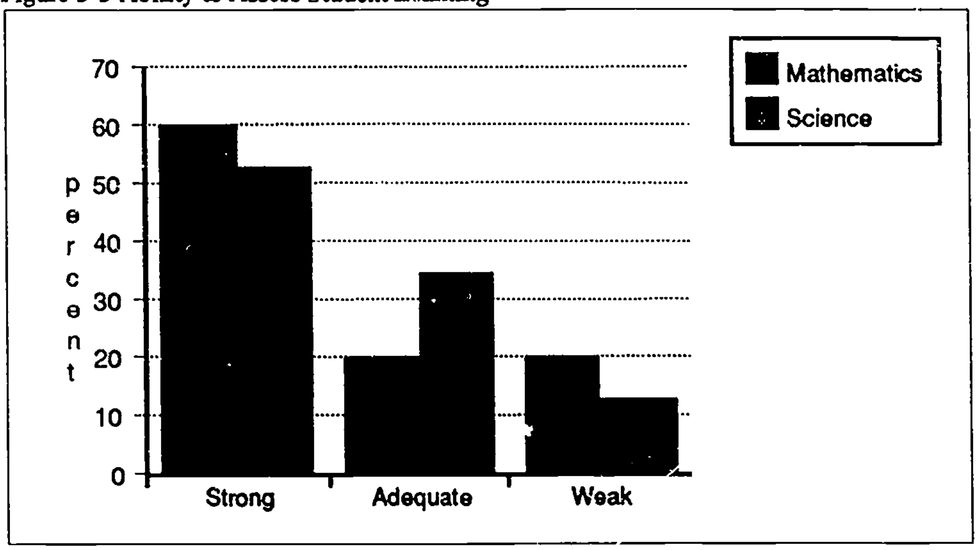


Table 5-9 Perceived Strengths and Weaknesses for Assessing Student Learning

	Strong		Adequate	Weak	
	5 Percentage	4 Percentage	3 Percentage	2 Percentage	1 Percentage
Mathematics	23.7	36.3	20.0	12.6	7.4
Science	19.3	33.5	34.4	8.5	4.2

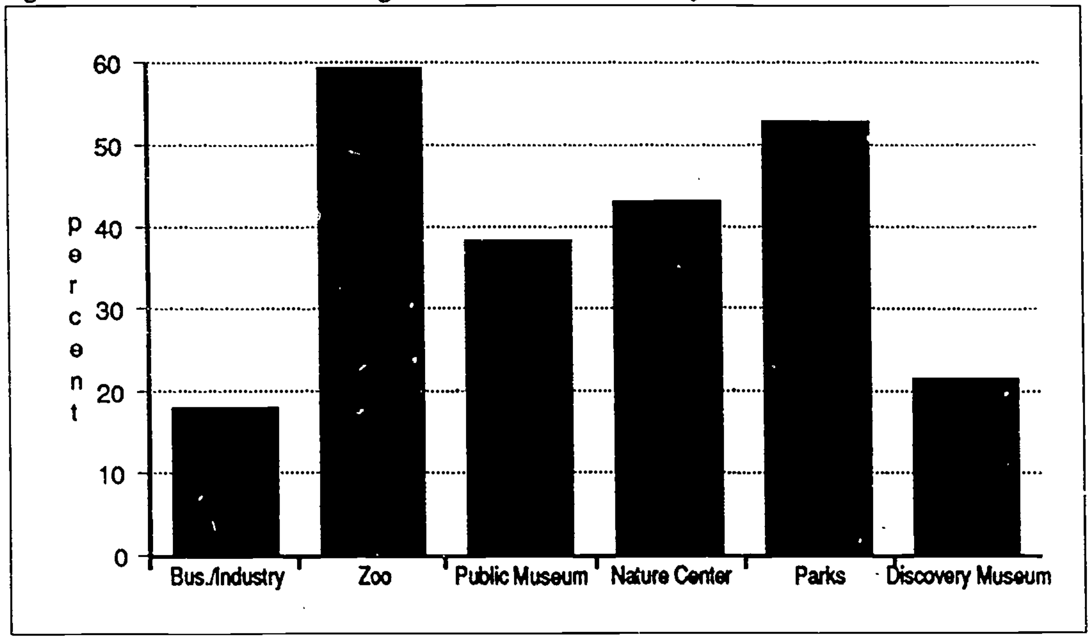
INFORMAL LEARNING ENVIRONMENTS

As shown in table 5-10 and figure 5-6, less than 20 percent of teachers used a business or industry as an informal learning environment. Over half of the teachers utilize the zoo and parks for student learning.

Table 5-10 Use of Informal Learning Environments in Elementary School

	Percentage
Business/Industry	18.1
Zoo	59.5
Milwaukee Public Museum	38.3
Nature Center	43.2
Parks	52.9
Discovery Museum	21.6

Figure 5-6 Use of Informal Learning Environments in Elementary School



Teaching science outdoors was considered a strength by many more teachers than teaching mathematics outdoors as shown in figure 5-7 and table 5-11. However, about a fourth of the teachers did consider their ability to conduct outdoor learning activities in science a weakness.

Figure 5-7 Ability to Conduct Outdoor Learning Activities

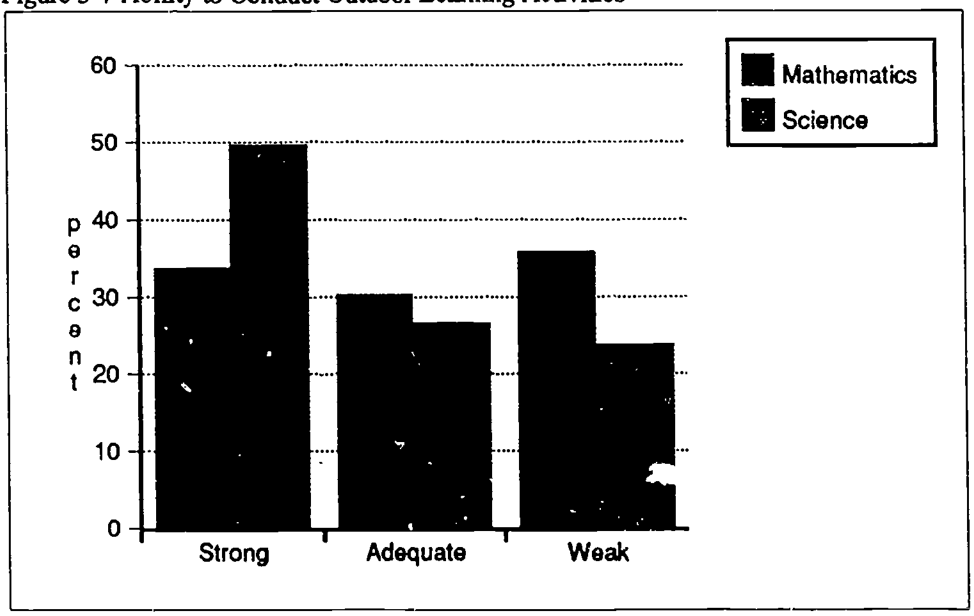


Table 5-11 Ability to Conducting Outdoor Learning Activities

	Strong		Adequate	Weak	
	5 Percentage	4 Percentage	3 Percentage	2 Percentage	1 Percentage
Mathematics	10.0	23.8	30.5	19.5	16.2
Science	20.5	29.0	26.7	13.8	10.0

CALCULATORS AND COMPUTERS

Table 5-12 indicates that half of the elementary teachers had access to computers in their classrooms. Teachers who had computers available in the classroom had a mean of 2.7 computers (SD=5.7) with a range from 1 to 30. About a third of the teachers indicated that computers were available in their school but that they were difficult to access for mathematics and science learning activities.

Table 5-12 Availability of Computers in Elementary School

	Percentage
Available within the classroom	54.4
Available but difficult to access	32.3
Not available	13.4

Frequency of computer and calculator use is shown in table 5-13 and figures 5-8 and 5-9. Computers were used more frequently than calculators for mathematics or science. However, 40.1 percent of the teachers reported that they never use computers for science and 26.2 percent stated that they never use calculators for mathematics.

Table 5-13 Frequency of Calculator and Computer Use in Elementary School

	Almost daily Percentage	At least weekly Percentage	At least once a month Percentage	Rarely Percentage	Never Percentage
Calculators					
Mathematics	1.9	15.5	28.2	28.2	26.2
Science	2.0	5.5	12.0	26.5	54.0
Computers					
Mathematics	23.4	41.6	10.3	15.4	9.3
Science	5.9	16.3	12.4	25.2	40.1

Figure 5-8 Frequency of Calculator Use in Elementary School

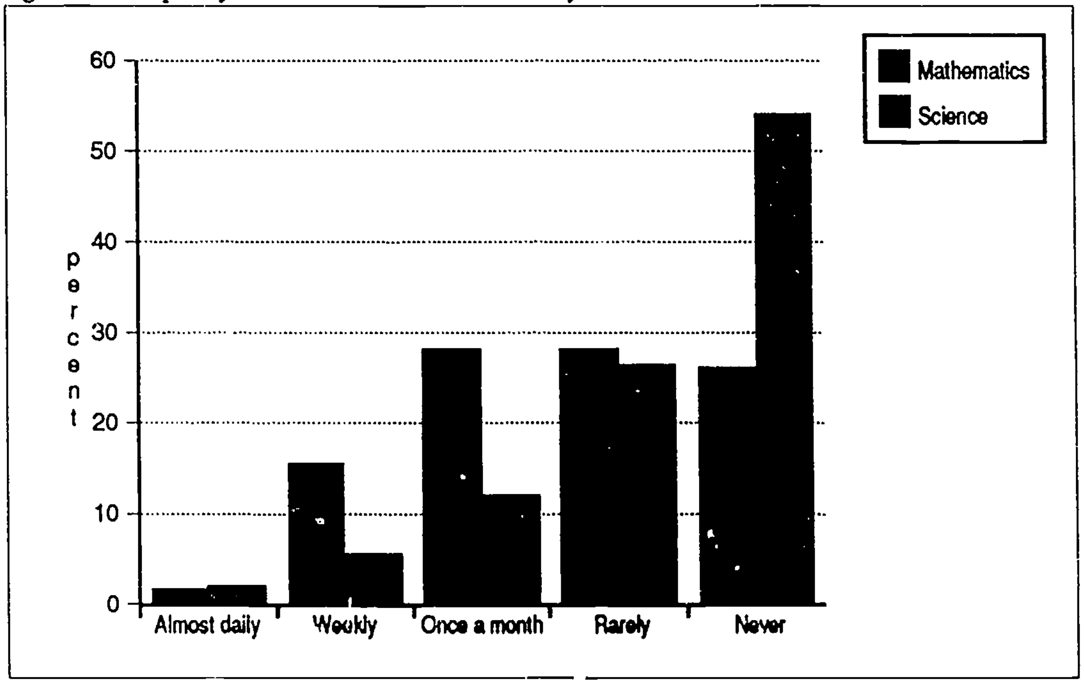
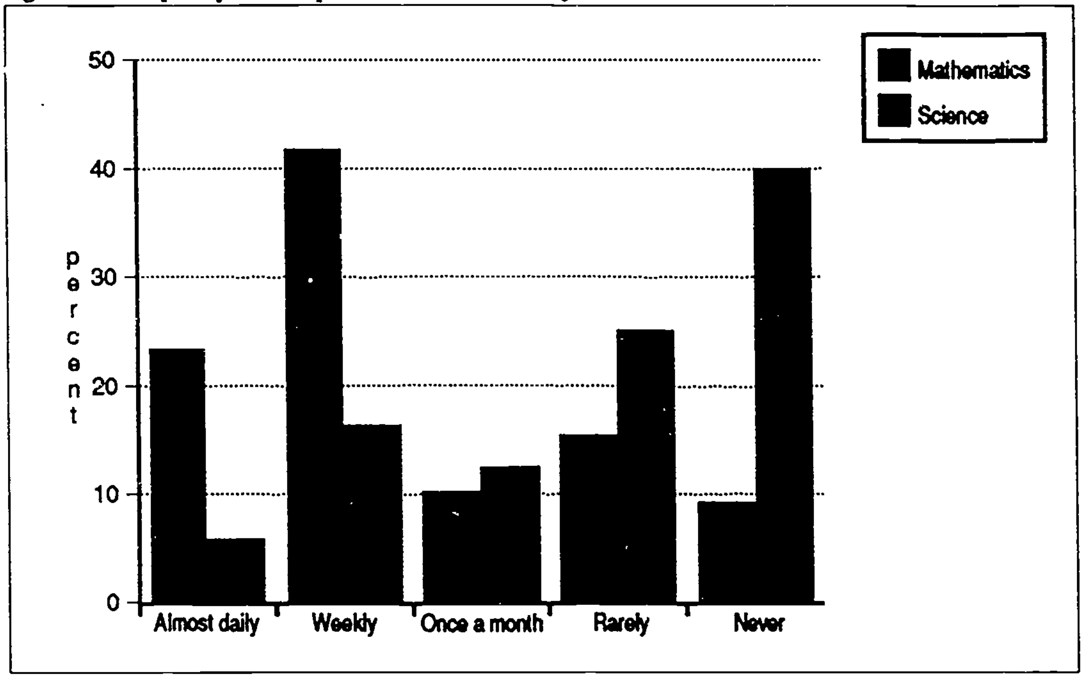


Figure 5-9 Frequency of Computer Use in Elementary School



While 80.3 percent of students had access to school calculators for mathematics, only 10.2 percent were allowed unrestricted use of them as shown in table 5-14. Some teachers indicated that students were allowed to use calculators on tests and encouraged their use for homework.

Table 5-14 Policies on Calculator Use in Elementary School Mathematics

	Percentage Responding 'Yes'
Do students have access to calculators owned by the school?	80.3
Are students allowed to use calculators on tests?	15.1
Are students encouraged to use calculators for homework?	21.4
Are students permitted unrestricted use of calculators in class?	10.2

Teachers were asked to rate their ability to use computers and calculators in their teaching (see table 5-15 and figures 5-10 and 5-11). Using calculators to teach mathematics was viewed as a weakness by 38 percent of the teachers. Using computers to teach mathematics was considered a strength by about half of the teachers. Computer use for science was considered a weakness by 44.9 percent of the teachers.

Table 5-15 Ability to Use Calculators and Computers for Teaching in Elementary School

	Strong		Adequate	Weak	
	5 Percentage	4 Percentage	3 Percentage	2 Percentage	1 Percentage
Using calculators					
Mathematics	15.6	19.0	27.3	14.6	23.4
Science	9.2	10.8	20.0	23.6	36.4
Using computers					
Mathematics	22.3	30.7	25.6	10.7	10.7
Science	11.8	18.7	24.6	21.7	23.2

Figure 5-10 Ability to Use Calculators for Teaching in Elementary School

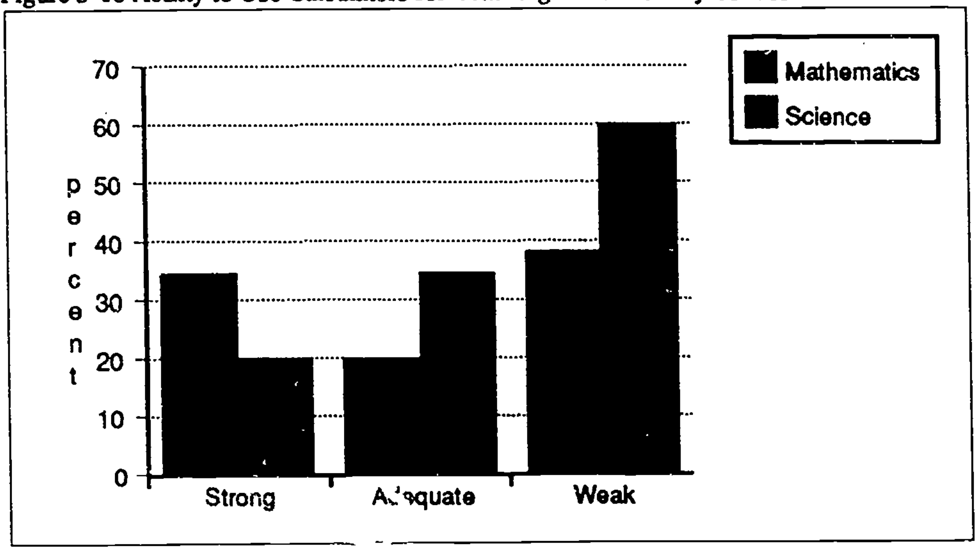
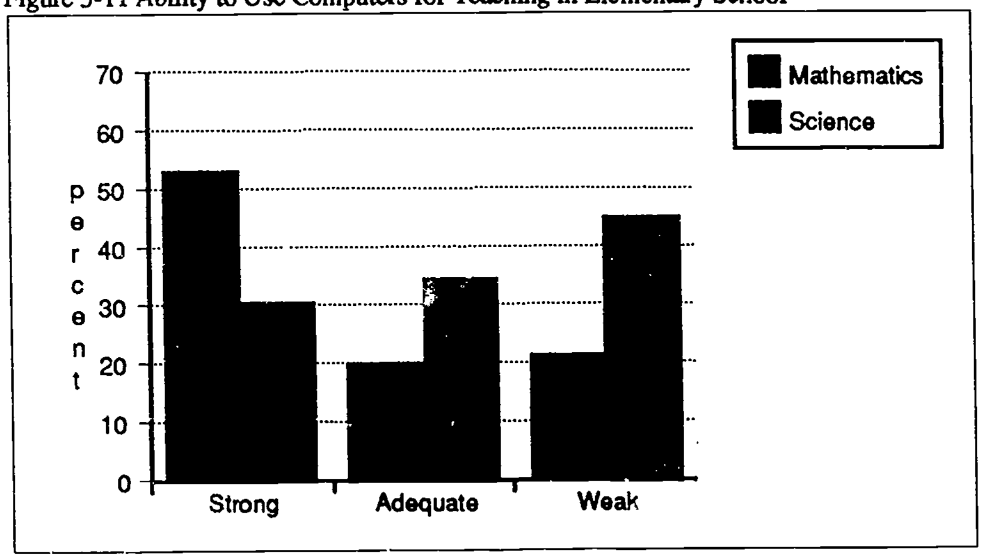


Figure 5-11 Ability to Use Computers for Teaching in Elementary School



RESOURCES

Teachers were asked to indicate the adequacy of planning time for teaching mathematics and science in their school. Between 62 and 72 percent of teachers rated the adequacy of individual and collaborative planning time for mathematics and science as unsatisfactory as shown in table 5-16 and figures 5-12 and 5-13.

Table 5-16 Adequacy of Planning Time in Elementary School

	Excellent Percentage	Good Percentage	Satisfactory Percentage	Unsatisfactory Percentage	Not applicable Percentage
Individual planning time					
Mathematics	1.4	10.0	24.9	62.0	1.8
Science	1.9	7.9	20.9	67.4	1.9
Collaborative planning time					
Mathematics	1.4	5.9	16.7	71.5	4.5
Science	0.9	4.7	17.2	72.1	5.2

Figure 5-12 Adequacy of Individual Planning Time in Elementary School

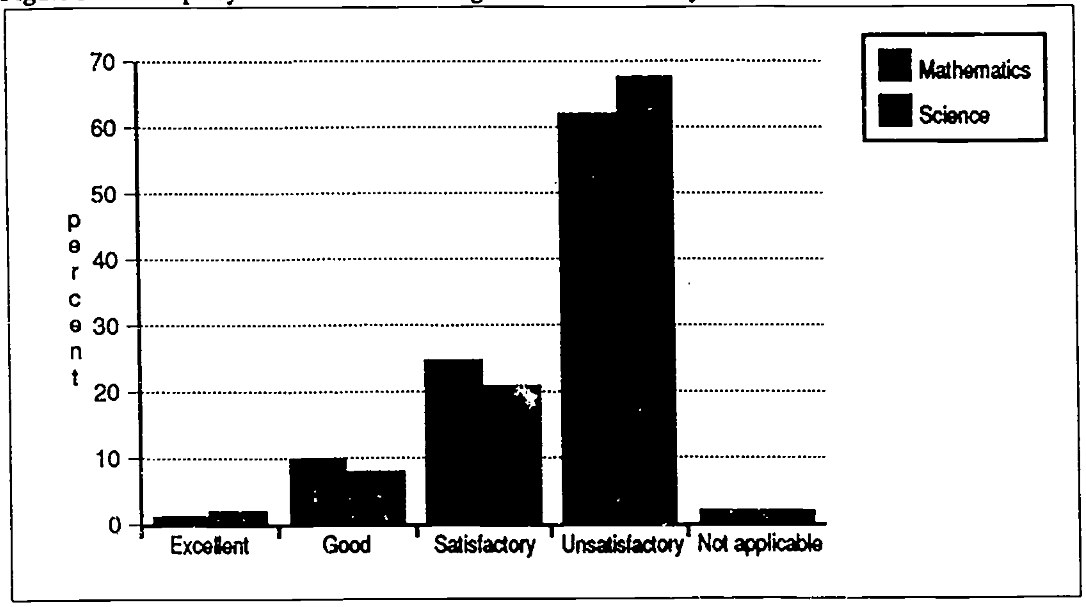
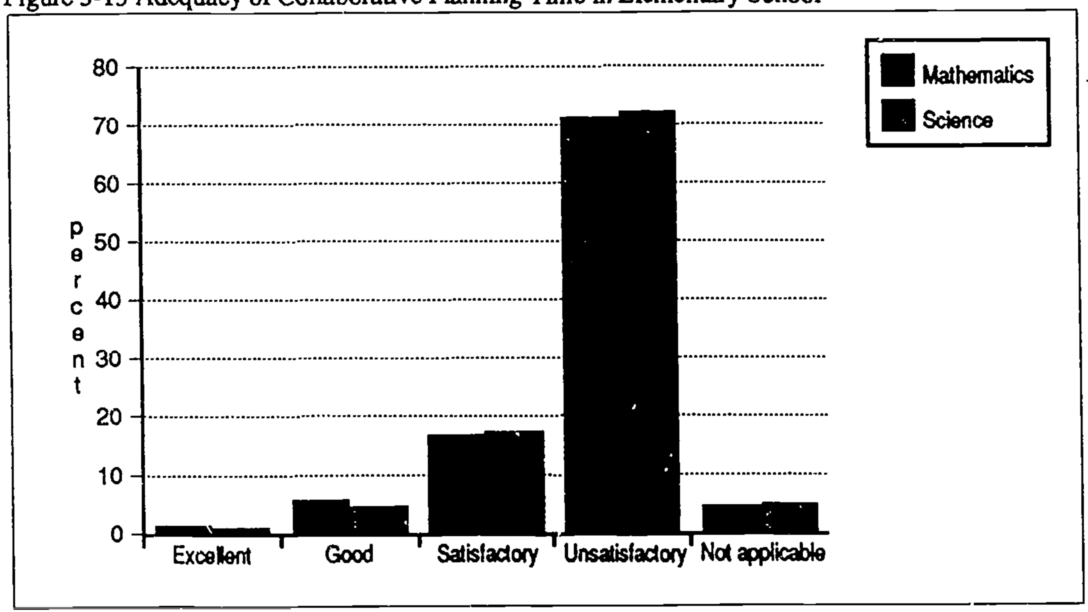


Figure 5-13 Adequacy of Collaborative Planning Time in Elementary School



Teachers were asked to comment on the adequacy of class size, class time, space for students to work, and space for storage in its relationship to the teaching of mathematics and science. Table 5-17 reveals that over half of the teachers indicated that mathematics and science class sizes are unsatisfactory. About one third of the teachers also noted that class time for science was not satisfactory. Storage space was unsatisfactory for many teachers for both science and mathematics.

