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ABSTRACT

The shortcomings in elementary and secondary mathematics and science education have been the focus of numerous national reports calling for educational reform. In response to the recommendations contained in those reports, a variety of actions on the part of state education agencies (SEA) resulted. This document reviews the results of a project designed to explore successful approaches to major issues in the field, promote the participation of women and minority males into all mathematics and science initiatives, and promote exemplary action by selected SEAs, while encouraging other SEAs to adapt and adopt such actions. The major portion of this report addresses state actions aimed at integrating equity and excellence concerns through: (1) data collection; (2) teacher improvements; (3) curricular improvements; (4) enrollment; (5) policy; and (6) collaboration and information sharings. Included in the appendix are descriptions of selected model programs used by states. (TW)

Equity and Excellence

A Dual Thrust in Mathematics and Science Education

Model State Education Agency Efforts

Council of Chief State School Officers
Resource Center on Educational Equity

Council of Chief State School Officers
Resource Center on Educational Equity

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Project Advisory Committee on Mathematics and Science Education

assistance to SEAs in implementing plans growing out of the Institute's activities. Teams from the states of Iowa, Kentucky, Massachusetts, Minnesota, Montana, New Jersey, New York, North Carolina, Ohio, and Washington participated in the Institute.

A continuation grant for 1985 and 1986 built upon the previous model but used a regional approach to tailor the activities to a wider range of states and policy concerns. In 1985 and 1986, three regional conferences were held: a western regional conference, June 2-5, 1985 in Seattle, Washington; a southern regional conference, October 27-30, 1985 in Raleigh, North Carolina; and a northern regional conference, April 6-9, 1986 in Columbus, Ohio. In total, 126 participants from 22 states participated in these conferences.

The shortcomings in elementary and secondary mathematics and science education were the focus of numerous national reports in 1983 calling for education reform. In response to the recommendations contained in these reports, a bevy of actions on the part of state education agencies (SEAs) resulted.

Parallel to these recommendations and subsequent actions were concerns about their potential effect on student groups already underrepresented and underserved through current mathematics and science education programs. Needed were mechanisms to ensure that reform would not adversely affect females, minorities and other underrepresented and underserved student populations, but would serve to enhance the quality and level of their participation.

The roles and responsibilities of SEAs uniquely position them to bring about the types of broad-based changes required to ensure excellence and equity in elementary and secondary mathematics and science education. With funding from the Carnegie Corporation of New York, the Resource Center on Educational Equity of the Council of Chief State School Officers developed and implemented a project designed to:

1. bring together teams of state education policymakers and program specialists with recognized experts in mathematics and science education to explore successful approaches to major issues in this field;
2. assist SEAs in integrating the concern for increasing the participation of women and minority males into all mathematics and science initiatives; and
3. promote exemplary action by selected SEAs while encouraging other SEAs to adapt and adopt such actions.

In 1985 and 1986 three regional conferences were held. Teams of policymakers from twenty-two states attended and formulated approaches for improving the quality of K-12 mathematics and science education and ensuring that the benefits of these improvments were targeted on underrepresented and underserved student populations.

As a result of the conferences and the following technical assistance and resources provided, the states involved have done much to meld excellence and equity in their mathematics and science initiatives.

Whether the goal was data collection, teacher or curriculum improvement, the key strategy used repeatedly by state teams was to integrate a concern for equity into an established SEA framework. Hence, to ensure that equitable outcomes for females and minorites was a focus and a concern of all mathematics and science-related activities in the state, it was often necessary to include wording to this effect:

- in the standards for school accreditation;
- in state law requiring multicultural, nonsexist approaches for instruction
- as a focus in human relations and inservice training;
- in new education reform efforts; and
- as a factor in data collection, assessment, and evaluation efforts.

Undergirding any effort to integrate excellence and equity in mathematics and science education is the need to provide appropriate funding and staffing. With available funds, SEAs have been able to support local programmatic efforts, initiate pilot projects, sponsor mini-grants for districts and postsecondary institutions to address particular inequities in public schools, sponsor inservice training and awareness-building workshops, and provide the staff needed to supervise and coordinate the general effort.

The CCSSO Carnegie-funded project to increase the capability of state education agencies to promote excellence and equity in mathematics and science education did much to increase and promote affirmative actions by SEAs. Many projects, services, and activities were initiated which can be directly attributed to the resources provided and networks established during the life of the project. New collaborations were forged among SEA equity, instruction, and other categorical program personnel and with organizations external to the SEA. Additionally, new capacities were developed which can be used by SEAs in fulfilling their roles and responsibilities of regulating, administering, and providing leadership to state education programs, in developing policies and programs, and in monitoring equity goals.