Table 5-17 Adequacy of Class Size, Time, and Space in Elementary School

	Excellent Percentage	Good Percentage	Satisfactory Percentage	Unsatisfactory Percentage	Not applicable Percentage
Class size					
Mathematics	3.6	10.8	32.0	53.2	0.5
Science	3.2	7.9	33.5	53.2	2.4
Class time					
Mathematics	3.6	19.0	59.9	12.9	0.0
Science	2.3	12.1	50.0	34.1	1.3
Space for students to work					
Mathematics	15.8	42.5	29.0	12.7	0.0
Science	12.0	22.7	33.8	28.4	0.8
Space for storage					
Mathematics	7.7	18.8	32.0	41.0	0.5
Science	3.7	12.0	27.8	54.6	1.9

Teachers were asked to rate the adequacy of equipment and consumable materials for teaching mathematics and science. The results are displayed in table 5-18 and figures 5-14 and 5-15. About half of the elementary teachers indicated that science equipment was unsatisfactory. About half of the teachers for science and close to half of the teachers for mathematics also viewed the adequacy of consumable materials as unsatisfactory.

Table 5-18 Adequacy of Equipment and Materials in Elementary School

	Excellent Percentage	Good Percentage	Satisfactory Percentage	Unsatisfactory Percentage	Not applicable Percentage
Equipment					
Mathematics	10.6	24.3	45.0	20.2	0.0
Science	4.7	13.0	29.3	51.2	1.9
Consumables					
Mathematics	3.3	14.0	30.7	42.8	9.3
Science	2.9	6.7	28.7	52.6	9.1

Figure 5-14 Adequacy of Equipment in Elementary School

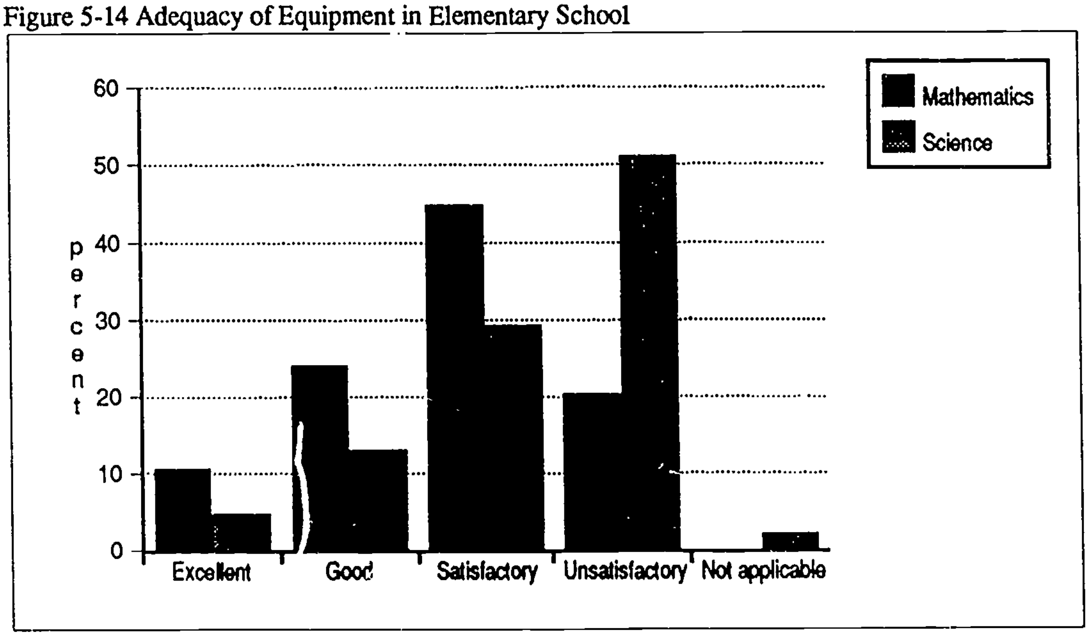


Figure 5-15 Adequacy of Consumable Materials in Elementary School

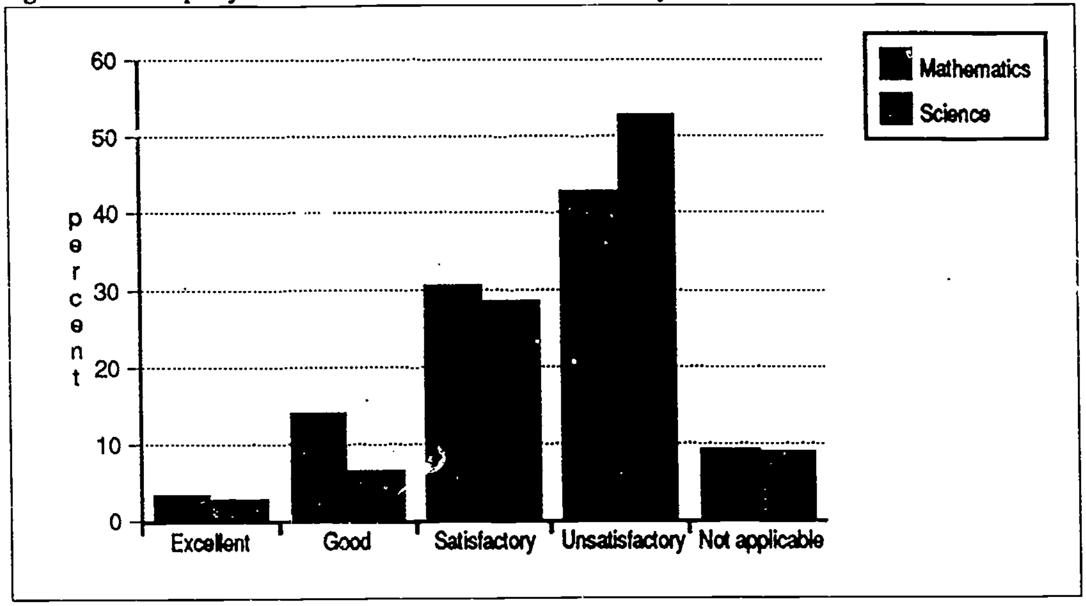


Table 5-19 reveals that over 60 percent of teachers view availability of consumable supplies as less than adequate in teaching both science and mathematics. Over half of the teachers indicated that non-consumable supplies were more than adequate for mathematics, and about one third felt they were less than adequate for science.

Table 5-19 Availability of Consumable and Non-Consumable Supplies

	More than adequate (All or Most)		Adequate (Some)	Less than adequate (Few or None)	
	5 Percentage	4 Percentage	3 Percentage	2 Percentage	1 Percentage
Consumable supplies are regularly purchased for student use					
Mathematics	7.4	8.3	22.1	21.7	40.6
Science	7.2	7.7	16.4	21.3	47.3
Non-consumable supplies are available for student use					
Mathematics	28.9	33.9	21.1	9.6	5.1
Science	13.0	22.2	29.5	19.3	15.9

TEACHERS' PERCEPTIONS

On a 5-point scale, with 5 being high, teachers were asked to indicate their degree of agreement with the statements shown in table 5-20. While over 80 percent of teachers perceived themselves as having a strong mathematics background, only 62.4 percent of teachers viewed themselves as having a strong science background. Teachers enthusiasm was higher for mathematics than for science. Teachers also felt that mathematics was more highly valued in their schools than science. In fact, about one fifth of the teachers felt that science was not valued in their schools.

Table 5-20 Perceptions of Students, School, and Self

	High		Neutral	Low		
	5 Percentage	4 Percentage	3 Percentage	2 Percentage	1 Percentage	
Mathematics						
Strong agreement that all students can learn mathematics	81.0	15.0	3.5	0.0	0.4	Strong disagreement that all students can learn mathematics
High perceived value of mathematics in one's school	58.8	28.8	10.2	1.8	0.4	No perceived value of mathematics in one's school
Strong (self) background knowledge in mathematics	43.0	40.3	14.9	1.4	0.5	Weak (self) background knowledge in mathematics
Strong (self) enthusiasm for mathematics	40.0	34.0	19.1	2.3	4.7	Weak (self) enthusiasm for mathematics
Science						
Strong agreement that all students can learn science	81.4	15.8	2.3	0.0	0.5	Strong disagreement that all students can learn science
High perceived value of science in one's school	30.2	27.5	22.5	14.9	5.0	No perceived value of science in one's school
Strong (self) background knowledge in science	26.2	36.2	22.0	7.8	2.2	Weak (self) background knowledge in science
Strong (self) enthusiasm for science	23.3	39.1	22.8	10.2	2.8	Weak (self) enthusiasm for science

Table 5-21 shows that elementary teachers are more comfortable teaching mathematics than science. Teachers also felt that mathematics was more enjoyable and satisfying to teach than science. A slightly greater percentage, however, felt that science was more exciting to teach than mathematics.

Table 5-21 Elementary Teacher's Feelings Towards Teaching Mathematics and Science

	High		Neutral	Low		
	5 Percentage	4 Percentage	3 Percentage	2 Percentage	1 Percentage	
Mathematics						
Enjoyable	53.0	32.0	14.2	0.9	0.0	Not Enjoyable
Exciting	37.9	35.6	23.3	3.2	0.0	Boring
Satisfying	38.5	36.2	21.1	3.2	0.9	Frustrating
Rewarding	38.7	36.4	19.4	5.1	0.5	Unfulfilling
Comfortable	45.0	32.3	17.7	3.6	1.4	Stressful
Science						
Enjoyable	36.0	37.0	19.0	6.6	1.4	Not Enjoyable
Exciting	40.5	33.3	21.0	4.3	0.5	Boring
Satisfying	28.4	34.1	28.4	7.7	1.4	Frustrating
Rewarding	33.2	31.7	28.4	5.8	1.0	Unfulfilling
Comfortable	27.8	31.1	30.1	9.1	1.9	Stressful

OTHER FACTORS

Teachers were asked to rate the adequacy of administrative support, teacher comfort level, and student reading skills. The results are displayed in table 5-22. Elementary teachers indicated that about one third of their students have reading skills that are unsatisfactory. Teachers felt that administrative support, as well as teachers' comfort levels, was stronger for mathematics than for science.

Table 5-22 Adequacy of Support, Comfort Level, and Reading Skills in Elementary School

	Excellent Percentage	Good Percentage	Satisfactory Percentage	Unsatisfactory Percentage	Not applicable Percentage
Administrative Support					
Mathematics	21.2	26.6	38.8	9.5	2.3
Science	19.8	21.2	42.5	13.7	2.9
Teacher comfort level					
Mathematics	20.4	41.2	31.7	6.3	0.5
Science	12.1	33.2	41.1	12.6	1.0
Reading skills of students					
Mathematics	1.8	14.1	46.8	30.5	6.8
Science	0.9	12.2	43.7	34.7	8.5

Table 5-23 displays the teachers' perceptions of parent involvement. Over 80 percent of the teachers felt that parent involvement in mathematics and science in elementary schools was low to non-existent.

Table 5-23 Parent Involvement in Mathematics and Science in Elementary School

	High		Neutral	Low		
	5 Percentage	4 Percentage	3 Percentage	2 Percentage	1 Percentage	
High involvement of parents in mathematics and science programs	0.9	2.6	14.1	23.8	58.6	No involvement of parents in mathematics and science programs

Professional Development

Table 5-24 shows the number of hours of professional development for mathematics and science. Nearly three fourths of the elementary teachers had 10 or fewer hours of professional development in either subject area in the last three years.

Table 5-24 Professional Development in Last Three Years for Elementary Teachers

	Mathematics	Science
0 hours	28.4	24.4
1-5 hours	27.0	28.7
6-10 hours	17.8	20.7
11-15 hours	7.2	9.1
16-20 hours	6.2	4.3
21-30 hours	6.3	4.4
31-40 hours	2.4	4.3
41 or more hours	5.0	4.4

Obstacles to Teaching

An open-ended item on the survey asked teachers to identify the major obstacles to teaching mathematics and science effectively. Many teachers listed two or more obstacles for a total of 340 responses. Of these responses, nine categories emerged as major areas of concern, with ten or more responses for each area. Illustrative comments from the teachers are included for each major area of concern.

Lack of Adequate Materials, Supplies, Resources, and Equipment. Twenty-six percent of the responses mentioned lack of needed materials. A few teachers noted that they needed more manipulatives, calculators, tables instead of desks, and consumable materials.

- Develop a MPS math and science equipment catalog to be distributed at every school. Allow teachers to phone in requests.
- We have no science equipment in our school. We used to have a lot of things, but then the store room was turned into the art room and all of the items were disposed of because no one had room to store them in their classrooms.

Lack of Planning Time. Fifteen percent of the responses stated that individual planning time or team planning time was inadequate.

- There's not enough time to dig deeper into subjects because of additions to the curriculum.
- We need collaborative planning time with other grade level teachers.
- More individual planning time—NOT more meetings.
- There are days when I have only the 15 minutes before school starts. If a parent or colleague needs me at that time, I have nothing. Sometimes I hurry or skip lunch, but I shouldn't have to do that daily. Other professionals don't.

Large Class Sizes. Twelve percent of the responses stated that large classes sizes were an obstacle to effective instruction.

- You cannot implement hands on curriculum with the class sizes we presently have, unless we have specialists or, at the very least, science rooms.
- I would prefer teaching math in small groups but I do not have an assistant.
- Classes have too many students. Furthermore, there is a wide range of ability and skill. It would be helpful to teach math to students at their level of need and success. Grouping for a large variance of skills works well in science but not in math.
- It is difficult to use manipulatives in a large class without additional help.

Not Enough Class Time. Seven percent of the responses indicated there is not enough class time.

- It takes a longer time for children to use manipulative tools and to share discoveries. There are too many activities, programs, and curricula to explore, and too many special things going on that one thing or another needs to be left out. Unfortunately, sometimes it's math.
- My class has three levels in math making it very difficult to spend much quality small group or one-on-one time with my students.
- I wish I could work one-on-one with students who are below grade level. Time constraints and the inability to leave the remainder of the class unattended prevents me from doing so.
- There are too many other curriculum demands for reading, writing, and non-curriculum demands, such as violence prevention.
- Though an integrated approach is used, there never seems to be enough time to do as much as one would like.

Lack of Adequate Staff Development and Inservice. Six percent of the responses centered on the need for more staff development. Specific areas included bringing teachers up to speed with the mathematics program, the new science curriculum, the use of manipulatives, and hands-on strategies.

- No age appropriate training and materials.
- A single inservice is not enough information.

- I wish I knew more about integrating science and math.
- Provide on-site inservice in current math and science activities, philosophies, and techniques.

Lack of Student Skills. Five percent of the responses stated that the range of student skills is too wide and that students lack prior experiences.

- Students have not mastered skills needed to enter the grade I teach.
- Reading comprehension can greatly affect story problems in math.
- Students lack skills. This includes: listening to directions so that an activity can proceed, reading ability sufficient to read any grade-level or near grade-level directions, social skills to stop arguing or blaming long enough to work in a group, basic math facts so that we can measure, estimate, and so on.
- They do not know how to work in groups or share materials.

Poor Textbooks or Lack of Textbooks. Three percent of the responses stated that the textbooks were poor or that they were not available.

- The teacher's manual is not user friendly. I spend most time in language arts area. I wish to develop an integrated approach in my teaching.
- The science textbook is terrible.
- Hands-on is a philosophy that doesn't face the reality of class size or emotional make up of many kids. It's the frosting on the cake, a good basic text is still needed.

The Mathematics Program. Four percent of the responses commented that the mathematics program is an obstacle to effective instruction.

- Math series is too vague and is frustrating to teach.
- The math program is horrible. No one I know uses it. We make up our own.
- I feel first graders should have consumable workbooks.
- Lack of worksheets

The New Science Curriculum. Three percent of the responses commented that the science program is an obstacle to effective instruction.

- Don't like new series, need a text for background knowledge, impossible to do hands-on activities daily.
- A good program but not easily adaptable to a regular classroom.
- Curriculum should have been given to teachers with inservice prior to the year implemented. MPS was not ready with materials and expected teachers to be when the program was thrown at us after school started.
- I feel children need some type of textbook or every school needs a science specialist.

Other Obstacles. The following responses were mentioned five to nine times each: (a) no access or little access to computers, (b) not enough classroom space, (c) need more manipulatives, (d) lack of teacher background knowledge, (e) lack of parental support, (f) poor student behavior, and (g) not enough storage space.

Other obstacles that were mentioned four or fewer times included: (a) lack of cooperation from other teachers, (b) lack of volunteers, (c) lack of money for field trips, (d) not having my own room, (e) need for realistic assessment, (f) lack of materials allowing for integrating subject areas, and (g) need for real life situations.

MIDDLE SCHOOL AND HIGH SCHOOL

The middle and high school surveys were distributed to all certified mathematics and science teachers. This included both middle and high school teachers. The mathematics survey was given to 298 teachers of which 124 (41.6 percent) were returned. The science survey was distributed to 194 teachers with 75 (38.7 percent) being returned.

PROFILE OF MATHEMATICS AND SCIENCE TEACHERS

Of those returning the mathematics survey, 82.0 percent taught at the high school level and 18.0 percent taught at the middle school level. The mean number of years of teaching for mathematics teachers was 16.9 (SD=10.0) with a range from 1 to 40 years. About half (51.2 percent) of the mathematics teachers percent were female, and 48.8 percent were male.

Of those returning the science survey, 68.9 percent taught at the high school level and 31.1 percent taught at the middle school level. The mean number of years of teaching for science teachers was 19.7 (SD=9.9) with a range from 1 to 35 years. About a third (34.7 percent) of the science teachers were female, and 61.3 percent were male.

Table 5-25 shows a profile of the middle school and high school teachers for both mathematics and science. The teachers in both subject areas were mainly Caucasian. About half of the mathematics teachers and science teachers had earned at least a master's degree.

Table 5-25 Profile of Middle and High School Teachers Completing Survey

	Mathematics Percentage	**Science** Percentage		**Mathematics** Percentage	**Science** Percentage
Race/Ethnicity			**Highest degree earned**		
African-American	5.8	7.2	BS/BA	19.7	6.7
Asian	1.7	2.9	BS/BA+16	9.8	16.0
Caucasian	87.5	89.9	BS/BA+32	23.8	18.7
Hispanic	0.0	0.0	MS/MA	7.4	5.3
Native American	0.8	0.0	MS/MA+16	14.8	12.0
Other	4.2	0.0	MS/MA+32	23.8	40.0
			Doctorate	0.8	1.3

INSTRUCTIONAL PRACTICES

Teachers were asked to indicate the frequency of use for a variety of instructional methods. Table 5-26 shows that mathematics and science were often taught separately from other subject areas.

Table 5-26 Description of Middle and High School Mathematics and Science Instruction

	Mathematics Percentage	**Science** Percentage
Integrated with other subjects	31.9	42.3
Taught separately	56.3	45.1
Other	11.8	12.7

Small group work is used more in science than in mathematics at the middle and high school levels as shown in figure 5-16 and table 5-27. However, about 60 percent of the teachers used small group work at least once a week when teaching mathematics or science. More than 70 percent of teachers had students work in pairs at least once a week when they learned mathematics or science. Whole group discussions occur on almost a daily basis in about 40 percent of both the mathematics classes and the science classes.

Figure 5-16 Small Group Work in Middle and High School

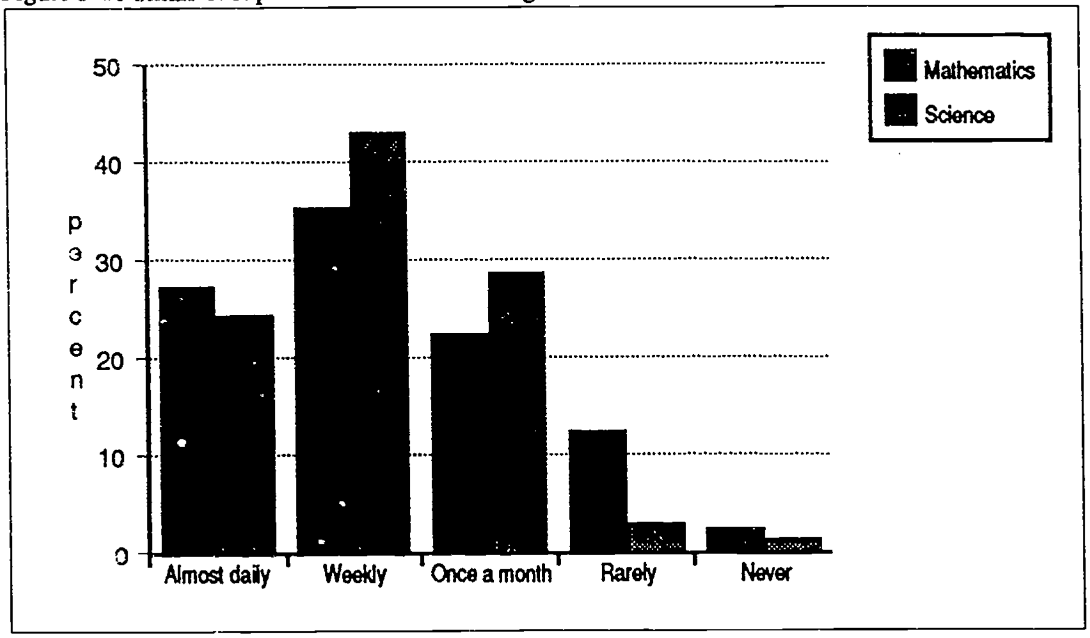


Table 5-27 Frequency of Instructional Practices in Middle and High School

	Almost daily Percentage	At least weekly Percentage	At least once a month Percentage	Rarely Percentage	Never Percentage
Small group work					
Mathematics	27.3	35.5	22.3	12.4	2.5
Science	24.3	42.9	28.6	2.9	1.4
Students working in pairs					
Mathematics	34.2	38.3	15.0	11.7	0.8
Science	33.3	39.1	21.7	4.3	1.4
Whole-group discussions					
Mathematics	47.1	29.8	12.4	10.7	0.0
Science	44.9	44.9	4.3	4.3	1.4

Table 5-28 shows that while 71.0 percent of teachers reported that students used a textbook in mathematics on an almost daily basis, only 43.7 percent of science teachers used a textbook that often. Students have many more opportunities to use materials or equipment in science than in mathematics; 81.1 percent of the teachers indicated that students use materials on an almost daily or weekly basis in science compared to 33.9 percent in mathematics. Sixty percent of the science teachers reported that students do experiments on a weekly basis and 18.6 reported that students do experiments almost daily.

Table 5-28 Frequency of Instructional Practices in Middle and High School

	Almost daily Percentage	At least weekly Percentage	At least once a month Percentage	Rarely Percentage	Never Percentage
Teacher explains or demonstrates.					
Mathematics	87.8	11.4	0.8	0.0	0.0
Science	62.0	33.6	0.0	1.4	0.0
Students use textbooks					
Mathematics	71.0	14.5	7.3	3.2	4.0
Science	43.7	43.7	7.0	1.4	4.2
Students use worksheets					
Mathematics	24.6	48.4	14.8	11.5	0.8
Science	18.3	52.1	19.7	9.9	0.0
Students use materials or equipment					
Mathematics	3.3	30.6	43.0	19.8	3.3
Science	27.5	53.6	18.8	0.0	0.0
Students do reference work					
Science	5.8	14.5	46.4	31.9	1.4
Students do experiments					
Science	18.6	60.0	17.1	4.3	0.0

*The question was not asked for mathematics.

Teachers were asked to rate their strengths and weaknesses on the instructional practices listed in table 5-29. Many teachers reported that conducting demonstrations, facilitating hands-on activities, and making connections to real life were strengths in their teaching of both mathematics and science.

Table 5-29 Strengths and Weaknesses for Instructional Strategies in Middle and High School

	Strong		Adequate	Weak	
	5 Percentage	4 Percentage	3 Percentage	2 Percentage	1 Percentage
Conducting demonstrations					
Mathematics	41.7	35.0	19.2	3.3	0.8
Science	45.1	36.6	14.1	2.8	1.4
Facilitating hands-on activities					
Mathematics	20.8	27.5	38.3	10.8	2.5
Science	49.3	39.4	8.5	2.8	0.0
Making connections to life					
Mathematics	23.1	40.5	30.6	5.0	0.8
Science	54.9	35.2	9.9	0.0	0.0

Over 85 percent of mathematics and science teachers were satisfied with their current teaching strategies as shown in table 5-30. A few teachers in both subject areas indicated that they were not satisfied with their teaching strategies.

Table 5-30 Satisfaction with Current Teaching Strategies in Middle and High School

	More than satisfied		Satisfied	Less than satisfied	
	5 Percentage	4 Percentage	3 Percentage	2 Percentage	1 Percentage
Mathematics	17.5	46.7	23.3	8.3	4.2
Science	14.1	45.1	29.6	8.5	2.8

ASSESSMENT PRACTICES

Teachers were told to indicate which assessment practices they use for mathematics and science from those listed in figure 5-17 and table 5-31. Performance tasks, observations, and teacher tests were the dominant assessment practices in both mathematics and science. About one third of the teachers used journals in science and about one fourth used them in mathematics.

Figure 5-17 Assessment Practices in Middle and High School

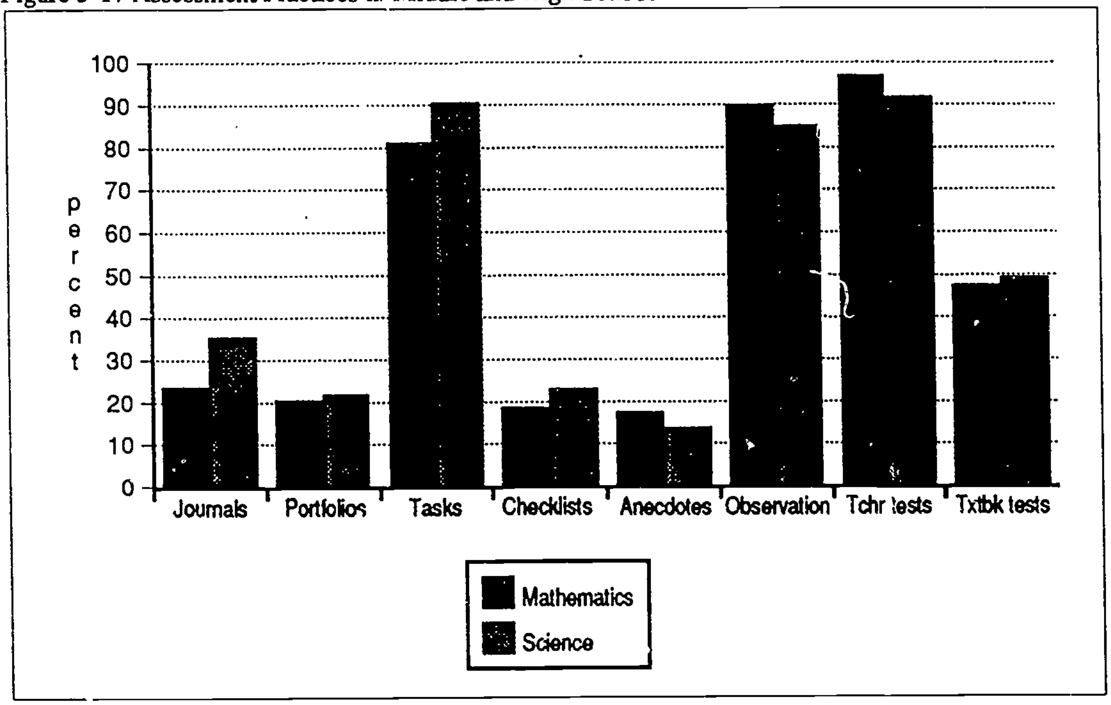


Table 5-31 Assessment Practices in Middle and High School

	Mathematics Percentage	**Science** Percentage
Journals/Learning Logs	23.8	35.6
Portfolios	20.5	21.9
Performance Tasks	81.1	90.4
Checklists	18.9	23.3
Anecdotal Records	17.2	13.7
Observation	90.2	84.9
Teacher-developed tests	96.7	91.8
Textbook tests	47.5	49.3

Teachers rated their ability to assess student learning as shown in table 5-32. Approximately three-fourths of the mathematics and science teachers perceived themselves as strong in their ability to assess student learning.

Table 5-32 Ability to Assess Student Learning for Middle and High School Teachers

	Strong		Adequate	Weak	
	5 Percentage	4 Percentage	3 Percentage	2 Percentage	1 Percentage
Mathematics	31.4	43.0	23.1	2.5	0.0
Science	35.7	42.9	20.0	1.4	0.0

INFORMAL LEARNING ENVIRONMENTS

Teachers were asked to indicate which informal learning environments their students experienced as part of their mathematics and science programs. The results are displayed in figure 5-18 and table 5-33. Far more science teachers than mathematics teachers utilized informal learning environments. Businesses and industries were the most widely used informal environment for mathematics.

Figure 5-18 Use of Informal Learning Environments in Middle and High School

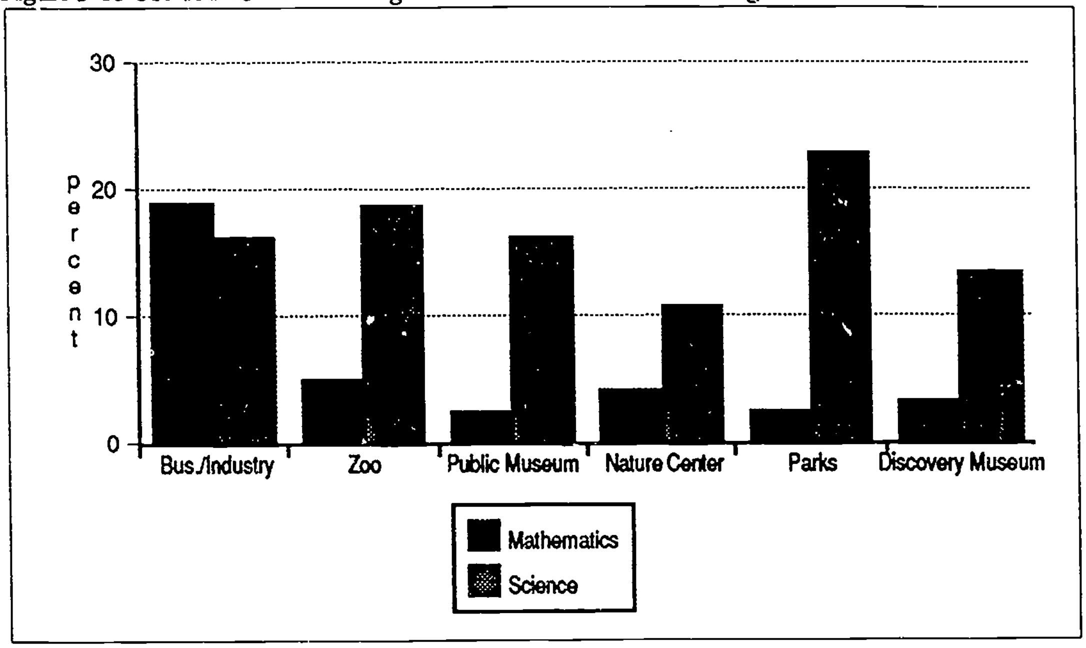


Table 5-33 Use of Informal Learning Environments in Middle and High School

	Mathematics Percentage	Science Percentage
Business/Industry	19.0	16.2
Zoo	5.0	18.7
Milwaukee Public Museum	2.5	16.2
Nature Center	4.1	10.8
Parks	2.5	23.0
Discovery Museum	3.3	13.5

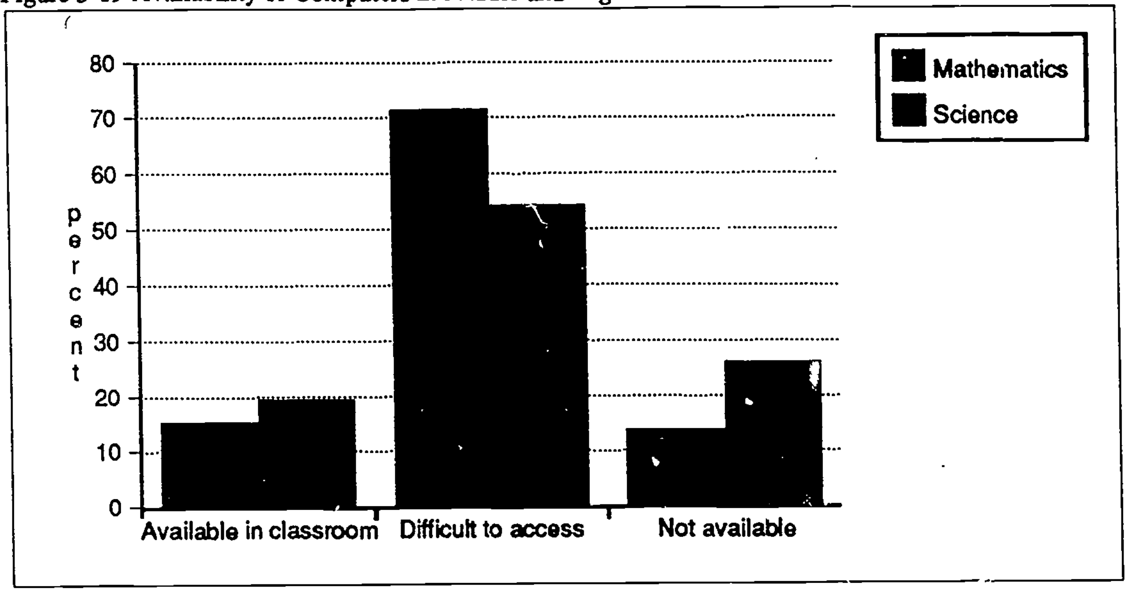
CALCULATORS AND COMPUTERS

Teachers who had computers available in their classroom for mathematics had a mean of 9.0 computers (SD=7.2) with a range from 1 to 20. Teachers who had computers available in the classroom for science had a mean of 4.0 computers (SD=3.5) with a range from 1 to 15. More than 80 percent of mathematics and science teachers had difficult or no access to computers as shown in table 5-34 and figure 5-19.

Table 5-34 Availability of Computers in Middle and High School

	Mathematics Percentage	Science Percentage
Available within the classroom	15.3	19.4
Available but difficult to access	71.2	54.2
Not available	13.6	26.4

Figure 5-19 Availability of Computers in Middle and High School



Teachers reported on the frequency of calculator use and computer use for mathematics and science. The results are shown in figures 5-20 and 5-21 and table 5-35. While 71.3 percent of mathematics teachers used calculators almost daily, only 14.1 percent of science teachers did so. Only a few mathematics teachers reported that their students rarely or never used calculators.

More teachers use computers in mathematics than in science. However, only a small number of teachers use computers on a regular basis in mathematics and very few in science. Half of the mathematics teachers and 68.1 percent of science teachers reported that they rarely or never used computers during their teaching.

Figure 5-20 Frequency of Calculator Use in Middle and High School

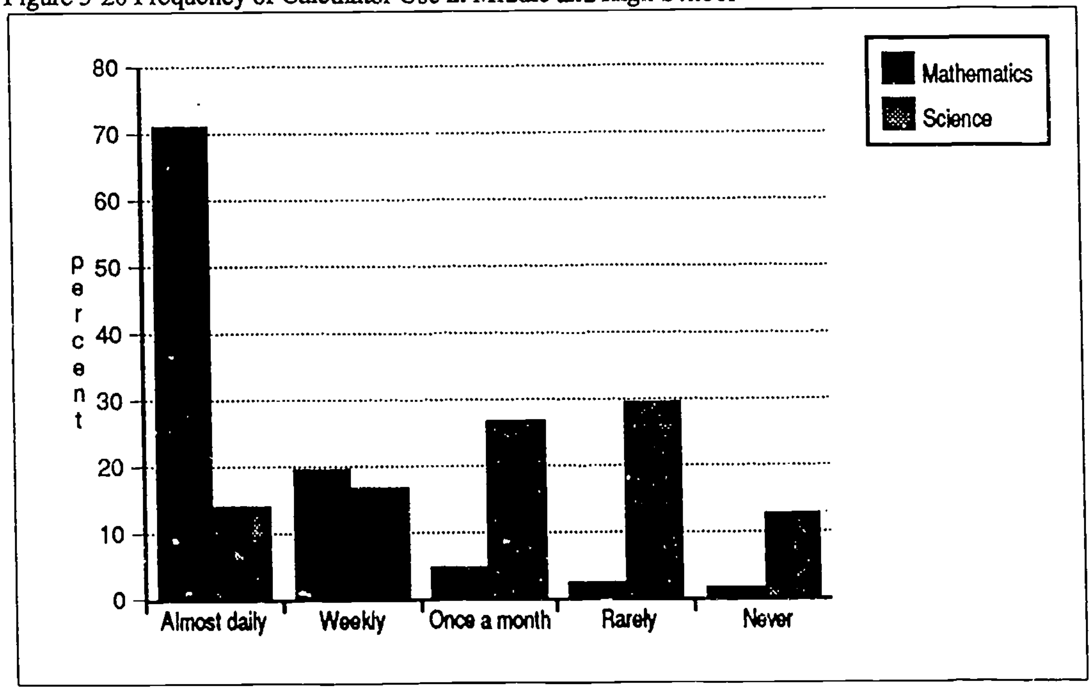


Figure 5-21 Frequency of Computer Use in Middle and High School

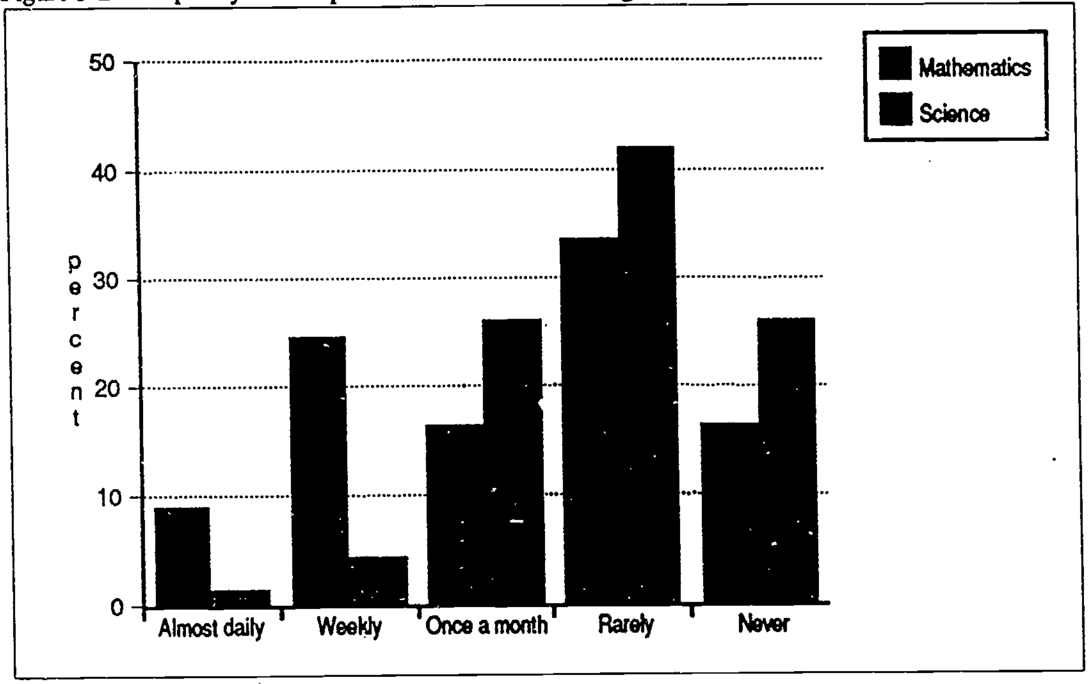


Table 5-35 Frequency of Calculator and Computer Use in Middle and High School

	Almost daily Percentage	At least weekly Percentage	At least once a month Percentage	Rarely Percentage	Never Percentage
Calculators					
Mathematics	71.3	19.7	4.9	2.5	1.6
Science	14.1	16.9	26.8	29.6	12.7
Computers					
Mathematics	9.0	24.6	16.4	33.6	16.4
Science	1.4	4.3	26.1	42.0	26.1

Table 5-36 reveals that teachers use a very flexible policy of calculator use in mathematics at the middle and high school levels. Almost all teachers allow students to use calculators on tests and encourage students to use calculators for homework. About 80 percent of the teachers allow students the unrestricted use of calculators in class, and close to 90 percent of the students have access to calculators owned by the schools. Teachers also noted the type of calculator used in their classes which ranged from basic four function calculators to scientific calculators to graphing calculators. Most teachers reported using scientific calculators, but many also noted access to graphing calculators.