As state education policymakers set goals and plan activities to improve the quality of instruction in mathematics and science in the nation's schools, they must keep in mind the critical importance of directly addressing equity issues. Specifically, state education agencies can:

"The current system of education in the sciences and mathematics has failed minority, female, and disabled students as well as a large number of white males. More work needs to be done to test methods shown to be effective with minority, female, and handicapped students and other student populations poorly educated or motivated in science and mathematics." Shirley Malcom, American Association for the Advancement of Science, in *Equity and Excellence: Compatible Goals*, 1984, p. ix.

- develop a policy statement on the importance of efforts to improve student achievement in mathematics and science and refer specifically to efforts directed towards barriers facing females, minority males, and disabled students in these fields;
- collect and review data on mathematics and science enrollment and achievement patterns by sex, race, national origin, and disability in each school district, and on the composition of the present and emerging teacher pool;
- establish a State Task Force to assess issues related to student achievement in mathematics and science and instruct the group to specifically address issues related to the participation and achievement of underrepresented and underserved student groups;
- support research and disseminate projects that isolate and publicize the key components of school-based programs with demonstrated success in increasing the percentage of females and minority males in mathematics and science courses;
- provide training and materials related to increasing the enrollment of females and minority males in mathematics and science to local school district administrators, teachers and counselors;
- review and update state mathematics and science curricula guidelines to reflect a heightened awareness of gender, racial, and ethnic stereotyping in these areas; and
- regularly evaluate and monitor the success of state efforts to increase participation of underrepresented and underserved student groups.

As a group, American high school students take substantially less coursework in mathematics and science than students in developed countries such as West Germany, Japan, and the U.S.S.R. Average enrollments in high school science have actually declined from levels of 20 years ago. And though the number of mathematics courses taken has increased by a semester in the last decade, this is essentially due to increased enrollment in general and remedial mathematics and in computer courses (Raizen and Jones, 1985).

By the year 2000, a greater proportion of employment and career opportunities will require higher levels of technological training—training that has its roots in an early, solid foundation of mathematics and science instruction. The participation and success of Americans in mathematics and science education is important not only for the United States' position in the world scientific and technological community but also to assure an educated populace for our future. Despite the overwhelming and demonstrated need, many Americans continue to be semi-literate in mathematics and science knowledge.

International comparisons coupled with concern that the future United States workforce was not being prepared to meet our country's scientific and technological labor market needs fueled demands for improvements in the educational system. Issues of mathematics and science education improvement figured prominently in this discussion and resulted in specific recommendations such as:

- the adoption by state education agencies (SEAs) and local education agencies (LEAs) of sets of prescribed courses for high school graduation—three years of mathematics, three of science, and one-half year of computer science (National Commission on Excellence in Education, April 1983);
- emphasis on quantitative and logical reasoning skills needed for improved worker production (Business-Higher Education Forum, 1983);
- new pedagogical approaches and a redefined core curriculum inclusive of specific science, technology, and mathematics sequences (Boyer, 1983);
- a focus on basic mathematics and science literacy and a strengthened curriculum supportive of that goal (Twentieth Century Fund, 1983); and
- the need to revamp K-12 mathematics, science, and technology curricula to incorporate appropriate practical issues and to foster traditional basic skills (National Science Board, 1983).

Parallel to these recommendations were concerns about the potential effect of these reforms on student groups already underrepresented and underserved through current mathematics and science education programs.

Females and minorities, with the exception of Asian/Pacific Americans, are underrepresented in mathematics and science education and careers. Disparities in participation are reflected in performance at various points in the school continuum and later in the career options for which students prepare and become ultimate practitioners.

For the most part gender differences in mathematics achievement can be traced to differences in the number of mathematics courses taken by girls and boys in high school. Even among college-bound students, males enroll in a greater number of mathematics courses than females though the gap has narrowed in recent years. Thus for females, encouragement and support for electing advanced mathematics and science courses is important.

In the last ten years, the progress of women in science and mathematics fields has been encouraging and reflects the impact of education legislation and societal efforts to promote equitable outcomes for females. The number of science and mathematics degrees earned by females at all levels has increased, but still falls short of the percentage earned by males. It is important to note that within the hopeful trends evidenced for females generally, it is difficult to assess the status of minority females.

"The goal is to make girls independent problemsolvers and to carefuly monitor classrooms for subtle biases in teacher-student interactions." Martha Myers, Ohio State University, at the CCSSO Northern Regional Conference, Columbus, Ohio, "Achieving Quality Through Equity," April 7, 1986.

Despite recent progress in closing the gap, differences in student participation by racial and ethnic groups persist. Disparities exist in the average number of years of secondary school mathematics and science courses taken by and in the quality and content of courses available to racial and ethnic student groups. The quality of the elementary and secondary education experienced directly bears on the availability of and participation in courses requisite to later success in quantitative-based courses and careers.