Table 5-36 Policies on Calculator Use in Middle and High School Mathematics

	Percentage Responding 'Yes'
Do students have access to calculators owned by the school?	87.4
Are students allowed to use calculators on tests?	95.8
Are students encouraged to use calculators for homework?	94.2
Are students permitted the unrestricted use of calculators in class?	79.3

Teachers were asked to rate the degree of strength or weakness in their ability to use computers and calculators in their teaching. Only 41.9 percent of mathematics teachers and 31.4 percent of science teachers felt strong in their ability to use computers for teaching as shown in figure 5-22 and table 5-37. About 40 percent of the teachers in both mathematics and science felt their ability to use computers in their teaching of these subject areas was weak. Most teachers perceived their ability to use calculators in their mathematics teaching as strong.

Figure 5-22 Ability to Use Computers for Teaching in Middle and High School

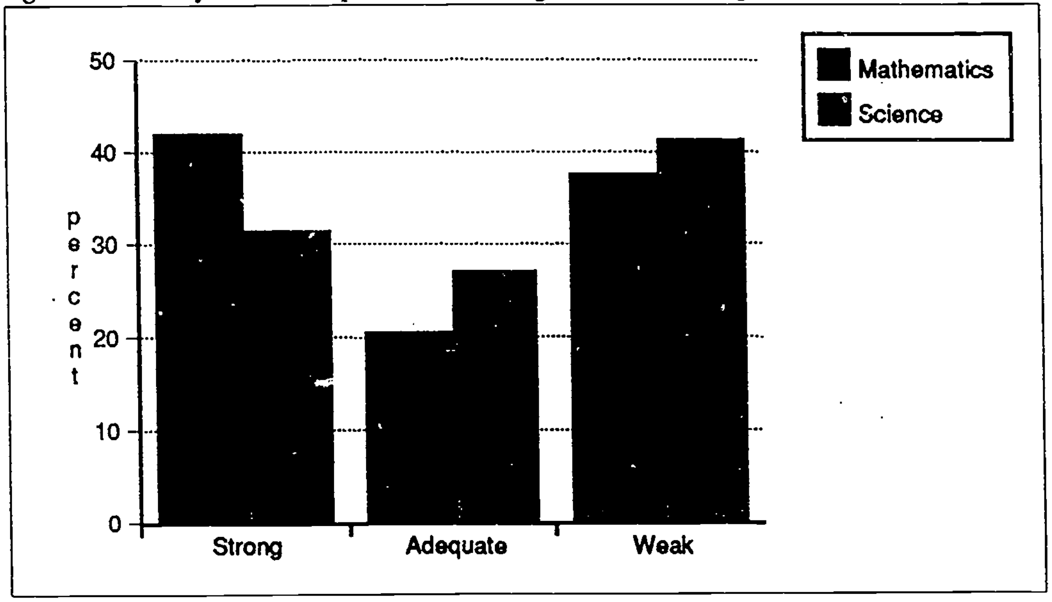


Table 5-37 Ability to Use Calculators and Computers for Teaching in Middle and High School

	Strong		Adequate	Weak	
	5 Percentage	4 Percentage	3 Percentage	2 Percentage	1 Percentage
Using calculators*					
Mathematics	46.3	37.2	11.6	2.5	2.5
Using computers					
Mathematics	23.1	18.8	20.5	18.8	18.8
Science	17.1	14.3	27.1	17.1	24.3

* This question was not asked for science.

RESOURCES

Teachers were asked to indicate the adequacy of individual and collaborative planning time for teaching mathematics or science in their school. The results are displayed in figures 5-23 and 5-24 and table 5-38. About one third of the mathematics teachers and close to half of the science teachers stated that the adequacy of individual planning time was unsatisfactory. Over half of both the mathematics teachers and the science teachers reported that time for collaborative planning was unsatisfactory.

Figure 5-23 Adequacy of Individual Planning Time in Middle and High School

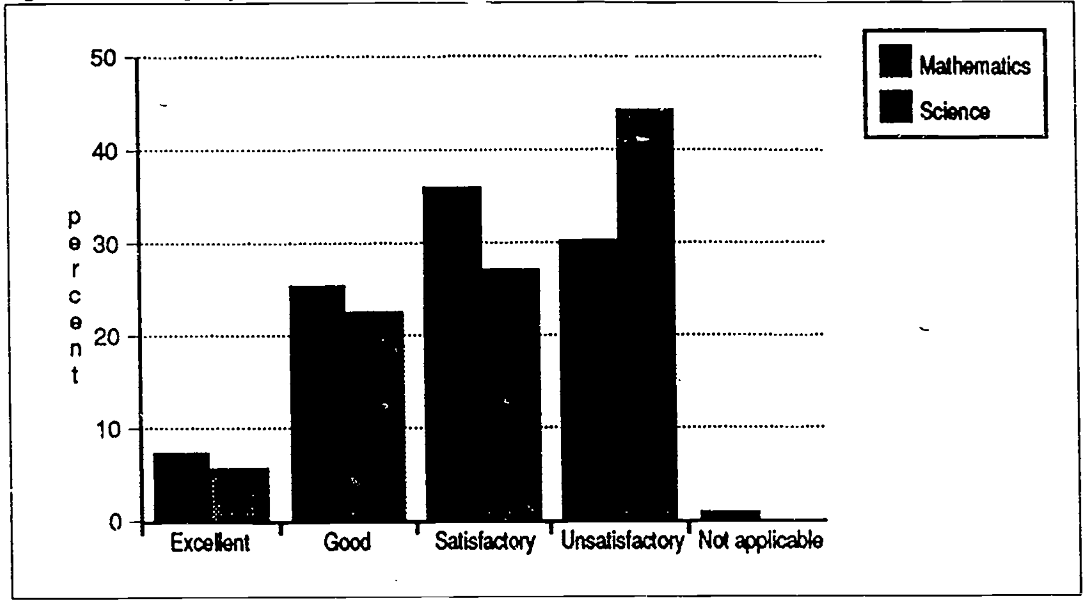


Figure 5-24 Adequacy of Collaborative Planning Time in Middle and High School

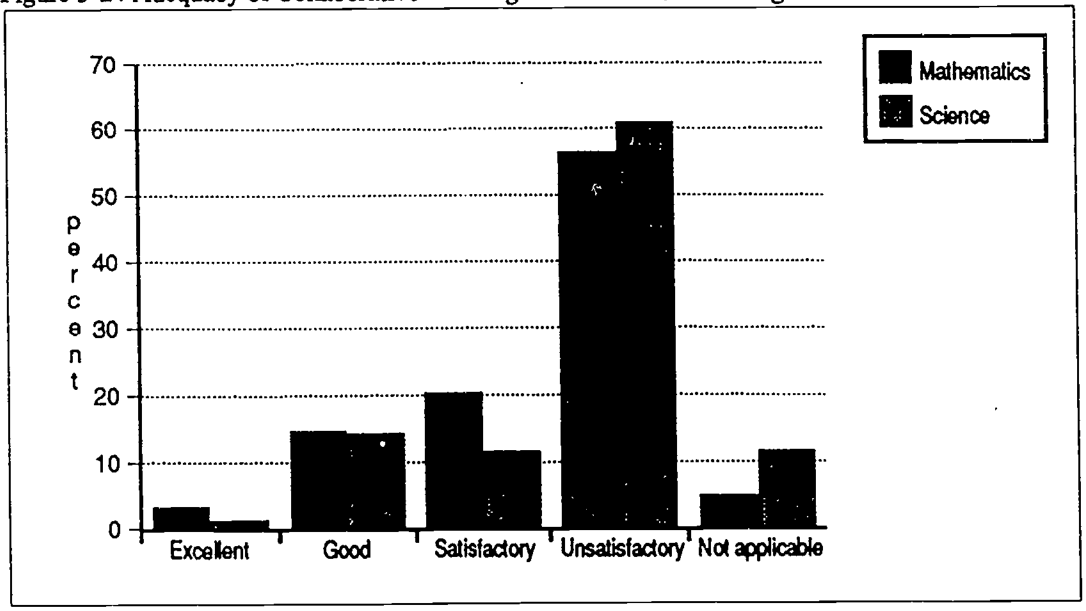


Table 5-38 Adequacy of Planning Time in Middle and High School

	Excellent Percentage	Good Percentage	Satisfactory Percentage	Unsatisfactory Percentage	Not applicable Percentage
Individual planning time					
Mathematics	7.4	25.4	36.1	30.3	0.8
Science	5.7	22.7	27.1	44.3	0.0
Collaborative planning time					
Mathematics	3.3	14.8	20.5	56.6	4.9
Science	1.4	14.5	11.6	60.9	11.6

Teachers were asked to comment on the adequacy of class size, class time, space for students to work, and space for storage in its relationship to the teaching of mathematics and science. The results are shown in figure 5-25 and table 5-39. Many teachers were not satisfied with the adequacy of class time for either mathematics or science, and especially so for science. Class size was viewed as unsatisfactory by a third of the mathematics teachers and close to half of the science teachers. Most teachers reported that space for students to work was satisfactory. About one third of the teachers in both subject areas indicated that storage space was not satisfactory.

Figure 5-25 Adequacy of Class Time in Middle and High School

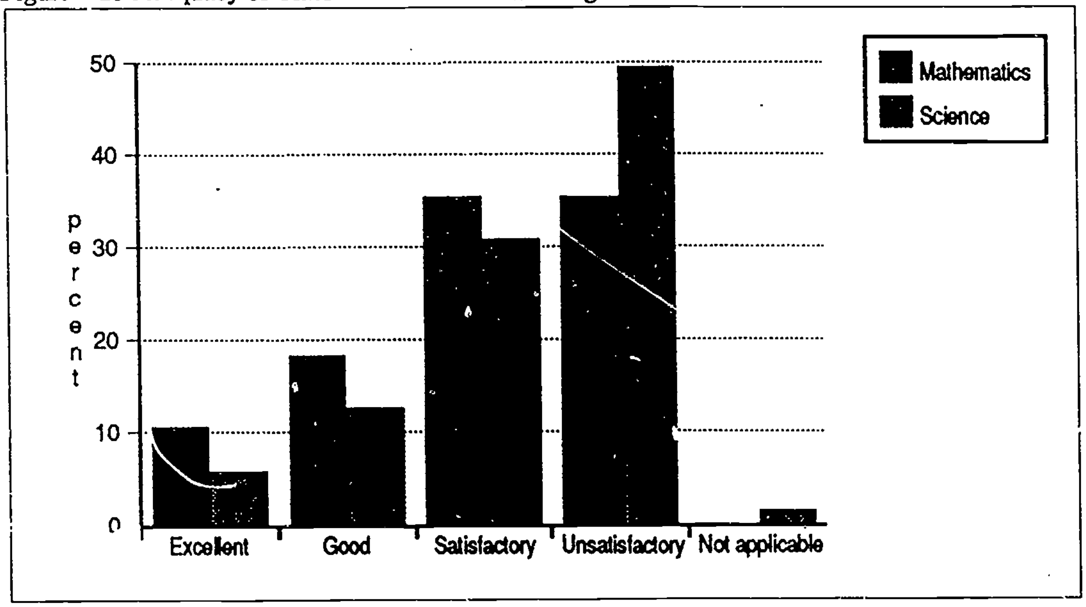


Table 5-39 Adequacy of Class Size, Time, and Space in Middle and High School

	Excellent Percentage	Good Percentage	Satisfactory Percentage	Unsatisfactory Percentage	Not applicable Percentage
Class size					
Mathematics	10.7	18.2	35.5	35.5	0.0
Science	5.6	12.7	31.0	49.3	1.4
Class time					
Mathematics	6.6	26.4	44.6	22.3	0.0
Science	7.0	16.9	42.3	32.4	1.4
Space for students to work					
Mathematics	31.1	36.9	19.7	12.3	0.0
Science	33.3	27.5	20.3	18.8	0.0
Space for storage					
Mathematics	16.4	23.8	29.5	28.7	1.6
Science	20.0	18.6	25.7	35.7	0.0

Teachers also indicated the adequacy of equipment and materials for mathematics and science as shown in table 5-40. About 25 percent of the mathematics teachers and 32.4 percent of the science teachers stated that the equipment was unsatisfactory. Most teachers reported that consumable materials were adequate.

Table 5-40 Adequacy of Equipment and Materials in Middle and High School

	Excellent Percentage	Good Percentage	Satisfactory Percentage	Unsatisfactory Percentage	Not applicable Percentage
Equipment					
Mathematics	5.7	21.3	47.5	25.4	0.0
Science	8.5	33.8	25.4	32.4	0.0
Consumable Materials					
Mathematics	4.2	18.3	51.7	21.7	4.2
Science	14.1	29.6	40.8	15.5	0.0

Teachers reported on the availability of consumable and non-consumable supplies. The results are displayed in figure 5-26 and table 5-41. Over half of the science teachers stated that the availability of consumable supplies was more than adequate. Conversely, over half of the mathematics teachers stated that the availability of consumable supplies was less than adequate. Most teachers indicated that the availability of non-consumable supplies was adequate.

Figure 5-26 Availability of Consumable Supplies in Middle and High School

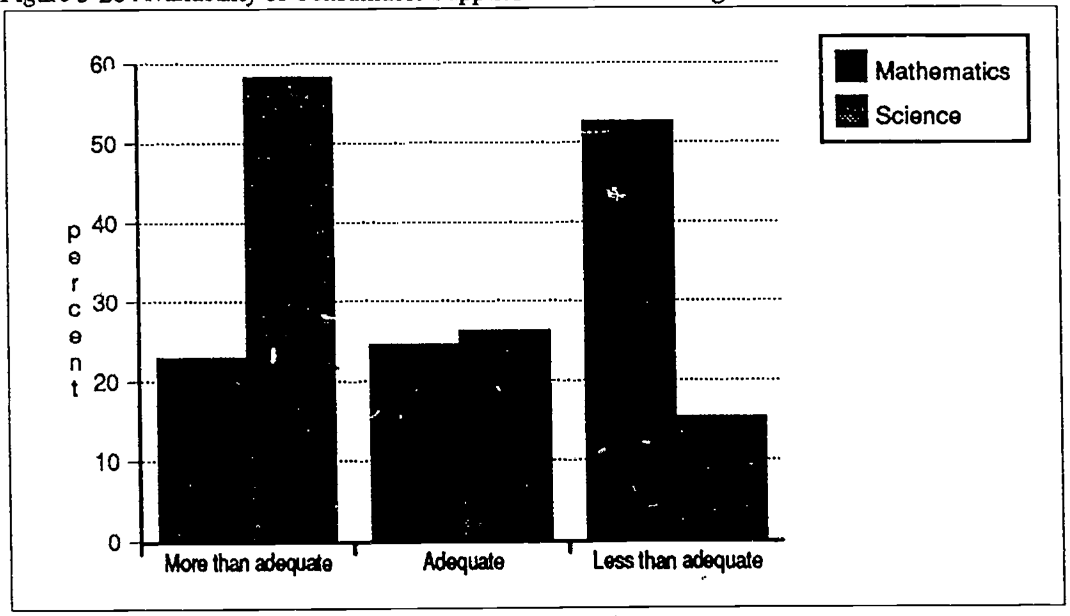


Table 5-41 Availability of Consumable & Non-Consumable Supplies in Middle and High School

	More than adequate (All or Most)		Adequate (Some)	Less than adequate (Few or None)	
	5 Percentage	4 Percentage	3 Percentage	2 Percentage	1 Percentage
Consumable supplies are regularly purchased for student use					
Mathematics	7.6	15.3	24.6	22.9	29.7
Science	27.8	30.6	26.4	11.1	4.2
Non-consumable supplies are available for student use					
Mathematics	17.8	25.4	33.9	14.4	8.5
Science	16.9	25.4	38.0	12.7	7.0

TEACHERS' PERCEPTIONS

Teachers indicated their degree of agreement with the statements shown in table 5-42. Nearly 90 percent of mathematics and science teachers believe strongly that all students can learn the subject they teach. Almost all teachers in both areas perceive their background knowledge and enthusiasm as strong. Some mathematics and science teachers perceived their subject area as receiving little value in their schools.

Table 5-42 Perceptions of Students, School, and Self

	High		Neutral	Low		
	5 Percentage	4 Percentage	3 Percentage	2 Percentage	1 Percentage	
Mathematics						
Strong agreement that all students can learn mathematics	59.7	28.2	8.1	3.2	0.8	Strong disagreement that all students can learn mathematics
High perceived value of mathematics in one's school	20.2	29.0	34.7	10.5	5.6	No perceived value of mathematics in one's school
Strong (self) background knowledge in mathematics	65.0	28.3	5.8	0.8	0.0	Weak (self) background knowledge in mathematics
Strong (self) enthusiasm for mathematics	70.2	24.8	4.9	0.0	0.0	Weak (self) enthusiasm for mathematics
Science						
Strong agreement that all students can learn science	69.9	19.2	5.5	5.5	0.0	Strong disagreement that all students can learn science
High perceived value of science in one's school	25.0	29.2	29.2	11.1	5.6	No perceived value of science in one's school
Strong (self) background knowledge in science	67.6	29.6	1.4	1.4	0.0	Weak (self) background knowledge in science
Strong (self) enthusiasm for science	78.9	18.3	2.8	0.0	0.0	Weak (self) enthusiasm for science

Over half of he mathematics and science teachers find teaching their subject is enjoyable, exciting, satisfying, rewarding, and comfortable as shown in table 5-43. About 10 percent of the mathematics teachers felt their teaching was very stressful, and about 10 percent of the science teachers noted that their teaching was very unfulfilling.

Table 5-43 Middle & High School Teacher's Feelings Towards Teaching Mathematics & Science

	High		Neutral	Low		
	5 Percentage	4 Percentage	3 Percentage	2 Percentage	1 Percentage	
Mathematics						
Enjoyable	52.9	35.5	5.8	4.1	1.7	Not Enjoyable
Exciting	40.0	35.0	22.5	2.5	0.0	Boring
Satisfying	32.2	30.6	22.3	5.8	9.1	Frustrating
Rewarding	29.8	29.8	29.8	7.4	3.3	Unfulfilling
Comfortable	33.3	27.5	15.0	13.3	10.8	Stressful
Science	64.3	21.4	12.9	1.4	0.0	
Enjoyable	47.1	41.4	10.0	1.4	0.0	Not Enjoyable
Exciting	29.0	33.3	21.7	8.7	7.2	Boring
Satisfying	27.5	29.0	33.3	8.7	1.4	Frustrating
Rewarding	33.3	29.0	23.2	4.3	10.1	Unfulfilling
Comfortable	27.8	31.1	30.1	9.1	1.9	Stressful

OTHER FACTORS

Teachers rated the adequacy of the factors listed in table 5-44. Less than 10 percent of mathematics and science teachers stated that the reading skills of their students were good or excellent. Most teachers indicated that administrative support was satisfactory or better for mathematics and science.

Table 5-44 Adequacy of Support, Comfort Level, and Reading Skills in Middle and High School

	Excellent Percentage	Good Percentage	Satisfactory Percentage	Unsatisfactory Percentage	Not applicable Percentage
Administrative Support					
Mathematics	12.4	23.1	43.8	20.7	0.0
Science	11.3	33.8	25.4	26.8	2.8
Teacher comfort level					
Mathematics	15.0	30.8	40.0	14.2	0.0
Science	15.9	37.7	30.4	14.5	1.4
Reading skills of students					
Mathematics	0.0	7.5	31.7	60.8	0.0
Science	1.4	8.5	21.1	67.6	1.4

Teachers rated the level of parent involvement in mathematics and science as shown in table 5-45. About 75 percent of the teachers noted that parent involvement in mathematics and science was low.

Table 5-45 Parent Involvement in Mathematics and Science in Middle and High School

	High		Neutral	Low		
	5 Percentage	4 Percentage	3 Percentage	2 Percentage	1 Percentage	
High involvement of parents in mathematics programs	0.8	4.1	13 1	35.2	46.7	No involvement of parents in mathematics programs
High involvement of parents in science programs	0.0	2.8	18.3	21.1	57.7	No involvement of parents in science programs

PROFESSIONAL DEVELOPMENT

In the last three years, 40 percent of middle and high school mathematics teachers reported having 61 or more hours of professional development, and 25.9 percent of the mathematics teachers had 10 hours or less as shown in table 5-46. In comparison, 13.7 percent of the middle and high school science teachers had 61 or more hours of professional development, and 55.1 percent of the science teachers had 10 hours or less of professional development in the past three years.

Table 5-46 Professional Development in Last Three Years for Middle and High School Teachers

	Mathematics Percentage	**Science** Percentage
0 hours	9.6	19.0
1-5 hours	9.6	17.2
6-10 hours	6.7	18.9
11-15 hours	4.8	15.5
16-20 hours	10.6	6.9
21-30 hours	2.9	5.1
31-40 hours	3.9	3.4
41-60 hours	11.5	0.0
61 or more hours	40.0	13.7

OBSTACLES TO TEACHING MATHEMATICS

An open-ended item on the survey asked teachers to identify the major obstacles to teaching mathematics effectively. A total of 244 separate responses were given for this question. Several teachers listed more than one obstacle. Seven major areas of concern emerged, with 12 or more individuals identifying each as an obstacle. Illustrative comments from the teachers are included for each major area of concern.

Apathy, Poor Student Attitude, and Fear of Mathematics. Twenty-one percent of the responses (51 individual responses) commented that student apathy and attitude or student fear of mathematics were obstacles.

- Student willingness to put blame for their failures on others. They don't take personal responsibility.
- No future vision of students.
- Irresponsible students who come to class without any pencil, pen, or paper.
- Lack of involvement by students.
- Lack of understanding of realistic value for long-term success.
- Many students do not have the time or will not take the time to do any work outside of class.
- Many with past failures are fearful of math.

Poor Student Background or Skills and Poor Class Placement. Twenty percent of the responses (48 individual responses) stated that students have a poor mathematics background or were placed in inappropriate classes.

- Students are programmed above their level. They have failed so often that they don't want to be there.
- Skill level of entering students in high school. Also, as they pass a class in high school, they are sometimes not adequately prepared for the next subject level, and it keeps them further behind.
- Most have trouble with the four basic operations of arithmetic.
- It's hard to teach algebra to students who cannot read and/or add integers.
- Lack of preparation of students in lower levels.
- Lack of basic arithmetic skills.
- Lack of background knowledge.
- More than two-step problems causes mutiny.
- Poor or uneven preparation in mathematics.

Absenteeism and Student Mobility. Eleven percent of the responses (28 individual responses) commented on poor student attendance and on student mobility.

- Horrible attendance of all students—in a P.A.T. algebra class of 26, 16 already have poor attendance.
- Student mobility. In my Algebra class this year, I've had 66 students added to my list and 44 dropped.

Large Class Sizes. Seven percent of the responses (17 individual responses) stated that large class sizes were an obstacle to effective instruction in mathematics.

- Classes are too large.
- Too many students in a class.

Lack of Parental Support. Six percent of the responses (14 individual responses) stated that parents lack knowledge and skill in mathematics to assist their children with homework.

- No support from a home where little emphasis is placed on the importance of learning.
- Inadequate parent support with lower level students.

Poor student behavior. Five percent of the responses (13 individual responses) stated that disruptive students were an obstacle.

- Class disruptions by poorly behaved students.
- Massive dumping of 'reform school' types of students.
- Peer support and conflict.

Lack of administrative support. Five percent of the responses (12 individual responses) stated that the central office, principals, department heads, and other administrators did not provide enough support.

- No support for discipline.
- District wants us to do projects with the students but gives us no project ideas. Many directives, little support.
- School goals are not important to all staff and administration.
- Insufficient administrative guidance and support.
- Little school department leadership.
- Not enough administrative support in enforcement of high expectations.
- Little departmental cohesiveness.
- Mandates which reduce flexibility in working with students.

Other obstacles. The following responses were mentioned four to 11 times each: (a) outside influences such as TV, videos, home life, neighborhood violence, poverty, lack of role models, and community lack of support for education; (b) not enough planning time; (c) not enough class time for students to understand concepts because the class periods are too short; (d) lack of computers, calculators, or other equipment; and (e) problems with the curriculum, such as lack of clarity, not always integrated, too much material to cover, and lack of applications.

Other obstacles that were mentioned three times or fewer times include: (a) inadequate textbooks; (b) lack of materials; (c) teachers resistant to change; (d) need for staff development, (e) need to apply mathematics to real life situations in the way students can understand; (f) classroom interruptions; (g) paperwork; (h) lack of field trip opportunities; (i) school building is dirty and old; and (j) unprofessional, staff unwilling to change.

OBSTACLES TO TEACHING SCIENCE

A total of 197 separate responses were identified as major obstacles to teaching science effectively. Several teachers listed more than one obstacle. Eight major areas of concern emerged, with 13 or more individuals identifying each as an obstacle. Illustrative comments from the teachers are included for each major area of concern.

Lack of Adequate Time for Planning. Eighteen percent of the responses (25 individual responses) stated that time for lab set-up, preparation, staff development, and shared time with other teachers was inadequate.

- Very limited time to do the job even adequately; this means being a leader for the department and an exemplary teacher.
- We need to have sufficient planning time. Right now we spend most of our planning time, including lunch and homeroom, helping absent students catch up.
- Not enough time to create new materials.
- Lack of staff development time to integrate science and allow science teachers to share techniques, ideas, and information.

Lack of Student Interest, Poor Attitude, Motivation, and Curiosity. Twelve percent of the responses (23 individual responses) refer to students.

- Students have so few experiences and knowledge of the world; it's hard to discuss anything.
- Reduced chances of financial success for students. There are few good paying jobs after leaving school.
- Students don't care. Society doesn't place value on science.
- Many students have agendas other than school—gangs, parenting, sports.
- Student background. Students have poor study habits, poor motivation, lack of parental support, poor math skills, and are working.

Large Class Sizes. Eleven percent of the responses (22 individual responses) stated that class sizes are too large.

- Classes of 35 are not conducive to lab or group work. I lose a lot of personalization.
- My class sizes are larger than the number of laboratory work stations.
- Too many students in a class and not enough time to give individual attention during experiments. The students become frustrated.

Limited or No Access to Technology and Current Textbooks. Eleven percent of the responses (21 individual responses) stated that they had limited or no access to computers, software, videodisc players, TV monitors, VCRs, overhead projectors, and textbooks. Many also stated that equipment and textbooks were outdated.

- Unable to have students network via computer.
- We have Macintosh computers, but only sixteen with little or no software. Our floppy disks are one per package, not 25 in a class set or site license.
- Our book is approaching seven plus years. Science/Biology is ever changing and the concepts and discoveries are on-going. We cannot teach from old books when daily there are exciting, controversial issues that students are wanting to address.

Poorly Prepared Students. Nine percent of the responses (18 individual responses) stated with that students had low basic skills.

- We need to challenge the advanced students more and do more involved work in Biology. We are spending too much time in enrichment and remedial work.
- Levels are extremely low in ability to read and understand simple directions.

Lack of Supplies. Nine percent of the responses (18 individual responses) stated that they lack needed consumables or that budgets were inadequate to purchase supplies.

- Supplies, supplies, supplies!
- Not being able to use chemicals other than household supplies, not enough money per classroom to purchase supplies.

- Fronting money for supplies and waiting to be reimbursed.

Poor student behavior. Eight percent of the responses (16 individual responses) commented that student disruptive student behavior was a major obstacle.

- I spend too much time with disruptive students, while the well-behaved students lose out. This makes me less patient to help those students with special needs. It makes teaching very exhausting.
- I would like to be able to allow my students to do more lab work, but I can't always trust them.
- The few disruptive students in each class who poison the progress of the rest.

Inadequate rooms. Seven percent of the responses (13 individual responses) stated that storage space and work space were inadequate and that they lacked access to water and tables.

- Poor facilities—two or three teachers share the same classroom. Can't set up demonstrations and leave it all day. Moving to different classrooms.
- Science taught in non-science rooms.

Other obstacles. The following responses were mentioned six to 11 times each: (a) poor student attendance (11 responses); (b) lack of support from administrators, other teachers, central office, or others (8 responses); and (c) rigid class schedules, short class periods, and lack of flexible scheduling (6 responses).

Other obstacles that were mentioned five times or fewer included: (a) lack of training for the new textbook adoption in middle school, (b) little or no parent involvement, (c) non-science certified teachers at the middle school level, and (d) lack of laboratory assistants.

SUMMARY

Elementary, middle, and high school teachers from across the entire school district were surveyed to enhance the view of mathematics and science education in the Milwaukee Public Schools. Three different survey instruments were used: (a) elementary school mathematics and science, (b) middle school and high school mathematics, and (c) middle school and high school science. The following is a summary of some of the major findings from the surveys of mathematics and science.

- About half of the elementary teachers reported that they integrate mathematics and science with each other or with other subject areas.
- Many teachers at all levels and in both subject areas indicated that they use small group or pair work on a daily or weekly basis.
- Teachers reported that students rarely use materials or equipment on a daily basis in middle school and high school mathematics.
- Over 80 percent of the teachers at all levels indicated that they explain or demonstrate on a daily basis during mathematics instruction.
- More middle and high school teachers than elementary teachers reported having students do science experiments on a weekly basis.
- Elementary teachers indicated that their background knowledge was stronger in mathematics than in science.

- Elementary teachers felt more comfortable and were more enthusiastic teaching mathematics than science, spent more time engaging students in mathematics learning, and were more satisfied with their teaching strategies for mathematics than for science.
- Most middle and high school mathematics and science teachers were satisfied with their current teaching strategies and were comfortable teaching their respective subject areas.
- Teachers at all levels reported using a variety of assessment practices, including portfolios and journals, with textbook and teacher tests being dominant assessment practices.
- Teachers indicated that calculator use by students in elementary classrooms was infrequent for mathematics and even more infrequent for science.
- Most middle and high school mathematics teachers stated that their students use calcul almost daily, while most science teachers indicated that students seldom alculators in their classes.
- Teachers indicated that computers were used by students more frequently than calculators in elementary classes, particularly for mathematics.
- Teachers reported that computers were rarely used by students in middle and high school science classes.
- Middle and high school mathematics teachers felt their ability to use calculators for teaching was strong.
- Many elementary teachers felt their ability to use calculators for mathematics teaching was weak.
- About 40 percent of the middle and high school mathematics and science teachers felt their ability to use computers for teaching was weak.
- Many elementary teachers felt their ability to use computers was adequate for mathematics but weak for science.
- Most teachers at all levels indicated that both individual and collaborative planning time available to teachers was unsatisfactory.
- About one third of the elementary school teachers felt that class time for science was inadequate.
- About half of the middle and high school science teachers indicated that class time for science was unsatisfactory, and about one third of the mathematics teachers felt class time for mathematics was unsatisfactory.
- Most elementary teachers were dissatisfied with the availability of equipment and consumable supplies for science.
- Most middle and high school science teachers were satisfied with the availability of equipment and supplies. Middle and high school mathematics teachers were also satisfied with the availability of equipment, but felt the availability of consumable supplies was inadequate.
- Teachers at all grade levels reported low to no parent involvement in their mathematics and science programs.
- Teachers identified the following major obstacles to teaching mathematics and science effectively at the elementary level: (a) lack of adequate materials, supplies, resources, and equipment; (b) lack of adequate time for planning; (c) large class sizes; (d) not enough class time; and (e) lack of adequate staff development and inservice.

- Teachers identified the following major obstacles to teaching mathematics and science effectively at the middle school and high school levels: (a) student apathy, poor attitude, and fear of mathematics; (b) poor student background or skills and poor class placement; (c) absenteeism and student mobility; (d) lack of parental support; (e) poor student behavior.
- Teachers identified the following major obstacles to teaching mathematics and science effectively at the middle school and high school levels: (a) lack of adequate time for planning; (b) lack of student interest, or poor attitude, motivation, and curiosity; (c) large class sizes; (d) limited or no access to technology and current textbooks; and (e) poorly prepared students.

CHAPTER 6
FOCUS GROUP RESULTS

Without the input of community members and parents, the landscape would be unfinished. Their reflections, when combined with the in-depth focus obtained from interviews, classroom observations, and survey results, produced a wide angle view that represented all stakeholders.

Through a focus group format, representatives from a broad spectrum of Milwaukee's businesses, industries, agencies, and other institutions added their shadings to the MPS portrait. Three focus groups were held with community members and parents. A fourth focus group was held with MPS parents.

The community focus groups were held at a community center in Milwaukee. An experienced consultant was hired to facilitate the discussion of the three community focus groups, while a parent and former teacher with experience working with MPS families facilitated the parent group. Observers took extensive field notes containing numerous quotations and comments made during the focus group discussions. These notes were synthesized for perspectives on the current situation, key points and examples, and suggestions for improving mathematics and science education in MPS.

COMMUNITY FOCUS GROUPS

Twenty-seven individuals participated in the community focus groups. Participants represented business and industry, cultural agencies, parents of MPS children, parent organizations, community organizations, universities and colleges, city government, the state department of education, and the state department of natural resources.

The following themes and summaries of current situations emerged through the focus group process. Key points, examples, and suggestions illustrate comments from the focus group participants.

THEME: PARADIGM SHIFTS ARE NECESSARY TO ENSURE TRUE CHANGE AND REFORM

Current Situation. Most schools are still operating on the one teacher–one class for one academic year paradigm. Students need more access and exposure to role models in science and mathematics to see how it is used outside the classroom. Science and mathematics are too often taught as separate subjects and students do not see the links between mathematics, science, and other subjects to the skills needed after high school graduation.

Key Points and Examples

- Secondary schools have fifty minute classes and then the students move to another class, another teacher, another subject.
- Students do not get enough time in the real world to apply what they have learned in the classrooms.

Suggestions

- Administration needs to free teachers to change, not for fear but from innovation.
- Integrate science and mathematics with other subjects throughout the system.
- Schools need to adopt more flexible scheduling and be open other hours of the day.
- Expand the idea of informal education agencies as additional learning opportunities and classrooms, not just field trips.
- Change the format of how mathematics and science learning is delivered.
- Change the teacher contract to allow for more teaching and time flexibility.

THEME: ENTIRE COMMUNITY OWNS THE RESPONSIBILITY FOR EDUCATING ITS CHILDREN

Current Situation. The community sees education as the job of the schools, but the community needs to reclaim the schools—everyone owns the responsibility.

Key Points and Examples

- Historically, schools did not educate children, the community always did. We all need to function in a bottom line environment—Howard Fuller can't do it alone; we need community support.
- Drive past a school. It's locked from 8:00 to 3:00. The community can't get in and the children don't get out. Teacher conferences are only a nice step.
- I'm in industry and would like to be involved if my involvement is focused.
- Collaboration must involve mutual recognition of the problem and solutions.

Suggestions

- All parts of the community need planned time to create solutions.
- Decisions must be made horizontally and vertically.
- Schools need to be open more hours for community participation and learning.
- People other than parents need to visit schools on a regular basis.
- Identify the role of every person in the school or who visits the school, so that all know where their resources would be most useful
- Each school must come to the community with its specific needs.
- Make it a community process to translate the vision.
- Employers must be sensitive to parents' needs. If time is needed to go to a child's school, parents should get that time.
- Once all segments of the community understand and focus on a common goal, they can work together toward reaching that goal.
- Invite the community to help asses student outcomes.

THEME: COMMUNICATION AMONG PARENTS, SCHOOLS, DISTRICT, AND THE COMMUNITY

Current Situation. Not all segments of the community have input into school reform or know what is being reformed or why. The number of people attending school events is declining. The Milwaukee Public Schools often has a negative image in the eyes of the public.

Key Points and Examples

- Students who succeed have a vision of where they want to be and where they want to go. Too often the rug is pulled out from under them after they leave school. Involve the whole community to provide for these outcomes.

- Parents, students, teachers, and staff must realize they need each other and must ask each other for help.
- Being proficient in mathematics and science often promotes a negative image among students.
- Negative attitudes and beliefs toward mathematics and science need to be changed by parents, teachers, administrators, and the rest of the community so all can help students form their own visions and reach their goals.
- Milwaukee needs to be proud of its facilities compared to other cities.

Suggestions

- Spend more time with focus groups, like this, so that everyone is touched. Then all segments of the community will understand reform and be involved.
- All groups need to participate in the planning. Make it a community process to translate the vision and help others to understand what forming a vision means.
- Provide a system for community feedback.
- Allow students to create and produce marketing strategies for change.
- Promote not only what staff and students are doing, but what families are doing.
- Churches and community organizations can assist in communicating what is happening in the schools to parents and the community. They can also act as change agents for school image and school success.

THEME: LEARNING CAN BE CHANGED THROUGH SYSTEMIC EFFORTS

Current Situation. The distribution of technology between the schools is inequitable. We have thrown all resources at a few schools and still they fail. Innovation by teachers and schools is often hampered or stopped by contract restrictions. Women and ethnic and racial minorities are not represented as mathematics and science role models in significant numbers.

Key Points and Examples

- In a large organization, everyone has his or her own turf and change means crossing into others' turf. Collaboration demands that people give up a piece of the pie to work toward a larger vision. It's possible, but it's still a threat.
- The word "systemic" puts the burden of change on everyone.
- The success of MPS is related directly to the success or failure of Milwaukee as a city.
- Right now, principals really only have time for crowd control and are not directly participating in mathematics and science programs.

Suggestions

- USI needs to address gender, racial, and ethnic equity through role models in the schools and in the community, as well as changes in image.
- Resources must be allocated more equitably. For example, several schools can collaborate and share the salary of one technology trainer to rotate among the schools to train the staff.
- Define success and allow failures to flow toward success.
- Provide rewards and support for successful programs.
- Mathematics and science must be integrated into all subjects and be relevant to student lives.

- Work with the union to lift restrictions and policies to allow innovation. Break down some barriers so the union will help develop the courage to innovate.
- Prepare the community to understand the realities of the change process—it brings discomfort and takes a long time. Establish a realistic time frame for change.
- Each school needs to develop its own vision.
- Break schools down into smaller units so students aren't just numbers.
- Have administrators participate in education programs to improve their own skills in mathematics and science.
- Good things happen in all schools. What can you bring to the table that is the best? This is the first step to change—the buy-in to get everyone there.

THEME: PARENTS ARE IMPORTANT TO THE WHOLE PROCESS OF SYSTEMIC CHANGE

Current Situation. Parents are expected to help their children with school work, however, they often do not have the skills themselves. Parents often feel intimidated by the schools. Employment responsibilities sometimes restrict parental involvement in the schools.

Key Points and Examples

- Parents need to be more demanding and students need to see the roles parents can play in the schools.
- Our paradigm as parents is self-preservation; don't show the school what you don't know.

Suggestions

- Include parents as part of the USI planning as well as being recipients of support, involvement, empowerment, skill development ,and encouragement.
- Expand opportunities for parents, teachers, administrators, and students to learn together on a regular basis. Children and adults can learn together.
- If parents are in the schools and classrooms regularly, school becomes less threatening for them.
- Get teachers into the homes.

THEME: STAFF DEVELOPMENT AND SUPPORT IS CRITICAL

Current Situation. Many teachers do not know how to use state-of-the-art technology. Teachers need to get out into other work environments. Teachers are asked to do more and more, but are not given the time or opportunities to learn themselves.

Key Points and Examples

- Colleges and universities are traditional and traditional methods turn off our students. Where do we see instructors still using lectures, chalk, and chalkboards? There is nothing like a college to show how far behind we are.
- For greater understanding, business needs to be in the classrooms and teachers need to see what is happening in the workplace and what skills are needed.

Suggestions

- Opportunities must be made available for teachers to be learners and role models for their students.
- Provide not only new technology, but also the time and opportunities for teachers to learn how to use it.

- Provide more planning and collaborative time for teachers.
- Involve teachers in deciding what their own needs are.
- Work with colleges and universities to improve teacher preparation programs in mathematics and science.
- Pay more attention to the research on education and learning.
- Support teachers as primary role models

THEME: ACCOUNTABILITY IS NEEDED

Current Situation. We are in a loop—standards are articulated on local, state, and national levels, but they are not clear. When things are not working, we change the curriculum, and when things still do not work, we change the curriculum again. The system of accountability needs to be changed.

Key Points and Examples

- The foundation of accountability is support for the people who need to produce the education. Not enough support is offered to enough people at one time.
- I, as an engineer, have to go through a performance review. What is the review process for teachers? What are the criteria? What are the corrective actions? Also, in manufacturing, there's a product. What is the product evaluation in education?

Suggestions

- MPS must be held accountable for mathematics and science proficiency, not just competency, for all students.
- The process needs evaluation. Learner outcomes are needed and a way to assess activities. We need to learn how to assess: What do we want? How can we get it? What are we getting? How can we help the person who is doing it to get there?
- We need to set up a model of assessment and convince unions to lift policies.

PARENT FOCUS GROUP

Nine parents participated in the parent focus group. They represented four high school students, three middle school students, and six elementary students in MPS. Several parents also had grown children who had attended MPS.