Racial and linguistic minorites disproportionately attend inadequate school facilities characterized by frequent shortages of adequately trained and/or certified mathematics and science teachers. They are overrepresented in general and vocational education programs and underrepresented in

academic/college-bound programs. They often have limited access to microcomputers and teachers trained in the use of technology, and where these technologies are available, their use is characterized by drill and practice not programming. Misuse of standardized tests, ability grouping, and tracking have often served to limit options open to many minority students.

Removing the barriers to greater participation and achievement in mathematics and science for all females and minorities will require the concerted efforts of teachers, counselors, curriculum specialists, parents, and policymakers. Of importance is the type of classroom, academic, and career training provided and engaged in by students and whether these represent quality experiences which are sex, race, and ethnically fair, i.e., consider linguistic and cultural differences and do not exhibit gender stereotyping. Other considerations concern student counseling, the availability of role models, and the level of encouragement accorded students in achieving proficiency in mathematics and science and preparing for mathematics and science-based careers.

Clearly, if the national need for an increase in the number of technically-trained workers and scientifically literate citizens is to be met, specific efforts must be made to address the factors contributing to the under-representation of females and minority males in scientific and mathematical fields. It is an issue of demographics as well as question of equity—females are one-half of the population and minorities comprise a disproportionate share of the nations's youth.

"Only when I begin to see males and females, blacks, Hispanics, Native Americans, and Orientals having achievement in mathematics that is not affected by what subpopulation they belong will equity be achieved." Elizabeth Fennema, University of Wisconsin, Madison at the CCSSO Leadership Institute, "A Dual Thrust in Mathematics and Science Education," Princeton, New Jersey, April 10, 1984.

Any effort to achieve equity in mathematics and science education must consider issues of student opportunity, access, participation, and performance Opportunity and access are antecedent and necessary to participation, and participation is requisite to performance. The potential and capability for ensuring these prerequisites firmly reside within the roles and responsibilities of state education agencies (SEAs).

Although specific details differ from state-to-state, the state education agencies are generally responsible for regulating and administering state education programs, and providing leadership for the improvement of education at the state and local levels. Included among leadership activities are: identifying the long-range education needs at the local and state levels, directing and financing educational research, conducting and supporting experimentation and innovation, providing consultative services in the solution of problems in local education programs, and disseminating methods, procedures, and practices essential for successful local efforts. SEAs also sponsor cooperative programs with colleges and universities, local education agencies, and task forces organized to implement new programs. Most SEAs provide not only resources for the inservice education of their own staff, but also for inservice activities at the local and regional levels.

To date, many states have risen to the challenge of addressing inequities in education. These efforts have resulted in the implementation of equity laws, constitutional provisions, and programs which, in some cases, are more far-reaching than existing federal mandates. Additionally, every state funds some programs for children with extra educational needs. Building on this foundation, effort is now being directed toward developing and expanding comprehensive approaches, eliminating inequities and reaching the goal of equitable educational outcomes for *all* students.

The approach, presently being stressed by the CCSSO Resource Center on Educational Equity and already a reality in many states, involves integration of equity concerns into all SEA activities (e.g., content/program, technical assistance, curriculum development, assessment and evaluation, and data collection). A coordinated and integrated approach is necesssary to achieve the equity goals of opportunity, access, participation, and successful performance

in mathematics and science. Equitable participation and performance in mathematics and science programs cannot be assured by focusing on the classroom alone, but will require the combined efforts of a variety of players including state and local policymakers, practitioners, teacher trainers, researchers, and equity specialists.

State education agencies are in a unique position to effect the systemwide change necessary to address the multiple components of the current crisis in mathematics and science education because they are:

- the legal entity with responsibility for the supervision of public elementary and secondary education throughout the state;
- a critical link between local school districts and institutions of higher education; and
- a principal force shaping the state's teacher preservice and inservice training programs.

Given the functions of SEAs, ample room and opportunity exist for providing the type of leverage and oversight needed to: facilitate improvement and change in mathematics and science curricula; enhance the quality of teaching in those fields; and increase the enrollment and achievement of students, particularly females and minority males, in related courses.

This publication describes the actions of the project states to integrate equity concerns into mathematics and science education reform initiatives. Detailed are some of the approaches and resources used by the states. They are presented to illustrate not only the range of approaches but also to serve as models for other states to adopt or adapt as they consider their own responses to the needs of student populations underrepresented or underserved in these important subject areas.

"We should recall that in the present instance the traditional hurdle, i.e., denial of access, has been scaled. Equality of opportunity is no longer an issue. . . The issue has become equality of outcome; and equality of outcome has proven to be a much more difficult concept at emotional, intellectual, and even legal levels. Nonetheless, such an achievement is obligatory" Luther S. Williams, Atlanta University, at the CCSSO Southern Regional Conference, "Achieving Quality Through Equity," Raleigh, North Carolina, October 27, 1985.

In addressing the dual goals of equity and excellence in mathematics and science education, project states employed a variety of approaches. These approaches illustrate the range of activities SEAs can initiate in promoting quality and equitable public education. Following are descriptions of activities implemented in selected states which participated in the 1984 Leadership Institute or the regional conferences.

Teams of policymakers from participating states developed a variety of goals and inititated numerous activities. Many of these goals and activities are described below. They are summarized and categorized as they pertain to: data collection, teacher improvements, curriculum improvements, enrollment, policy and collaboration/information sharing.

Data Collection

Information gathering and reporting for the purposes of evaluating and assessing inequities of participation and educational progress were starting points for many states. SEAs were interested in knowing who is enrolled in and/or teaching upper level mathematics, science, and computer science courses.

Student course enrollment data by sex, race, and disability are important factors in determining which student groups are and are not representative participants in the courses which serve as critical filters to science and mathematics-based careers. For some states it was important to analyze these data on a district-by-district basis in order to monitor existing and potential equity problems and to better target technical assistance and other activities for remedying the problems. Where this information was not available, prescribed systems for collecting and reporting data were often developed.

Preliminary to data collection on students and teachers, it was often necessary to determine what data were currently collected by the SEA and other agencies. This activity helped define additional data needs or refinements for recommended data collection procedures.

Other data collection efforts centered on reviewing and summarizing current state policies, laws, procedures, or other information relative to equity,

mathematics and science education, and targeted groups such as females, blacks, Hispanics, Native Americans, and the disabled. States used this information to support and give impetus to proposed policy initiatives and to better coordinate existing ones.

Other data collection efforts involved the identification of local, regional, and national resources which could be coordinated and better used, or implemented to address the identified equity concern. In some instances this meant surveying postsecondary institutions, minority and women organizations, and other divisions within the SEA to determine available programs, projects, and activities, and ways of coordinating these resources.

Among the specific data collection approaches and stategies used by state teams:

- **Colorado** proposed surveying high schools to determine the ethnic/gender composition of students and teachers in advanced mathematics, science, and computer classes. The team also proposed examining current data sources in the Department to determine what data were collected which answered equity-related questions, and to develop a uniform system for efficiently and effectively using the data. This process was also viewed as an opportunity to increase awareness of mathematics and science equity concerns throughout the Department.
- **Michigan** planned a survey of information currently collected in the Department pertaining to the mathematics and science participation and achievement of students at all levels. Michigan sought data not only supporting racial/ethnic patterns and sex differences or similarities, but also data on patterns of participation and achievment of students with different types of impairments or handicaps. Additionally, the Michigan team proposed collecting information on existing state policies pertaining to targeted groups (women, blacks, Hispanics, Native Americans, and the handicapped), and using this information to shape recommendations for needed policy changes.
- **Georgia** had not resolved the issue of who comprised the "underserved" and therefore proposed to refine the definition of the underserved by seeking supporting data.
- In addition to gathering enrollment data, **Colorado, Oregon,** and **Maine** planned to collect informaion on promising model local and national mathematics and science equity programs for dissemination to the local education agencies during inservice training sessions. The team from

Maine planned to combine their data collection activity with efforts within the Department to meet the data collection requirements of the EESA Title II grant program. (The Education for Economic Security Act, P.L. 98-377, is a federal program which provides funds to states to improve teachers' skill and instruction in mathematics, science, computer learning, and foreign languages. Provision is also made for efforts to serve underrepresented and underserved student populations.)

To provide for quality mathematics and science education and to determine if inequities exist in the mathematics and science teacher pool, some states gathered information on the composition of the teaching staff by sex, race, certification status, and subject area. Efforts were also made to determine characteristics of students in teacher education programs. Collecting this information was important for developing programs for retraining educators certified in other fields to teach mathematics and science, for encouraging females and minority males to participate in retraining models, and for encouraging a greater number of females and minority males to complete mathematics and science teacher education programs.

- Kentucky looked at field-test data on the National Teacher Examination (NTE), a prerequisite to teacher certification, which indicated poorer performance by minority and disadvantaged college students than nonminority students. This information led to SEA activities designed to impact the performance rate and assure representative participation in the teacher pool.

Approximately half of the project states proposing data collection activities reported success in meeting this goal.

- Kentucky collected information on mathematics and science teachers by sex, race, and course title. Also, data were collected on student enrollment in advanced mathematics and science courses.
- Idaho has data on teachers by sex and race but not student enrollment by sex and race. The sex equity and data collection units are working to identify mechanisms for gathering these data.
- In collaboration with Title IV equity specialists, the team from Delaware collected and published course enrollment data.
- Maryland completed its data collection activities and presented its findings at a meeting of state mathematics and science supervisors and Title IX sex equity coordinators. The team compiled a sampling of current mathematics

and science equity programs in the state and a listing of equity materials suitable for use in teacher training programs.

- Since 1985 the Iowa SEA has collected data annually on secondary enrollments in mathematics and science courses by sex, race, and disability. The availability of this data allows Department of Public Instruction and local personnel to monitor existing and potential equity problems.