The following themes and summaries of current situations emerged through the focus group process. Key points, examples, and suggestions illustrate comments from the focus group participants.

THEME: IMPROVE COMMUNICATION BETWEEN SCHOOL AND HOME

Current Situation. Many parents do not know what occurs in classrooms, schools, and in the district. Little uniformity in parent-school communication exists. Parents need greater access to schools and need to feel welcomed.

Key Points and Examples

- My high school daughter has trouble with math. I helped her the way I did it in college. I got a note from her teacher not to do it this way.

- Parents need to be involved, but sometimes the definition of parent involvement often is the teachers want us to do what they want. The ideal situation is that parents and schools are team players, not competitors.
- Right now, my role as a parent at school is an adversarial thing. Teachers and parents are a threat to each other.
- Access of parents to the system should not be one of superior and subordinate. Parents need equal access and equal partnership in their children's education. Parents should not need permission to come to school, but they should freely come to sit in on the classrooms. (While some focus group parents said they never had a problem with access to school, others had different experiences.) Some parents have been told they are coming too much.
- A concern exists that some parents have access to schools and then choose not to do anything about it.
- Parents need to learn the new education "buzz words."

Suggestions

- Reforms such as USI need to be marketed. We can't depend on the children or school counselors to get the information to parents.
- Some of the USI funding should be used to get information to parents.
- More dialogue needs to exist—not just sharing of information.
- Use direct mail.
- The parent Academy with Equity 2000 is already in place. Use it.
- Announcements and information can be passed on through churches. Most have education committees.
- Use public service announcements.
- Communicate through PTOs and PTAs.
- More information about schools should be passed on through the MPS radio station. WMYS is severely underused. USI could use the radio station. A pet peeve of mine is that MPS can't see the forest for the trees. The radio station isn't used as an integral part of the school system.
- Employ a parent to work in the school on parent relations and communication. This person can call parents at home and be a liaison between other parents and the school. This parent would not be asked to do anything else in school but work with parents and communication.
- Develop mentoring relationships among parents which would spread the subtle message that parents are the foundation in their children's' education.
- Teachers should provide parents with a syllabus of what will be taught.

THEME: PARENTS ARE LEARNERS

Current Situation. Parents need more access to schools and programs that assist them with overcoming their own mathematics and science anxieties, that help them actively participant in their children's education, and that help them continue their own advancement and learning. Many parents would need initiatives to take advantage of such programs.

Key Points and Examples

- Children often learn things their parents cannot do or do not understand.
- Adults can learn from children.

- Some elementary schools have Family Math and Family Science programs in the evening and Saturdays. The children bring the parents to school and they do things together. This also provides an opportunity for teachers and staff to speak directly to parents.
- Teachers as well as parents need to feel less afraid of mathematics and science. This fear or lack of understanding is communicated to their children. Offer inservice for parents and teachers together.

Suggestions

- Give the initiative and help to parents who want to continue their own education. If the parents value education, then their children will.
- Provide projects where parents learn with their children—learning goes up, discipline problems go down.
- Some USI funding could go to a few schools to create models for parent involvement and education and then use the models city-wide.
- Send home parent involvement assignments with each child of each class. One activity a week for each subject for parents and students to do together. Have it on the homework hot-lines. Have a procedure for parents on how to repeat things at home that have been taught at school.

THEME: TEACHERS ARE LEARNERS

Current Situation. MPS needs to equip and support teachers to effectively teach mathematics and science.

Key Points and Examples

- To be a teacher you have to be a learner.
- All students need to take Algebra by the ninth grade. This is going to be a rough year for the students and the teachers. People who are teaching now are products of learning mathematics differently. The teachers need more training and staff development so they are comfortable with it themselves.
- Children need to experience anxiety free mathematics and science at an early age.
- The teachers need to know how to use manipulatives.
- Great mathematicians do not make good mathematics teachers. The teachers need to be educators. Children need to be involved.

Suggestions

- How about Eisenhower funds for teaching assistants? The importance of para-professionals and aids needs to be emphasized. Teaching assistants should have paid inservice in mathematics and science like the teachers.
- Teachers need to have a choice of where they teach. This does not happen now.
- More training needs to occur for new teachers at the new teacher orientation. Everyone gets different training in college. It would be great to have parents at this orientation to welcome these new teachers. This would help make MPS more friendly to new teachers. These new teachers are often lost at first. They need more support and someone to take them under their wing. A nucleus of parents could help support new teachers.
- MATC has a Pre-Teacher Organization (PTO). Future teachers do mentoring and tutoring with one child They get out with the children and deal with some of the problems before they become teachers. This program is just getting started. MPS could support more programs like this at colleges and universities.

THEME: THE SCHOOL IS A COMMUNITY, NOT JUST CHILDREN AND TEACHERS

Current Situation. New initiatives and reforms need parent input in the early stages of planning, not after the fact.

Key Points and Examples

- More activities should involve parents, teachers, and students. At the Saturday Academy (attended by a parent and her child), mathematics and science were integrated. The parents and their children were in the same room doing problem solving. This allowed the parents to feel how their children feel. A parent noted, "We felt great because we accomplished something. It was a great experience."
- How do I feel about reforms and initiatives? We need to be creative on how we sell this to people and who will implement it so it doesn't stay status quo. Get parents involved in the beginning of the process. Parents can act as implementors at schools where they are familiar with the staff and the programs.
- Parents need to be brought in more and right at the beginning. Too often it is "we'll call you when we need you" messages. Parents need to do the planning and have a decision making capacity. If you're a stakeholder, you should be there.
- School to Work sent the wrong message to me. Only business was involved, at least that's what it looked like to me. Parents got the implementation plan at the meeting. The planning was all over by then. It was insulting to parents.
- A problem exists for parents who are not informed. A parent commented, "I went to a two-day School to Work conference and still had questions. Parents need lots of information and need to be able to visits the sites. When I visited a site for School to Work, I saw a classroom there that the students would be using. I could embrace the idea more after seeing where the children would be."
- The interaction outside of the classroom would be good. The students need the work experience, and then they need to come back together.
- Taking children out of the classroom should not infringe on other programs.
- Students should not work without getting paid.

Suggestions

- Many pre-college programs exist, but they need to become more accessible to all students. Statewide programs, such as Science World, are difficult for students to get into, so perhaps these types of programs could be developed in this area. Some programs should also be developed for younger children.
- We need tutors, both parents and children. Sometimes a parent is the worst person to tutor his or her own child. Other resources are needed. Create a peer tutor program and show how it can work. College students are under-utilized in this respect. High school students could be given time to work with younger children.
- The community-school concept is good. Everything we do separates the family and the school. Everyone can go to school at night and be introduced to the many things we've been talking about here. Children go to 10 different schools in my block. If a school were open to the community, these children and their parents could do things together in the neighborhood in which they live.
- The students need lots and lots of person to person time. We need to help people understand that education does not just happen in the classroom.
- The cost of the buses to get to places is too much. I worked with a plan in New York. Each teacher got a special sheet that allowed them to take students on the subway or the city bus at reduced prices. It was cheap public transportation. We could work out something like this with the transportation department. This would

teach people to ride public transportation more. It would also open up more opportunities for smaller groups and impromptu situations.

- How about using the space behind the O'Donnell Park building for a mathematics and science center. I think it's empty and it looks great. It's also a transit system hook-up. Everyone could take the bus there!
- I, as a parent, have always experienced good flexibility on the part of my employer to attend functions at my children's schools.
- Other visitors should have access to the schools. It will give the message that all children are our children.

THEME: CHANGES IN CURRICULUM AND INSTRUCTION ARE NEEDED

Current Situation. Smaller class sizes or assistants are needed to help teachers. MPS needs to integrate the curriculum more, especially in high school, and provide for more flexible scheduling. Mathematics and science need to be applied to real life.

Key Points and Examples

- Students need to learn how to learn. They need to know the tools of learning.
- Students need to see the mathematics connections from early on.

Suggestions

- Hands-on science and mathematics should begin with the very young children, while they are still excited about learning.
- Older students could work with younger children to teach them science and mathematics. Allow students to take responsibility for other students.
- Perhaps some programs could feed off of one another. For example, a geometry class could design half time shows for the marching band.
- A cross section of all teachers should be involved in this mathematics and science initiative—the arts, language, physical education.
- Instead of "she just doesn't understand what I'm teaching here," teachers need to think, "How can I impart this information in a better way?" Teachers need to stimulate and challenge the children. With excitement, they will learn.
- They need to know what it really means to do mathematics and apply it in various ways as in real life. I believe in education being relevant to whatever is going on in the world. Children are not the future, they're the present.
- Children learn by doing, not by what we do. Some children just hear it and learn. Others are visual learners. Others are hands-on learners. Some are a combination. It's different for different people. Schools need to address all learning styles, as well as peer learning, cooperative learning, and collaborative learning.
- Better connections need to occur between schools and the private sector. A connection is needed between things such as drafting, databases, and spreadsheets. The computer does not put people out of work, it is just a tool.

THEME: PARENT LIAISONS AND VOLUNTEERS ARE CRITICAL TO SCHOOL REFORM

Current Situation. Some parents do not feel welcome in the schools or they feel uncomfortable.

Key Points and Examples

- Hospitality is an important issue. The parents must feel welcome. Parents must be acknowledged and not be mistreated. I'm sure teachers are taken for granted in the same way. People need to see the benefits of visiting the school and becoming familiar with the staff and programs.

- Sometimes the administration is fearful to tell the volunteer what to do—it might scare them off. These stereotypes need to be changed.

Suggestions

- Perhaps there could be a paid parent position. This person would work with the staff and parents as a liaison. He or she could teach parents they have a right to be in that school and be an ambassador for the parent that does not feel comfortable communicating with the staff. This person would help parents see the school staff not as the enemy but as a team member. Some parents are afraid, perhaps, because of their own school experiences when they were young. We need more time for teachers to spend with parents and their children. This person may be the one who works the longer day to contact parents and to set up tutoring.
- Volunteers need a job description. They could be called "Volunteer Staff."
- Volunteer parents in the schools need to know the people who are there. This is a key. The children also need to be familiar with the volunteers.

SUMMARY

Focus groups were held with community members and parents to broaden the landscape perspective of mathematics and science education in MPS. Three focus groups were held with individuals from a broad representation of Milwaukee's businesses, industries, agencies, and other institutions, and a fourth focus group was held with MPS parents. The following is a summary of the common concerns and suggestions that surfaced from the four focus groups.

- The entire community is responsible for a child's education.
- Children's learning should take place in the community as well as the classroom.
- The schools need to be open to the community and parents for visiting and learning during regular school hours, evenings, and weekends.
- To gain a better understanding of what the community can offer, teachers and students need to get into the workplace. Individuals from the community also need to get into the schools.
- A variety of resources should be put into place to allow for clearer and better communication between schools, parents, and the Milwaukee community.
- Mathematics and science learning needs to be integrated, hands-on, and related to children's lives.
- School day scheduling needs to be more flexible.
- Parents need to be part of reform planning from the very beginning.
- Learning opportunities should be provided for parents, teachers, and administrators, as well as for the children.
- Opportunities should exist for parents and teachers to become more comfortable with science and mathematics skills and content.
- Colleges, universities, and MPS should work more closely together in teacher preparation in mathematics and science.

APPENDIX A
MEMBERS OF THE WORKING GROUP

Stephen Adams	City of Milwaukee-DPW	City Representative
Jeffrey Anderson	Vincent High School	Teacher
Ed Anhalt	Greater Milwaukee Education Trust	Community
Joanne Anton	Office of the Mayor	City Representative
Patricia Barry	Wright Multilanguage Middle School	Teacher
Carmen Baxter	Milwaukee Public Schools	Curriculum Specialist
Conni Blomberg	Ronald E. McNair School	Teacher
Marva Bredendick	J.W. Riley School	Teacher
Sallie Brown	Trowbridge Street School	Elementary Principal
David Caruso	Custer High School	Teacher
Greg Coffman	Downey, Inc.	Community
Ramon Cruz	Morgandale School	Elementary Principal
David DeBruin	MPS Board of School Directors	Community
Lynn Doyle	University of Wisconsin-Milwaukee	Project Assistant
Cynthia Ellwood	Milwaukee Public Schools	Director, Educ. Services
Michael Endress	Grand Avenue Middle School	Teacher
Larry Enochs	University of Wisconsin-Milwaukee	Post Secondary
Elizabeth Freeman	Edison Middle School	Teacher
Howard Fuller	Milwaukee Public Schools	Superintendent
David Guerrero	Milwaukee Area Technical College	Post Secondary
Rebecca Guerrero	Parent	Parent
Karleen Haberichter	Milwaukee Public Schools	K-5 Coordinator
Janie Hatton	Milwaukee Trade and Tech. H.S.	Principal
Judy Heine	Milwaukee Public Schools	Chapter 1 Supervisor
Mary Henry	Milwaukee Public Schools	Equity 2000 Coordinator
DeAnn Huinker	University of Wisconsin-Milwaukee	Post Secondary
Bob Jasna	Milwaukee Public Schools	Deputy Superintendent
Jared Johnson	MPS Board of School Directors	School Board Director
Patricia Kenner	Douglass School	Teacher
Steven Kreklow	Budget and Management Division	City Representative
Jim Kurtz	Milwaukee Public Schools	Chapter 1 Supervisor

Darlene Liston	Milwaukee Public Schools	Supervisor
Dan Lotesto	Riverside University High School	Teacher
Hazel Luckett	Kagel School	Teacher
Michael Mahoney	Park Bank, East Office	Community
Connie Manke	Bay View High School	Teacher
Edward Mooney	Wright Multilanguage Middle School	Teacher
Mary Morris	Parent	Community & Parent
Floyd Mosley	Milwaukee Public Schools	Ex. Ed. Program Adm.
Diane Neicheril	Clarke St. School	Principal
Vince O'Connor	Milwaukee Public Schools	Curriculum Specialist
Corey Odom, Jr.	Milwaukee Area Technical College	Post Secondary
Martin Ordinans	Milwaukee Public Schools	Supervisor
Jacqueline Patterson	Milwaukee Education Center	Principal
Cyntha Pattison	Department of Public Instruction	DPI Representative
Gretchen Pearson	Parent	Parent
Eric Peli	Milwaukee Public Schools	Supervisor
Cynthia Pierson	Parkview School	Parent
Judith Pokrop	Milwaukee School Of Engineering	Post Secondary
Bill Rawles	South Division High School	Mathematics Teacher
Annie Rheams	Marquette University	Post Secondary
Barry Rosen	Milwaukee Public Museum	Community
Jerry Schnoll	Zablocki Elementary School	Teacher
Fred Schroedl	Milwaukee Public Schools	Curriculum Specialist
Katrina Simmons	J.W. Riley Elementary School	Teacher
Rhulene Swanigan	Kluge Science Center	Teacher
Karen Villwock	Milwaukee Public Schools	Chapter 1 Supervisor
Catherine Washabaugh	Hartford Avenue School	Principal
Ella Washington	Milwaukee Public Schools	Chapter 1 Supervisor
Charles Wikenhauser	Milwaukee County Zoo	Community
Blaine Wisniewski	Riverside University High School	Teacher
James Wojtech	Stuart School	Teacher
Kay Zupko	Lloyd Street School	Teacher

APPENDIX B

SITE VISIT GUIDE
AND
DATA COLLECTION INSTRUMENTS

Mathematics and Science Education

Site Visit Guide

DeAnn Huinker

Acknowledgments. Contributors to this guide include: Lynn Doyle, Gretchen Pearson, Karleen Haberichter, Karen Villwock, Cynthia Pierson, Greg Coffman, Patricia Kenner, Charles Wikenhauser, James Wojtech, Elizabeth Freeman, Dan Lotesto, David Guerrero, Darlene Liston, Blaine Wisniewski, David Caruso, and Mary Henry.

Center for Mathematics and Science Education Research
2400 E. Hartford Ave 265 Enderis Hall
University of Wisconsin-Milwaukee
Milwaukee, WI 53201-0413
414-229-6646
huinker@csd4.csd.uwm.edu

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Guidelines for Conducting a Site Visit

The purpose of the site visit is to develop an understanding of the science and mathematics programs at each school site and to discover both the strengths and needs of these programs. The site visit team will consist of three individuals, including both school personnel and community representatives. A site visit will include:

- Six classroom observations, three mathematics and three science;
- Two student group-interviews, six students each;
- One or two teacher group-interviews, three to six teachers each;
- A principal interview, and
- Team debriefing.

Before the Visit

√ The team leader will receive a packet of materials that includes:
- Site visit schedules and school rosters
- 6 copies of the classroom observation form
- Interview protocol for students, teachers, and principal interviews
- Information sheets for students, teachers, and principal interviews
- 4 or 5 audio tapes
- Site visit general impressions form

√ The team leader will contact each team member to confirm:
- Arrival time at the site
- Site visit responsibilities for each team member
- Special instructions for parking and entering the school (e.g. which door to use).

√ Each team member should obtain an audio tape recorder that you can use for conducting interviews. The tape recorder should run on batteries, so you can position it in a way to best capture interviewee responses. Thus, also obtain batteries. You may want to bring along an extra set of batteries, just in case. If you do not have access to a tape recorder, contact your team leader so she/he may make arrangements to bring an extra tape recorder to the site visit.

Arriving at the Site

√ Please sign in at the office and acquire visitor badges.

√ Get site visit schedule, school roster, observation forms, information sheets, protocols, and audio tapes from the team leader.

√ Confirm responsibilities for observations and interviews with other team members.

√ Confirm room locations for conducting interviews and observations. If time allows, you may want to locate the rooms and tour the school.

During the Site Visit

√ Be FLEXIBLE and make changes as needed.

√ As emergencies arise or if teachers or students are absent, an observation may need to be canceled or an interview conducted with fewer teachers or students than planned. Just make note of any changes on the information sheets or observation forms.

√ The plan is to observe six classes, three mathematics and three science. However, if the school's schedule does not allow this, there may be fewer observations and two team members may want to observe a class together.

√ If the schedule allows, one team member may want to conduct an interview as another team member observes and takes notes.

Conducting Classroom Observations

√ Introduce yourself to the teacher. Thank her or him for the opportunity to observe the class.

√ Position yourself towards the back or side of the classroom.

√ If non-obtrusive, feel free to move about the room during the observation to better hear what students are saying as they work in pairs or small groups or to better see what students are working on or writing.

√ Record your observations directly on the observation form, or if you prefer you may record your observations on other paper and then transfer your notes to the form later. You will have to decide what is most comfortable for you—you may want to do a combination of both.

Conducting Interviews (More information on conducting interviews is given later.)

√ It is important that the room in which the interviews are conducted allow for privacy. The door should be closed. You may want to put a sign on the door which states, "Interview in progress, do not disturb."

√ For group interviews, it is best if all interviewees sit around the same table with the interviewer. This puts each person at the same level. Then the tape recorder can be positioned in the center of the table. If the interviewees are sitting at desks, rearrange them into a circle and find an appropriate place to position the tape recorder.

√ If teachers or the principal refers to any specific school documents, try to obtain a copy of these documents and return them with the site visit materials.

Reflecting on the Site Visit

√ After the completion of classroom observations and interviews, the site visit team should find a place (with privacy) where they can discuss and reflect on the events of the visit. Someone should record the team's general impressions of the school's mathematics and science programs. A recording form is provided in the team leader's packet of materials.

After the Site Visit

√ The team leader should collect the following materials:
- Classroom observation forms from all team members. (If team members need time to rewrite or finalize their observational notes, they may return the information themselves.)
- Principal interview audio tape recording and information sheet.
- Teacher group-interview audio tape recording and information sheet.
- Student group-interview information sheets.
- Site visit team general impressions.
- Any other information or documents that were gathered.

√ Summary Reports of Student Interviews: Members of the site visit team are asked to summarize the information from the student interviews. Please listen to the tape recording from each interview and summarize the students' responses to each question. You do not need to transcribe direct quotes unless you feel a response is particularly insightful, interesting, or important for the purpose of understanding the student perspective of the school's mathematics and science programs. Forms for recording your summaries are provided in the team leader's packet of materials.

√ Return all materials to your Site Visit Team Leader or to:

U.S. Mail
Vince O'Connor
Curriculum & Instruction
Milwaukee Public Schools
PO Box 2181
Milwaukee, WI 53201

Deliveries
Vince O'Connor
Central Administration Bldg, rm 265
Milwaukee Public Schools
5225 West Vliet Street
Milwaukee, WI 53208-2698

Site Visit Team Leader Information

Prior to the Site Visit

√ You will receive a packet of materials for each school visit that includes:
- 3 site visit schedules and 3 school rosters
- 6 copies of the classroom observation form
- Student group-interview protocol and information sheets (2 copies)
- Teacher group-interview protocol and information sheet (1 or 2 copies)
- Principal interview protocol and information sheet
- 4 or 5 audio tapes
- Site visit general impressions form
- 2 copies of the student group-interview summary report form

√ Contact the site visit school to confirm site visit appointment and arrangements.

√ Contact each team member to confirm:
- Arrival time at the site.
- Assignment of site visit responsibilities for each team member.
- Availability of tape recorders.
- Special instructions for parking and entering the school (e.g. which door to use).

√ Arrange for audio tape recorders for yourself and any team members that may need one.

Arriving at the Site

√ Confirm the site visit schedule with the principal and make arrangements for a room where the site visit team can meet after the visit to discuss and reflect on the events of the visit.

√ Confirm responsibilities for observations and interviews with other team members.

√ Distribute materials to team members: site visit schedule, school roster, observation forms, information sheets, protocols, and audio tapes.

During the Site Visit

√ <u>Be FLEXIBLE</u> and make changes as needed.

√ If time constraints become a problem, attempt to complete activities as prioritized below:
- Classroom Observations
- Teacher interviews
- Student interviews
- Principal interviews

Reflecting on the Site Visit

√ Gather the team together to reflect on the events of the visit. Someone should record the general impressions and comments made during this discussion. A recording form is provided.

After the Site Visit

√ If any changes occurred to the original site visit schedule, please make note of them on the schedule. This should be returned along with the other materials.

√ Check to see that all audio tapes are labeled properly.

√ Identify who will prepare <u>summaries of the student interviews</u>. Members of the site visit team are asked to summarize this information to assist with the analysis of the data. Give those individuals should be given the audio tape recordings from the student group-interviews.

√ Collect the following materials from the team:
- Classroom observation forms from all team members. (If team members want to rewrite or need to finalize their observation notes, they may return the information to Vince.)
- Principal interview audio tape recording and information sheet.
- Teacher group-interview audio tape recording and information sheet.
- Student group-interviews information sheets.
- Site visit team general impressions.
- Any other information or documents that was gathered and is relevant to the self-study.

Classroom Observation Guide

School ______________________________

Date ________________________________

Name of Observer ____________________

Time Observation: began ________

ended ___________

Grade level /Course ____________________

Subject area: mathematics or science

Student Information

total number of students ______________

males ____________ Hispanics ____________

females ____________ Asian-Am. ____________

African-Am. ____________ Native Am. ____________

Caucasians ____________ Others ____________

Teacher Information

Gender __________ Ethnicity/Race ______________

Materials, Tools, Technology

1. What materials are readily available? (e.g. computers, calculators, math manipulatives, science supplies, animals, plants, rocks, microscopes, etc.)

2. What materials are the students and teacher using?

   Students:

   Teacher:

3. Other comments.

Classroom Climate

Seating arrangement: _____Rows ____Groups

____Pairs

1. Does the classroom seem crowded?

   ____

   Are furniture and space appropriate and adequate for instructional purposes? ____________________

   Describe.

2. Imagine you are a student. Does the room look inviting? Give examples. (e.g. What is on the walls? bulletin boards?)

3. Characterize and describe student engagement and enthusiasm (e.g. engaged, active, passive, going through the motions). Give examples.

4. Characterize the teacher's enthusiasm and excitement for the subject area. Give examples.

5. Other comments.

Instruction	Teacher Focus
1. Describe the content focus of the lesson and the methods of instruction. (e.g. What are students learning about or investigating? How are they learning this? Through lecture, whole class discussion, individual inquiry, small group, etc.) 2. Describe connections made to students' every day lives? to careers? to other disciplines/subject areas? 3. Other comments.	1. Describe the teacher's role in the classroom (e.g. lecturer, director, facilitator, coach, etc.)? Give examples. 2. What is the teacher stressing? Give examples. _____ Understanding: _____ Problem Solving: _____ Risk Taking: _____ Following Directions: _____ Memorization: _____ Other: 3. Other comments.

Student Focus

1. What are the students doing? (e.g. listening to the teacher; working in groups; doing lab or hands-on activities; doing workbook or text exercises; explaining their reasoning; participating in class discussions; etc.)?

2. Describe how the students interact with the teacher. (e.g. Who does most of the talking?)

3. Describe how the students interact with each other.

4. Were the students engaged in cooperative or competitive activities? Give examples.

(Student Focus continued.)

5. Describe evidence of student self-assessment (teacher or student initiated; e.g. journal writing, summaries, etc.)

6. Other comments.

Equity

1. Comment on the diversity of gender/race/ethnicity among small groups or pairs of students and seating arrangements.

2. Does the teacher seem to equally engage, encourage, and interact with **all** students regardless of gender / ethnicity / race? Give examples.

3. Other comments on evidence of or lack of equity.

Other Descriptions, Examples, and Comments

Describe any episodes that made an impression on you, positive or negative, or comment on other observations.

General Impressions

Circle the number that corresponds to your perception of this lesson for each item according to this rating scale.

5=Very Often 4=Often 3=Sometimes 2=Seldom 1=Never

	Very Often				Never
1. The lesson was student-centered (e.g. opportunities existed for students to investigate problems of interest).	5	4	3	2	1
2. Students talked with each other and interacted for the purpose of making sense of the ideas being examined and for helping each other investigate problems.	5	4	3	2	1
3. The teacher helped the students build upon their prior knowledge and experiences (e.g. asked students to think about important ideas from past lessons).	5	4	3	2	1
4. Students were given responsibility and control over their learning and were encouraged to think independently (e.g. to use their own ideas and ways of investigating problems).	5	4	3	2	1

Note: Collect copies of any handouts or worksheets and attach them to this report.

Guidelines for Conducting Interviews

Preparation for the Interview

√ Review the interview questions.

√ Check the cassette player and batteries. Also, check for clarity of recording by playing back the introductory remarks (listed below).

√ Record the following information on the audio tape:
• Type of interview: Teacher, Principal, or Student.
• School
• Date
• Name of interviewer
For example, "This is a student group-interview at Hi-Mount Elementary School. Today is February 23, 1994. The interviewer is (your name)."

√ The above information should also be written on the label on the tape.

Conducting the Interview

√ Before the tape recorder is turned on, you must state the purpose of the interview and inform the interviewee(s) of the fact that confidentiality will be preserved. See statement on the protocoi.

√ Fill out the information sheet, record gender and ethnicity/race for each interviewee, as well as grade level for students and teaching position for each teacher.

√ As you conduct the interview, be careful not to get into a discussion with the interviewees. Simply pose the question. Then use mainly nonverbal cues to encourage the interviewees to elaborate and verbalize (e.g. nod your head, remain silent when the person stops talking, etc.). However, do probe the interviewees when needed to get more responses and more detail. For example, here are some probes you might want to use:
• Does anyone else have something to add? (with a long pause)
• What do you think?
• Would you elaborate on that? or Tell me more about that.
• Could you give an example?
• What you are saying is very important. It would help if you would say more about that.

√ Listen carefully to the interviewees' responses. You may need to make adjustments in question format or repeat questions based on the characteristics of comments made.
• Shallow responses: Ask them to elaborate.
• Off-target responses: Rephrase the question to focus attention.
• Rambling/unfocused responses: Let me stop you there for a moment.... rephrase question.

√ In the event that the tape recorder fails at some point during an interview, (1) attempt to quickly find another tape recorder; or (2) re-schedule the interview if possible; or (3) write notes to capture as much of the interview as possible.

After the Interview

√ Be sure the information sheet has been filled out.

√ Punch out the two tabs at the back of the cassette to prevent it from being accidentally erased.

√ For teacher and principal interviews, give information sheet and audio tape to the team leader to be returned. For student interviews, give the information sheet to the team leader to be returned and give the audio tape to the individual who has volunteered to summarize the interview.

Student Group-Interview
Information Sheet

School ____ Date ______________________

Interview Conducted by:____

	Gender*	Ethnicity/Race**	Grade Level
Student 1			
Student 2			
Student 3			
Student 4			
Student 5			
Student 6			

*M: male; F: female

**AA: African-Am.; H: Hispanic; C: Caucasian; AS: Asian-Am.; NA: Native Am.; O: Other (please indicate ethnicity/race if possible)

Comments

Teacher Group-Interview
Information Sheet

School ______________________________ Date ____________________

Interview Conducted by:____

	Gender*	Ethnicity/Race**	Teaching Position
Teacher 1			
Teacher 2			
Teacher 3			
Teacher 4			
Teacher 5			
Teacher 6			

*M: male; F: female

**AA: African-Am.; H: Hispanic; C: Caucasian; AS: Asian-Am.; NA: Native Am.;
O: Other (please indicate ethnicity/race if possible)

Comments

Principal Interview
Information Sheet

School ______________________________________ Date ____________________

Interview Conducted by: ____

Principal Information

Gender (circle one): Male Female

Ethnicity/Race: ______ African-American ______ Hispanic ______ Caucasian

______ Asian-American ______ Native American

______ Other (please indicate) ______________________________

Comments

Student Group-Interview Protocol

(Introduce yourself and explain the purpose of the interview. Here is an example introduction.)

Hi. My name is __________ and I'm visiting your school today with two other people. We've been observing some math and science classes, as well as talking with some of your teachers and with your principal. The reason I wanted to talk with you is because we think that students can teach us a lot about how math and science can be made more meaningful and interesting.

We are interested in your opinions. There are no right or wrong answers. I'm going to run a tape recorder because I can't write fast enough to get everything down on paper that you'll be saying. Don't worry, no one here at the school will listen to the tape—not your teacher, not the principal, not anyone. We want you to tell us what you think and how you feel.

(Turn on the tape recorder. Position it in the center of the group.)

For elementary and middle level students:
I'd like for each of you to tell me what grade you are in.

For high school students:
I'd like for each of you to tell me what grade you are in and what math and science classes you are taking right now.

We're going to start out with some brainstorming. How many of you have done brainstorming before? What is it?

1. I am going to show you something and then I'm going to ask you to tell me what came to your mind when you saw that. Ready? (Wait a moment, then show the card with "math class" written on it. Pause a moment longer.) What did you think of when I showed you **math class**?

   (Be sure to get at least one response from every student. Probe interesting responses.)
   Probes: What do you think? What else comes to mind? What do you mean by that?

2. I am going to show you something else and then I'm going to again ask you to tell me what comes to your mind when you see this word. Ready? (Wait a moment, then show the card with "science class" written on it. Pause a moment longer.) What did you think of when I showed you **science class**?

   (Be sure to get at least one response from every student. Probe interesting responses.)
   Probes: What do you think? What else comes to mind? What do you mean by that?

3. I would like you to pretend that you are in control of your **math** class. You can decide what is taught and how it is taught. You are still in the class, but you make the plans for this ideal **math** class.

   a. If you could describe your ideal **math** class, what would you be doing?

   b. What would your teacher be doing?

   c. What would you study or learn about?

   d. What kinds of activities would you be doing?

   e. How does this differ from what typically happens in your **math** class?

4. This time I would like you to pretend that you are in control of your **science** class. You can decide what is taught and how it is taught. You are still in the class, but you make the plans for this ideal **science** class.

   a. If you could describe your ideal **science** class, what would you be doing?

   b. What would your teacher be doing?

   c. What would you study or learn about?

   d. What kinds of activities would you be doing?

   e. How does this differ from what typically happens in your **science** class?

5. In **math or science** class, if you could choose, would you rather work in groups or alone? Why?

6. A lot of kids wonder why they have to study **math and science** in school.
   - How will it help you with anything outside of school?
   - Can you give me some examples?

7. What kinds of special things—things like materials, tools, toys, equipment, and machines—do you use in your **math and science** classes?

   Probes: Do you ever use <u>calculators</u> or <u>computers</u> in **math or science** class?
   How often do you get to use them? *or* Would you like to use them? Why?
   What types of things do (would) you use them for?

8. Think of someone in your class who is 'good' in **math**. (Wait a few seconds.) Why did you pick that person?

9. Think of someone in your class who is 'good' in **science**. (Wait a few seconds.) Why did you pick that person?

10. Sometimes people find **math or science** difficult. Tell us what you do when **math or science** is hard for you.

    Probes: Does anyone <u>at home</u> ever help you with your **math or science** work?
    Who helps you?

11. Do you think your teachers like **math or science**? How can you tell?

    Or you may prefer to phrase the question this way for middle and high school students:

    Do you think your **math teacher** likes **math**? How can you tell?
    Do you think your **science teacher** likes **science**? How can you tell?

12. Is there anything else you'd like to tell us about your **math or science** classes?

13. Is there anything you would like to ask us?

Teacher Group-Interview Protocol

(Introduce yourself and explain the purpose of the interview. Here is an example introduction.)

I really appreciate your willingness to participate in this interview about your mathematics and science programs. We are grateful for the opportunity to observe some of the mathematics and science classes in this school, to talk with your principal and some students, and to talk with you.

I will be audio taping the interview so that I can be free to concentrate on what we are talking about, rather than having to take extensive notes. The recording will be kept confidential. No individual names, or even the name of the school, will be associated with any of your comments.

(Turn on the tape recorder. Position it in the center of the group.)

1. I'd like for each of you to state your position in this school and briefly describe your responsibilities in the areas of mathematics and science.

   Probes: What grade level? What subject area? How many classes do you teach?

2. Let's begin by talking about your goals for teaching mathematics or science. I'd like a few of you to talk about one or two of your goals, and then have the rest of you comment on how your goals are similar or different or describe additional goals.

3. What do you feel is the most important resource needed to truly make a positive change in your mathematics or science program?

   Probes: What about additional materials? equipment? time? staff? money? inservice?

4. A lot of things can get in the way of effective mathematics and science instruction. What are the biggest barriers to effective mathematics and science instruction?

   Probes: What can be done to reduce or eliminate these barriers?

5. What are the strengths or needs of your school related to the use of technology for teaching mathematics or science?

6. What factors or conditions make it possible or difficult for each of you to regularly engage your students in hands-on investigations or in small group work?

7. Let's talk about monitoring students' progress and understanding in mathematics and science. What kinds of assessment strategies do you use in your classrooms?

   Probes: Do you use any special strategies to encourage student self-assessment of their mathematics and science learning?

8. Why do you think there is a performance gap between white (or Caucasian) students and minorities in mathematics and science?

9. What, if anything, could be done differently with respect to your staff development that could improve your ability to implement your mathematics and science programs more effectively?

   Probes: What do you see as the priority for staff development in your school?
   Who decides the content of staff development programs?

10. What opportunities are there for you as a mathematics or science teacher to discuss or share ideas and resources with teachers of similar or other curricular areas?

    Probes: What opportunities exist within your school? (at same and different grade levels)
    What opportunities exist within the district? (at same and different school levels)

11. It's often difficult to integrate mathematics and science with other subject areas. What successes have you had in doing this?

12. Could you describe the level of family involvement in your school?

    Probes: To what extent are families involved in mathematics and science?
    What kinds of activities are families involved in?
    What activities occur to support families in assisting their children's mathematics and science learning at home?

13. Could you describe the level of support from business and industry, cultural agencies, and other community organizations for mathematics and science in your school?

    Probes: What kinds of support have you received (or would you like to receive)?
    What opportunities exist for student participation in out-of-school activities related to mathematics and science (e.g. outdoor activities, field trips, camping trips, career shadowing experiences)?

14. Is there anything else you would like us to tell us about your mathematics or science programs?

Principal Interview Protocol

(Introduce yourself and explain the purpose of the interview. Here is an example introduction.)

I really appreciate your willingness to participate in this interview about your mathematics and science programs. We are grateful for the opportunity to observe some of the mathematics and science classes, to talk with some of the teachers and some students, and to talk with you.

I will be audio taping the interview so that I can be free to concentrate on what we are talking about, rather than having to take extensive notes. The recording will be kept confidential.

(Turn on the tape recorder.)

1. On a scale from 1 to 10, with one being low and ten being high, how would you rate your **mathematics** program?

   Probes: Why did you rate it a ______ ?
   What is your school doing well in regards to its **mathematics** program?
   What needs to happen for your **mathematics** program to improve?
   What have you seen that concerns you?

2. This time on a scale from 1 to 10, how would you rate your **science** program?

   Probes: Why did you rate it a ______ ?
   What is your school doing well in regards to its **science** program?
   What needs to happen for your **science** program to improve?
   What have you seen that concerns you?

3. In your judgment, how comfortable are the teachers with the mathematics and science programs that they are implementing? Why do you say that?

4. What support systems are available in your school to help teachers implement their mathematics and science programs?

5. What opportunities do teachers have for sharing ideas and resources related to mathematics and science instruction?

   Probes: How effective are these opportunities?
   Is your school typical in this area? If not, what accounts for the differences?

6. To what extent do classroom activities include the use of mathematics manipulatives or science materials to enhance understanding? Why do you think this is the case?

   Probes: *For elementary and middle school principals* :
   Your teachers were recently given a math manipulative kit, to what extent are the teachers using these materials? Why do you think this is the case?

7. Could you talk about the availability and use of calculators and computers for mathematics and science instruction.

   Probes: Do you have any plans or hopes for enhancing the technological resources available to teachers in this building?

8. Have mathematics or science been the focus of any staff development so far this year?

   Probes: What kinds of programs have been offered?
   How effective have they been?

9. What are the most important things you see your staff needing to work on in the areas of mathematics or science?

10. Are there any opportunities for teachers of different grade levels to get together to work on program development or address areas of concern or need?

    Probes: What opportunities exist within your school?
    What opportunities exist with other schools at the same level?
    What opportunities exist with schools at other levels (e.g. elementary and middle; middle and high; high and college)?

11. Could you describe the level of family involvement in your school?

    Probes: What kinds of activities are families involved in?
    What activities occur to support families in assisting their children's mathematics and science learning at home?

12. Could you describe the level of support from business and industry, cultural agencies, and other community organizations for mathematics and science in your school?

    Probes: What kinds of support have you received (or would you like to receive)?
    What opportunities exist for student participation in out-of-school activities related to mathematics and science (e.g. outdoor activities, field trips, camping trips, career shadowing experiences)?

13. What evidence have you seen that the mathematics and science instruction is having an effect on students?

14. Why do you think there is a performance gap between white (or Caucasian) students and minority students in mathematics and science?

15. Do you have any initiatives going on at the moment in the area of using alternative assessments in the area of mathematics and science? If so, please describe.

16. How would you characterize your staff's enthusiasm toward mathematics and science?

17. Is there anything else that you would like to tell us about your mathematics and science programs?

Site Visit General Impressions

School ________________________________ Date ____________________

Site Visit Team Members: ____

____

After the completion of classroom observations and interviews, the site visit team should find some time to discuss and reflect on the events of the visit. Use this sheet to record some of the team's general impressions of the school's mathematics and science programs.

APPENDIX C
SURVEY INSTRUMENTS

Survey of Elementary School Mathematics and Science

1. How much time do you teach each subject with a typical class during a typical week?

Mathematics	***Science***
_____ None	_____ None
_____ 1 hour	_____ 1 hour
_____ 2 hours	_____ 2 hours
_____ 3 hours	_____ 3 hours
_____ 4 hours	_____ 4 hours
_____ 5 or more hours	_____ 5 or more hours

2. Indicate how often you use each of the following methods in your teaching of **mathematics** by checking the appropriate column.

	Almost daily	At least weekly	At least once a month	Rarely	Never
a. Small group work (groups of 3 or more)	_____	_____	_____	_____	_____
b. Students working in pairs	_____	_____	_____	_____	_____
c. Teacher explanations/demonstrations	_____	_____	_____	_____	_____
d. Whole-group discussions	_____	_____	_____	_____	_____
e. Students using textbooks	_____	_____	_____	_____	_____
f. Students using worksheets	_____	_____	_____	_____	_____
g. Learning Centers	_____	_____	_____	_____	_____
h. Students using manipulative materials	_____	_____	_____	_____	_____
i. Students using calculators	_____	_____	_____	_____	_____
j. Students using computers	_____	_____	_____	_____	_____

3. Indicate how often you use each of the following methods in your teaching of **science** by checking the appropriate column.

	Almost daily	At least weekly	At least once a month	Rarely	Never
a. Small group work (groups of 3 or more)	_____	_____	_____	_____	_____
b. Students working in pairs	_____	_____	_____	_____	_____
c. Teacher explanations/demonstrations	_____	_____	_____	_____	_____
d. Whole-group discussions	_____	_____	_____	_____	_____
e. Students doing reference work	_____	_____	_____	_____	_____
f. Students doing experiments	_____	_____	_____	_____	_____
g. Students using textbooks	_____	_____	_____	_____	_____
h. Students using worksheets	_____	_____	_____	_____	_____
i. Learning Centers	_____	_____	_____	_____	_____
j. Students using materials or equipment	_____	_____	_____	_____	_____
k. Students using calculators	_____	_____	_____	_____	_____
l. Students using computers	_____	_____	_____	_____	_____

4. To what degree are you satisfied with your current strategies in teaching mathematics and/or science? (Circle the number on the scales below which reflects your satisfaction.)

Mathematics	Highly Satisfied	5	4	3	2	1	Not Satisfied
Science	Highly Satisfied	5	4	3	2	1	Not Satisfied

5. To what degree are parents involved in your **mathematics and science** programs?

Highly Involved 5 4 3 2 1 Not Involved

6. To what degree are consumable supplies regularly purchased by your school for student use? (Circle a number on each scale below.)

Mathematics	All are Purchased	5	4	3	2	1	None are Purchased
Science	All are Purchased	5	4	3	2	1	None are Purchased

7. To what degree are non-consumable supplies available in sufficient quantity for student use? (Circle a number on each scale below.)