Once identified and assessed as to applicability and utility, information collected was often disseminated via SEA publications, professional organization newsletters, and public newspapers. In this manner, SEA informational resources provided leadership to LEAs, concerned citizens, as well as to the State Department of Education to boost related activities such as workshops, conferences, proposals, and technical assistance.

- Washington developed and disseminated a publication entitled, "Excellence and Access in Mathematics and Science: Minority Involvement for the '80's— A Report on Achievement Levels, College Aspirations, and High School Course Enrollment for Selected Racial Groups." The publication provided a framework for examining questions for equity and access across the state.

Teacher Improvements

To provide leadership in strengthening academic programs and assuring equity, states devised approaches for improving the content knowledge and classroom methodologies of teachers as well as increasing teachers' awareness of equity concerns. Strategies included increasing the mathematics and science requirements for elementary teacher certification and revising content requirements of certification standards to include equity topics and methodologies for accommodating a variety of learning styles.

Most goals were broad in scope and centered on efforts to improve the quality of mathematics and science instruction at the elementary, middle, and high school levels. Among specific aspects or areas of mathematics and science teacher education identified for improvement:

- Tennessee wanted to stress teaching strategies which reinforce equitable mathematics and science outcomes.
- Idaho planned to address the issue of students' mathematics avoidance through teacher inservice training efforts.

- **Ohio** articulated the need for colleges of education to develop mechanisms to prepare future teachers to understand equity issues, use intervention strategies to assure equitable outcomes, and incorporate concepts related to test construction including the development of bias-free items. Ohio also sought to review and revise certification standards not only for teachers but for supervisors and couselors as well.
- **Kentucky** revised teacher certification requirements to parallel specific grade level curricula and emphasize mathematics and science requirements for teachers of the middle grades.
- **South Carolina** proposed the restructuring of content requirements for mathematics and science certification standards to include equity concepts, and higher order thinking skills. The plan also emphasized the need for teachers to accommodate a variety of student learning styles in their classroom methods.
- For **South Carolina,** the goals for mathematics and science equity would be strengthened by other education reform initiatives in the state such as the Program for Effective Teaching (PET), a training program for all instructional staff, as well as other staff development activities for teachers in areas of critical need (mathematics, science, computer education, and reading).
- **Georgia** planned to seek uniformity in mathematics and science preservice training among the state's teacher training institutions.
- **Michigan** was interested in raising the issue of underrepresentation of females and minorities in staff development activities for counselors, principals, and community decisionmakers.

Some states developed incentive loan programs to retrain teachers and alternative certification routes in order to increase the quality and the size of the pool of mathematics and science teachers.

- **Colorado** developed long-range goals for retraining educators certified in other fields and plans to encourage women and minority males to participate in mathematics and science teacher education and retraining programs.
- To ensure equitable representation in the teacher pool, **Kentucky** developed strategies to ensure representation of minorities in the state's loan

incentive programs; surveyed teacher education programs to assess student participation by race and sex; and initiated efforts to increase the performance rate of minorities on the NTE.

Training and technical assitance were frequent techniques employed to increase the content knowledge and awareness of education staff, parents, and community leaders. Inservice training models such as the EQUALS programs were often used as were conferences specifically designed by SEAs. (See Appendix for description of EQUALS and other model programs used by states.) Also, funds received under the EESA Program to improve teachers' skills and instuction in mathematics and science were crucial to the success of the inservice training efforts of many of the states.

- Delaware, Idaho, Maine, North Carolina, and Oregon conducted EQUALS workshops. North Carolina established an EQUALS Center in the Charlotte-Mecklenburg District which serves eight schools. In collaboration with Boise State University, Idaho offered credit-bearing EQUALS summer workshops to mathematics and science teachers.
- In Michigan, eight regional workshops were planned for teachers, administrators, counselors, and higher education personnel to develop an awareness of equity issues and to offer approaches to finding solutions.
- The Idaho mathematics consultant conducted a series of regional workshops for mathematics teachers on problemsolving skills.
- The team from Maryland conducted workshops on mathematics and science equity issues at the National Coalition for Sex Equity in Education Conference which took place in Washington, D.C. in July 1986. Also, in collaboration with the Mid-Atlantic Center for Race Equity, the team conducted a series of inservice projects during the 1985-86 school year.
- In South Carolina, the science consultant and the vocational education sex equity specialist pooled their resources to plan and conduct a workshop session on equity in science education at the 11th Annual South Carolina Science Council Conference. The conference is a statewide meeting of district science coordinators and science teachers.
- Maine sponsored a statewide inservice training workshop, COMETS (Career Oriented Modules to Explore Topics in Sciences) attended by 60 science teachers from 33 school districts. The purpose of the workshop

was to increase awareness of sexism which often exists in the methods and materials used in science teaching, to increase the participant's knowledge of the role of women in science, and to provide resources on nonsexist science teaching. Additionally, Maine coordinated a workshop session with the Northeast EQUALS Project at a mathematics conference held in Augusta. The activity was designed to promote improved understanding of attitudes toward mathematics and to promote equity in mathematics classrooms.