Mathematics	All are Available	5	4	3	2	1	None are Available
Science	All are Available	5	4	3	2	1	None are Available

8. To what degree do you agree with each of these statements:
   a. All students can learn mathematics.

      Strongly Agree 5 4 3 2 1 Strongly Disagree

   b. All students can learn science.

      Strongly Agree 5 4 3 2 1 Strongly Disagree

9. To what degree do you perceive mathematics and/or science to be valued in your school?

Mathematics	Highly Valued	5	4	3	2	1	Not Valued
Science	Highly Valued	5	4	3	2	1	Not Valued

10. How do you evaluate your students' performance in mathematics and/or science? (Check all that apply.)

	Mathematics	***Science***
a. Textbook tests	______	______
b. Teacher-developed tests	______	______
c. Teacher observation	______	______
d. Portfolios	______	______
e. Journals/Learning Logs	______	______
f. Performance Tasks	______	______
g. Checklists	______	______
h. Anecdotal Records	______	______

   i. Other. Please list and indicate whether it is used for mathematics (M), science (S), or both (B). ______________________________

11. What do you feel are your own strengths and weaknesses in teaching mathematics and/or science?(Circle the number on each scale which reflects the degree of strength or weakness.)

	Mathematics					***Science***				
	Strength				Weakness	Strength				Weakness
a. Background knowledge	5	4	3	2	1	5	4	3	2	1
b. Conducting demonstrations	5	4	3	2	1	5	4	3	2	1
c. Facilitating hands-on activities and experiments	5	4	3	2	1	5	4	3	2	1
d. Assessing student learning	5	4	3	2	1	5	4	3	2	1
e. Enthusiasm for subject	5	4	3	2	1	5	4	3	2	1
f. Making connections to real life	5	4	3	2	1	5	4	3	2	1
g. Conducting outdoor activities	5	4	3	2	1	5	4	3	2	1
h. Using computers	5	4	3	2	1	5	4	3	2	1
i. Using calculators	5	4	3	2	1	5	4	3	2	1

12. How available are computers for **mathematics and science** instruction?
   _____ Not available
   _____ Available but difficult to access
   _____ Available within the classroom (How many? __________)

13. Which of the following statements best describes **mathematics and science** in your classroom? (Check one.)
   _____ Integrated with each other
   _____ Integrated with other subjects
   _____ Taught separately
   _____ Other (please specify) ____________________

14. What informal learning environments did your students experience as part of your **science and mathematics** programs this school year? (Check all that apply.)
   _____ Business/Industry
   _____ Discovery Museum
   _____ Milwaukee Public Museum
   _____ Zoo
   _____ Park
   _____ Nature Center
   _____ Other (please list) ____________________

15. Certain factors may affect instruction. Please rate the adequacy of each of the following factors for teaching **mathematics** in your school by checking the appropriate column.

	Excellent	Good	Satisfactory	Unsatisfactory	Not Applicable
a. Space for students to work	_____	_____	_____	_____	_____
b. Space for storage	_____	_____	_____	_____	_____
c. Individual planning time	_____	_____	_____	_____	_____
d. Collaborative planning time	_____	_____	_____	_____	_____
e. Class size	_____	_____	_____	_____	_____
f. Class time	_____	_____	_____	_____	_____
g. Equipment	_____	_____	_____	_____	_____
h. Consumables	_____	_____	_____	_____	_____
i. Administrative support	_____	_____	_____	_____	_____
j. Teacher comfort level	_____	_____	_____	_____	_____
k. Reading skills of students	_____	_____	_____	_____	_____

16. Certain factors may affect instruction. Please rate the adequacy of each of the following factors for teaching **science** in your school by checking the appropriate column.

	Excellent	Good	Satisfactory	Unsatisfactory	Not Applicable
a. Space for students to work	_____	_____	_____	_____	_____
b. Space for storage	_____	_____	_____	_____	_____
c. Individual planning time	_____	_____	_____	_____	_____
d. Collaborative planning time	_____	_____	_____	_____	_____
e. Class size	_____	_____	_____	_____	_____
f. Class time	_____	_____	_____	_____	_____
g. Equipment	_____	_____	_____	_____	_____
h. Consumables	_____	_____	_____	_____	_____
i. Administrative support	_____	_____	_____	_____	_____
j. Teacher comfort level	_____	_____	_____	_____	_____
k. Reading skills of students	_____	_____	_____	_____	_____

17. Policies and practices for calculator use in **mathematics**:
   a. Do your students have access to calculators owned by the school? ____ yes ____ no
      If yes, what kind of calculators and how many? ________________________
   b. Are students allowed to use calculators on your tests? ____ yes ____ no
   c. Do you encourage students to use calculators for homework? ____ yes ____ no
   d. Do you permit students the unrestricted use of calculators in class? ____ yes ____ no

18. Circle the number on each scale below which reflects your feeling about teaching **mathematics**:

a. Enjoyable	5	4	3	2	1	Not Enjoyable
b. Exciting	5	4	3	2	1	Boring
c. Satisfying	5	4	3	2	1	Frustrating
d. Rewarding	5	4	3	2	1	Unfulfilling
e. Comfortable	5	4	3	2	1	Stressful

19. Circle the number on each scale below which reflects your feeling about teaching **science**:

a. Enjoyable	5	4	3	2	1	Not Enjoyable
b. Exciting	5	4	3	2	1	Boring
c. Satisfying	5	4	3	2	1	Frustrating
d. Rewarding	5	4	3	2	1	Unfulfilling
e. Comfortable	5	4	3	2	1	Stressful

20. Within the last three years, about how many hours of staff development in mathematics and/or science have you participated in?

    __________ Hours in Mathematics __________ Hours in Science

21. List below the factors which you feel are major obstacles to teaching **mathematics and science** effectively. Identify whether each factor is for mathematics (M), science (S), or both (B).

22. What grade level(s) do you teach? ________________________

23. What position do you currently hold? ________________________

24. How many years have you been teaching? ____________

25. Indicate the highest degree you have earned:
    _____BS/BA _____BS/BA+16 _____BS/BA+32
    _____MS/MA _____MS/MA+16 _____MS/MA+32
    _____Doctorate

26. Indicate your sex: _____Female _____Male

27. Indicate your ethnicity/race:
    _____ African-American _____ Hispanic
    _____ Asian _____ Caucasian
    _____ Native-American _____ Other (please specify) ____________

Thank you for completing this survey. Your contribution to this effort is greatly appreciated.

Survey of Middle School and High School Mathematics

1. How many mathematics classes do you teach in a typical week? (Please list.)

2. What other subjects do you regularly teach besides mathematics?

3. Indicate how often you use each of the following methods in your teaching of mathematics by checking the appropriate column.

	Almost daily	At least weekly	At least once a month	Rarely	Never
a. Small group work (groups of 3 or more)	______	______	______	______	______
b. Students working in pairs	______	______	______	______	______
c. Teacher explanations/demonstrations	______	______	______	______	______
d. Whole-group discussions	______	______	______	______	______
e. Students using textbooks	______	______	______	______	______
f. Students using worksheets	______	______	______	______	______
g. Students using manipulative materials	______	______	______	______	______
h. Students using calculators	______	______	______	______	______
i. Students using computers	______	______	______	______	______

4. To what degree are you satisfied with your current strategies in teaching mathematics? (Circle the number on the scale below which reflects your satisfaction.)

   Highly Satisfied 5 4 3 2 1 Not Satisfied

5. To what degree are <u>consumable</u> supplies regularly purchased by your school for student use in mathematics? (Circle a number on the scale below.)

   All are Purchased 5 4 3 2 1 None are Purchased

6. To what degree are <u>non-consumable</u> mathematics supplies available in sufficient quantity for student use? (Circle a number on the scale below.)

   All are Available 5 4 3 2 1 None are Available

7. To what degree do you agree with this statement: "All students can learn mathematics."

   Strongly Agree 5 4 3 2 1 Strongly Disagree

8. To what degree are parents involved in your mathematics program?

   Highly Involved 5 4 3 2 1 Not Involved

9. To what degree do you perceive mathematics to be valued in your school?

   Highly Valued 5 4 3 2 1 Not Valued

10. How do you evaluate your students' performance in mathematics? (Check all that apply.)
   a. Textbook tests ______
   b. Teacher-developed tests ______
   c. Teacher observation ______
   d. Portfolios ______
   e. Journals/Learning Logs ______
   f. Performance Tasks ______
   g. Checklists ______
   h. Anecdotal Records ______
   i. Other (please list) ______________________________

11. What do you feel are your own strengths and weaknesses in teaching mathematics? (Circle the number on each scale which reflects the degree of strength or weakness.)

	Strength				Weakness
a. Background knowledge	5	4	3	2	1
b. Conducting demonstrations	5	4	3	2	1
c. Facilitating hands on activities	5	4	3	2	1
d. Assessing student learning	5	4	3	2	1
e. Enthusiasm for subject	5	4	3	2	1
f. Making connections to real life	5	4	3	2	1
g. Using computers	5	4	3	2	1
h. Using calculators	5	4	3	2	1

12. How available are computers for mathematics instruction?
   _____ Not available
   _____ Available but difficult to access
   _____ Available within the classroom (How many? ____________)

13. Which of the following statements best describes mathematics in your classroom? (Check one.)
   _____ Integrated with other subjects
   _____ Taught separately
   _____ Other (please specify) ______________________________

14. What informal mathematics learning environments did your students experience as part of your mathematics program this school year? (Check all that apply.)
   _____ Business/Industry
   _____ Discovery Museum
   _____ Milwaukee Public Museum
   _____ Zoo
   _____ Park
   _____ Nature Center
   _____ Other (please list) ______________________________

15. Policies and practices for calculator use in mathematics:
   a. Do students have access to calculators in your classroom? ____ yes ____ no
      If yes, what kind of calculators and how many? ________________
   b. Are students allowed to use calculators on your tests? ____ yes ____ no
   c. Do you encourage students to use calculators for homework? ____ yes ____ no
   d. Do you permit students the unrestricted use of calculators in class? ____ yes ____ no

16. Certain factors may affect instruction. Please rate the adequacy of each of the following factors for teaching mathematics in your school by checking the appropriate column.

	Excellent	Good	Satisfactory	Unsatisfactory	Not Applicable
a. Space for students to work	_____	_____	_____	_____	_____
b. Space for storage	_____	_____	_____	_____	_____
c. Individual planning time	_____	_____	_____	_____	_____
d. Collaborative planning time	_____	_____	_____	_____	_____
e. Class size	_____	_____	_____	_____	_____
f. Class time	_____	_____	_____	_____	_____
g. Equipment	_____	_____	_____	_____	_____
h. Consumables	_____	_____	_____	_____	_____
i. Administrative support	_____	_____	_____	_____	_____
j. Teacher comfort level	_____	_____	_____	_____	_____
k. Reading skills of students	_____	_____	_____	_____	_____

17. Circle the number on each scale below which reflects your feeling about teaching mathematics:

a. Enjoyable	5	4	3	2	1	Not Enjoyable
b. Exciting	5	4	3	2	1	Boring
c. Satisfying	5	4	3	2	1	Frustrating
d. Rewarding	5	4	3	2	1	Unfulfilling
e. Comfortable	5	4	3	2	1	Stressful

18. Within the last three years, about how many hours of staff development in the area of mathematics have you participated in?

19. List below the factors which you feel are major obstacles to teaching mathematics effectively.

20. What grade level(s) do you teach? ______________________________

21. What position do you currently hold? ______________________________

22. How many years have you been teaching? ______________

23. Indicate the highest degree you have earned:

_____BS/BA _____BS/BA+16 _____BS/BA+32
_____MS/MA _____MS/MA+16 _____MS/MA+32
_____Doctorate

24. Indicate your sex: _____Female _____Male

25. Indicate your ethnicity/race:

_____ African-American _____ Hispanic
_____ Asian _____ Caucasian
_____ Native-American _____ Other (please specify) ______________

Thank you for completing this survey. Your contribution to this effort is greatly appreciated.

Survey of Middle School and High School Science

1. How many science classes do you teach in a typical week? (Please list.)

2. What other subjects do you regularly teach besides science?

3. Indicate how often you use each of the following methods in your teaching of science by checking the appropriate column.

	Almost daily	At least weekly	At least once a month	Rarely	Never
a. Small group work (groups of 3 or more)	_____	_____	_____	_____	_____
b. Students working in pairs	_____	_____	_____	_____	_____
c. Teacher explanations/demonstrations	_____	_____	_____	_____	_____
d. Whole-group discussions	_____	_____	_____	_____	_____
e. Students doing reference work	_____	_____	_____	_____	_____
f. Students doing experiments	_____	_____	_____	_____	_____
g. Students using textbooks	_____	_____	_____	_____	_____
h. Students using worksheets	_____	_____	_____	_____	_____
i. Students using materials or equipment	_____	_____	_____	_____	_____
j. Students using calculators	_____	_____	_____	_____	_____
k. Students using computers	_____	_____	_____	_____	_____

4. To what degree are you satisfied with your current strategies in teaching science? (Circle the number on the scale below which reflects your satisfaction.)

   Highly Satisfied 5 4 3 2 1 Not Satisfied

5. To what degree are <u>consumable</u> supplies regularly purchased by your school for student use in science? (Circle a number on the scale below.)

   All are Purchased 5 4 3 2 1 None are Purchased

6. To what degree are <u>non-consumable</u> science supplies available in sufficient quantity for student use? (Circle a number on the scale below.)

   All are Available 5 4 3 2 1 None are Available

7. To what degree do you agree with this statement: "All students can learn science."

   Strongly Agree 5 4 3 2 1 Strongly Disagree

8. To what degree are parents involved in your science program?

   Highly Involved 5 4 3 2 1 Not Involved

9. To what degree do you perceive science to be valued in your school?

   Highly Valued 5 4 3 2 1 Not Valued

10. How do you evaluate your students' performance in science? (Check all that apply.)
   a. Textbook tests _______
   b. Teacher-developed tests _______
   c. Teacher observation _______
   d. Portfolios _______
   e. Journals/Learning Logs _______
   f. Performance Tasks _______
   g. Checklists _______
   h. Anecdotal Records _______
   i. Other (please list) ____

____

11. What do you feel are your own strengths and weaknesses in teaching science?(Circle the number on each scale which reflects the degree of strength or weakness.)

	Strength				Weakness
a. Background knowledge	5	4	3	2	1
b. Conducting demonstrations	5	4	3	2	1
c. Facilitating hands on activities	5	4	3	2	1
d. Assessing student learning	5	4	3	2	1
e. Enthusiasm for subject	5	4	3	2	1
f. Making connections to real life	5	4	3	2	1
g. Using computers	5	4	3	2	1

12. Which of the following statements best describes science in your classroom? (Check one.)
   _____ Integrated with other subjects
   _____ Taught separately
   _____ Other (please specify) ____

13. How available are computers for science instruction?
   _____ Not available
   _____ Available but difficult to access
   _____ Available within the classroom (How many? _____________)

14. Certain factors may affect instruction. Please rate the adequacy of each of the following factors for teaching science in your school by checking the appropriate column.

	Excellent	Good	Satisfactory	Unsatisfactory	Not Applicable
a. Space for students to work	______	______	______	______	______
b. Space for storage	______	______	______	______	______
c. Individual planning time	______	______	______	______	______
d. Collaborative planning time	______	______	______	______	______
e. Class size	______	______	______	______	______
f. Class time	______	______	______	______	______
g. Equipment	______	______	______	______	______
h. Consumables	______	______	______	______	______
i. Administrative support	______	______	______	______	______
j. Teacher comfort level	______	______	______	______	______
k. Reading skills of students	______	______	______	______	______

15. What informal science learning environments did your students experience as part of your science program this school year? (Check all that apply.)

_____ Business/Industry
_____ Discovery Museum
_____ Milwaukee Public Museum
_____ Other (please list) ____________________
_____ Zoo
_____ Park
_____ Nature Center

16. Circle the number on each scale below which reflects your feeling about teaching science:

a.	Enjoyable	5	4	3	2	1	Not Enjoyable
b.	Exciting	5	4	3	2	1	Boring
c.	Satisfying	5	4	3	2	1	Frustrating
d.	Rewarding	5	4	3	2	1	Unfulfilling
e.	Comfortable	5	4	3	2	1	Stressful

17. Within the last three years, about how many hours of staff development in science have you participated in?

18. List below the factors which you feel are major obstacles to teaching science effectively.

19. What grade level(s) do you teach? ____________________

20. What position do you currently hold? ____________________

21. How many years have you been teaching? ____________________

22. Indicate the highest degree you have earned:

_____ BS/BA
_____ MS/MA
_____ BS/BA+16
_____ MS/MA+16
_____ Doctorate
_____ BS/BA+32
_____ MS/MA+32

23. Indicate your sex: _____ Female _____ Male

24. Indicate your ethnicity/race:

_____ African-American
_____ Asian
_____ Native-American
_____ Hispanic
_____ Caucasian
_____ Other (please specify) ____________________

Thank you for completing this survey. Your contribution to this effort is greatly appreciated.

APPENDIX D
FOCUS GROUP PARTICIPANTS

Essie Allen, United Way
Fran Bartley, GE Medical
Linda Bell, Milwaukee
Walter Brame, Urban League
Charles Causier, HNTB Corporation
Felmers Chaney, NAACP
Tyrone Dumas, City of Milwaukee
Miquel de Jesús, Milwaukee
Edith Finlayson, Greater Milwaukee Education Trust
Beverly Greenberg, Warner Cable
Daniel Grego, NOVA, Shalom High School
Mary Glass, Milwaukee
Lori Hammond, Milwaukee
Delorse Harrington, Private Industry Council
Kate Huston, Milwaukee Library
Laverne Jackson-Harvey
Jon Jensen, Marquette University
Rolf Johnson, Milwaukee Museum
Caroline Joyce, JASON Project
Pam Krajenka, Milwaukee
Vanessa Kuehner, Milwaukee
Carol Miller, Health Education Center
Jane Moore, Milwaukee Foundation
Steve O'Connell, Milwaukee Spectrum, Inc.
Jeffrey Osborne, Wisconsin Medical College
Judy Pokròp, Milwaukee School of Engineering
Mary Quilling, Department of Public Instruction
Annie Rheams, Marquette School of Education
David Riemer, Mayor's Office
Thelma Sias, Wisconsin Gas Company
Linda Simmons, Cardinal Stritch College
Joyce Staten, Milwaukee
Al Stenstrup, Department of Natural Resources
Debbie Stewart, Center for Education Research
Fran Swigart, Future Milwaukee
Edith Adekle Wilson, Milwaukee
Walter Zoller, Parents' Legislative Network

Appendix E

Focus Group Question Guides

COMMUNITY FOCUS GROUP QUESTIONS

The Current Situation

- In the areas of mathematics and science, what are the current challenges facing our society, students, and the workforce?
- What do you need and want in your incoming workforce (skills, abilities, values)?
- What's positive in this view? What are the gaps between what is needed and what is happening now?

The Future—Breaking Out of Old Paradigms

- What could schools do differently to better equip students and our entry workforce in the areas of mathematics and science? What changes could be made in these areas to benefit students and the community at large?
- What might the transformed mathematics/science learning environment look like?

Focus on Collaboration

The Milwaukee Urban Systemic Initiative has a basic assumption underlying it's efforts—that the involvement of the greater community in planning, supporting, and participating in the mathematics and science education process is essential to the success of the community.

- How can all the parts of Milwaukee's educational system—community, teachers, parents, administrators—collaborate to sustain quality mathematics, science, and technology education for all of Milwaukee's students?
- A goal of the initiative is to promote reciprocity (benefiting both the schools and the community). Considering new paradigms, what might this reciprocity look like?

Communicating the Vision

- How can these changes be communicated throughout the community?
- How can the community be prepared for these changes?
- How can positive support be promoted for these changes?

PARENT FOCUS GROUP QUESTIONS

Parent Involvement in the Schools

- How comfortable are you in your child's school? How comfortable do you feel other parents are?
- What kinds of communication do you experience between parents and school?
- Do you see connections between the school and the rest of the community?
- How do you feel about teachers preparation to teach mathematics and science?
- What is your knowledge of the mathematics and science curricula being taught in you child's school?

Instruction

- What does a good science class or mathematics class look like?
- How familiar are you with the various reforms in education here in Milwaukee, such as integrated curriculum, authentic and alternative assessment, cooperative learning?
- What are some experiences you have had in your children's mathematics and science education?
- How do you feel about student shadowing and apprenticeships in industry and business?

Attitudes and Satisfaction with Own Mathematics and Science Abilities

- How comfortable are parents with helping their children with mathematics and science homework?
- How do you think parents feel about their own abilities with technology?
- What do you envision as your role in mathematics/science/technology education for your children?

Parent and Community Involvement

- What do you see as barriers to your involvement with your child's school and with the district in regard to mathematics and science education?
- What do you see as barriers to community involvement in mathematics and science education?

Changes in the Schools and in the Community

- What are some ideas on how your vision of mathematics and science education can be realized in MPS?
- What changes will need to take place in the community to bring about systemic reform?
- How can the Urban Systemic Initiative communicate to parents to keep them informed on what is happening?