- North Carolina held COMETS workshops to train facilitators for statewide staff development. Additionally, regional coordinators were used as trainers for activities relating to COMETS, EQUALS, and SECME (Southern Consortium for Minorities in Engineering).

Improvements in Curricula

States proposed to change or modify existing mathematics and science curricula by placing more emphasis on mathematics and science (Vermont), encouraging the development of curricula that meets diverse student needs and backgrounds (Indiana, Michigan, and Pennsylvania), and by integrating equity concerns into mathematics, science, and computer education curricula (Oregon). Idaho planned a broad-based program with special emphasis at the elementary level. Consistent with the initiatives approved under its Education Improvement Act, the South Carolina team planned to present their concerns regarding the content of elementary science courses and general mathematics courses to the South Carolina Basic Skills Committee, a statewide education policymaking body.

Changes in curricula were often a direct result of the school reform efforts implemented in recent years. Statewide changes in mathematics and science curricula have taken place in South Carolina, Delaware, Colorado, Kentucky, North Carolina, and Tennessee among others and equity issues have been introduced through inservice training efforts (such as EQUALS workshops or the COMETS program). Tennessee has designed mathematics and science courses to meet the needs of both noncollege and college-bound students while satisfying state mandated increases in mathematics and science requirements. Several pilot projects to test the courses have been implemented in a number of schools.

In **Washington**, recommendations of mathematics and science curricula writing and review teams underscored the need for continued efforts to provide equal opportunies in science and mathematics education for every student. Goals reflecting this concern have been incorporated into *Guidelines for the Science Curriculum in Washington Schools.*

Enrollment

To raise awareness concerning the underrepresentation of females, **Delaware, Oregon,** and **Idaho** sponsored Expanding Your Horizons career awareness conferences for high school girls. These conferences are designed to promote interest in mathematics-based careers among junior and senior high school girls. In **Oregon,** approximately 800 girls attended the conferences. The sex equity coordinator in **Idaho** collaborated with the Title IV coordinator to hold four Expanding Your Horizons Conferences. A total of 1400 young women, 200 community women, 100 counselors, administrators, and teachers were in attendance.

The team from **Georgia,** in collaboration with the Georgia Board of Regents and the private sector, sponsored 15 Futurescape seminars. In addition to the goals described above for the Expanding Your Horizons Conference, the Futurescape seminars provide an opportunity for businesses and industry to present their concerns for education to the educators and students attending these conferences. The conferences were hosted by 13 colleges which provided facilities and personnel to assist in the planning and implementation of the conferences.

Family Math workshops were held in **Tennessee, Indiana, Idaho, Oregon,** and **Maine.** Family Math is designed to increase parental involvement in the child's mathematics experiences and create an awareness of the importance of mathematics for future careers. The **Indiana** workshops targeted students at the elementary level and their parents. In **Oregon,** 1400 parents and 1300 children were trained by Family Math educators. A member of the **Idaho** team collaborated wtih the director of the Chapter 1 (compensatory education) programs and sponsored Family Math workshops for teachers of Chapter 1 students. The planning committee from **Michigan** has recommended piloting a parent involvement project.

Delaware planned to expand the level of counseling services available to females and minorities at the local school level in an effort to increase enrollment in key mathematics and science courses.

Policy

Some states proposed actions with systemwide policy implications. These proposals were often broad in scope and called for the inclusion of equity considerations in the state education agency mission. Other states had in place state laws or policies supportive of the planned mathematics and science equity activities.

The **Iowa** plan for excellence and equity in mathematics and science education had as its foundation a 1977 state law requiring that all program areas including mathematics and science be taught from a multicultural, nonsexist approach. In response, all local education agencies adopted written plans, implemented by 1985, which included:

- goals and objectives with timelines for all program areas;
- evidence of systematic input from both sexes, diverse racial/cultural groups, and the handicapped;
- description of the inservice training planned for all staff members; and
- a strategy for monitoring and evaluating the plans.

Also in 1977-78, the State Board of Education approved rules requiring human relations training (inclusive of awareness of cross-cultural differences, sex role stereotyping, and ways in which awareness could be translated into positive learning experiences for children) for all students in preservice teacher education programs and for teachers renewing certificates.

The **Michigan** team developed a policy statement for adoption by the State Board of Education on equity and excellence in mathematics and science and a comprehensive plan to encourage female, minority, and disabled students to value and prepare for careers in these areas. **Colorado** proposed a similar mission statement. **Oregon** and **North Carolina** developed mechanisms for implementing the proposed policy initiative: **North Carolina**, through work with regional commissions on mathematics, science, and engineering; and **Oregon** by developing a Blue Ribbon Committee for Equity and Excellence in

Math, Science, and Computer Education. The Blue Ribbon Committee is responsible for developing a statewide Mathematics and Science Equity Plan for identifying strategies for implementing the Equity Plan. Committee members represent various levels of the Department as well as private and other public sector officials.

To maximize the success of a mathematics and science sex equity initiative, the Montana team implemented plans designed to ensure continuity and involvement at all levels of the educational system. Basic to implementation of the plan was the inclusion of equity standards and procedures in school accreditation requirements.

In response to a Department request that each division submit non-monetary school improvement initiatives, the Indiana team submitted their recommendations for state level mathematics and science initiatives. In Georgia, representatives from the state team have been working with the state colleges to establish uniformity in the preservice training of mathematics and science teachers.

Collaboration/Information Sharing

State teams collaborated and coordinated at a variety of levels both within and external to the SEA to carry out their equity goals.

- Delaware collaborated with Title IV equal educational opportunity specialists to collect and publish course enrollment data. In Idaho, important linkages between the sex equity and data collection units were established.
- Other intra-SEA collaborations such as those between the science and vocational education/sex equity divsions (South Carolina) and among compensatory education (Chapter 1), equal educational opportunity (Title IV), and EESA programs (Idaho) resulted in expanded resources and training efforts targeted on specific teacher and student populations.
- Other intra-SEA collaborations have resulted in the development of joint proposals and projects which integrate equity concerns into mathematics and science education efforts (Montana) and policies which require a focus on mathematics and science equity concerns in all SEA activites such as workshops, conferences, proposals, and technical assistance (Colorado).
- Maine and Vermont were interested in establishing stronger linkages with the LEAs. Vermont's team sought to expand opportunities for females and

rural students in science, technology, and mathematics programs by training local school leaders as "seeders" to raise awareness and provide information in their schools and districts. Maine proposed to strengthen collaborations among Department personnel such as affirmative action officers, science, mathematics, and ESOL consultants, and with state associations of science, mathematics, universities and colleges, and local school districts. These collaborations were for the purpose of developing models of community and industry support for equity issues related to excellence, leadership, and curricula.

- The science specialist in **Oregon** has strengthened the collaboration among the SEA, the Native American Science Association, and the university system with a project designed to increase the number of Native American mathematics and science teachers.
- **Michigan** proposed establishing partnerships with professional organizations, business and industry, universities, parents, and museums for the purpose of developing a pool of new resources, expanding ownership of problems and solutions, and increasing activities which include equity considerations.

Other states, however, used established partnerships in implementing their goals. This often involved coordinating inservice training workshops and student conferences with colleges and universities (**North Carolina, Georgia,** and **Idaho**), and working with statewide commissions, networks, business committees, and science, mathematics, and other professional associations (**Iowa, North Carolina, South Carolina, Maryland,** and **Oregon**) to identify and integrate equity goals into the ongoing activities of these groups.

For example, the **North Carolina** team collaborated with the North Carolina Commission on Minorities in Science, Mathematics, and Engineering in implementing statewide conferences on equity concerns and a pre-MESA program. MESA (Mathematics, Engineering, Science Achievement) is designed to encourage underrepresented minorities to acquire the necessary academic skills to pursue careers in the mathematics and science-related professions. The State Department of Education also worked closely with the North Carolina Mathematics and Science Network through their pre-college program which targets middle school level females and minorities in an effort to increase student participation in upper level mathematics and

science courses. The Network is a statewide consortium of nine teacher-training centers and a research center designed to develop a cooperative university and public school effort to improve mathematics and science education in public schools.

Beyond coordinating inservice training workshops, states also planned to identify mathematics and science model projects and disseminate the information to the LEAs (Maryland and Colorado). The role of parents in the mathematics and science learning process was important to Iowa and Tennessee whose teams planned to involve parents and the community in the mathematics and science education process.

Conclusion

Improvements in curricular offerings and the quality of teaching, and increased enrollment of minorities and females in advanced mathematics and science courses were the goals of the state mathematics and science equity project. Plans encompassing these goals but tailored to the specific concerns and capabilities of the respective states were important outcomes many of which have been realized.

The state activities and approaches highlighted in this publication are provided as models for other states concerned with implementing equitable mathematics and science programs. Through participation in this effort states have expanded their capabilities and can serve as resources to other states. For this purpose, a list of state contacts is provided in the Appendix.

References

Boyer, E.L., 1983. "High School: A Report on Education in America." The Carnegie Foundation for the Advancement of Teaching. New York: Harper and Row.

Business-Higher Education Forum, April 1983. "America's Competitive Challenge: The Need for a National Response." Washington, D.C.

Malcom, S.M., 1984. *Equity and Excellence: Compatible Goals.* Washington, D.C.: American Association for the Advancement of Science, Publication 84-14.

National Commission on Excellence in Education, April 1983. *A Nation At Risk: The Imperative for Reform.* Washington, D.C.: U.S. Government Printing Office.

National Science Board Commission on Precollege Education in Mathematics, Science, and Technology, September 1983. *Educating Americans for the 21st Century.*

Twentieth Century Fund. *Making the Grade.* New York: 1983.

APPENDIX
Selected Model Programs Used By States

COMETS (Career Oriented Modules to Explore Topics in Science) is a science/sex equity model used to encourage early adolescents to develop a broad knowledge of science concepts, career options, role models, and a keen interest in the pursuit of science study. The model is designed for use in grades 5-9 and contains over 100 classroom activities. For more information contact: COMETS, The University of Kansas, 205 Bailey Hall, Lawrence, Kansas 66045, (913) 864-4435.

EQUALS. Since 1977, at the Lawrence Hall of Science, University of California-Berkeley, the EQUALS program has produced curriculum and developed courses for children and adults to promote the participation of young women and minorities in mathematics and to encourage their interest in mathematics-based fields of study and work. Following is a brief description of some of the major EQUALS programs components.

EQUALS Inservice. A staff development program for teachers, counselors, and administrators serving grades kindergarten through 12 to attract and retain females and minorities in mathematics. The 30-hour inservice program includes: methods and materials that develop strategies for solving problems in mathematics content areas; a variety of instructional techniques to improve student attitudes towards mathematics, and increase students' and teachers' awareness of career options in mathematics-based fields of study and work.

EQUALS in Technology. A computer education program to help educators develop a sense of mastery over the computer; assist them in evaluating the appropriate use of computers and calculators; enable them to integrate computers into the curriculum; and ensure that women and minority students have equal access to high quality computer education.

Family Math. A 12-hour training program geared to teaching parents how to motivate and help their children with mathematics at home. Materials are based on the school mathematics curriculum for grades K-8 and are designed to supplement the child's school work. Career seminars provide families with information about mathematics-based occupations

For more information contact: EQUALS, Lawrence Hall of Science, University of California, Berkeley, California 94270, (415) 642-1823.

Expanding Your Horizons is designed to promote the participation of women in mathematics and science. Each conference provides hands-on workshops where students take part in experiments and problemsolving activities. Participants meet women already working in the sciences, engineering, and the trades, and get first-hand information about future job possibilities.

All workshops are led by local women. Parents and educators are also invited to attend the conference.

For more information contact: The Math/Science Network, Math/Science Resource Center, Mills College, Oakland, California 94613, (415) 430-2230.

MESA (Mathematics, Engineering, Science Achievement) is designed to increase the number of underrepresented minorities in the mathematics, engineering, and physical science-related professions. The program goals include:

- encouraging students to acquire the academic skills they need to major in mathematics, engineering, and the physical sciences at the university;
- promoting career awareness so that participating students may learn of opportunities in the mathematics and science-related professions early enough to prepare for them;
- ensuring that secondary schools, university, industry, engineering societies, and others cooperate with MESA by offering volunteer time and other vital human/fiscal resources; and
- striving to institutionalize the educational enrichment activities that prepare minority group students for engineering and other mathematics-based careers.

Students selected must have expressed an interest in mathematics and science-related careers and must complete college-preparatory mathematics courses (trigonometry, chemistry, physics, and four years of English). Activities include: the MESA class which introduces students to different fields within engineering, a Summer Enrichment Program, Academic and Career Advising, and field trips.

For more information contact: Lawrence Hall of Science, University of California, Berkeley, California 94722, (415) 642-5064.

(SECME) Southeastern Consortium for Minorities in Engineering. Representatives of twenty-one engineering colleges in eight states work together as a team known as the Southeastern Consortium for Minorities in Engineering (SECME). Begun in 1976, SECME is the largest of the National Association of Pre-College Directors' (NAPD) programs, serving thousands of students in Alabama, Georgia, Florida, Mississippi, South Carolina, North Carolina, Tennessee.

Engineering college faculty help nearby school systems develop local SECME projects designed to increase the number of underrepresented minorities in the engineering profession. Secondary school administrators who have the authority to implement new programs work with teachers from appropriate subject disciplines to design a project which meets local needs as well as SECME goals. All projects contain three major components:

- a plan for enriching and supporting mathematics, science, and language arts curriculum;
- an engineering guidance program
- a method for utilizing community resources such as local industry, professional, and parent groups.

Each newly funded school system sends at least two representatives to the SECME Summer Institute, where teachers and counselors are given an overview of engineering as a profession and an awareness of the opportunities for minorities in engineering. They are introduced to curriculum enrichment materials and make plans with engineering faculty coordinators on the operation of their local projects for the coming school year.

For more information contact: SECME, Georgia Institute of Technology, Atlanta, Georgia 30332, (404) 894-3314.

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