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ABSTRACT

The current push for reform in mathematics and science education cannot succeed unless it addresses the critical and persistent issue of equity. This executive summary reviews the literature regarding that issue. Its purpose is to provide a reference tool for those who are working to change educational policy and practice. Part 1 of the review discusses the importance of equity--the moral, social, and economic imperatives for assuring educational success for all students. This section also describes the multiple meanings of the term equity as it is used in the educational literature. Part 2 explores a range of equity issues, from the structure and financing of schools to teacher training, expectations, and classroom practice. Part 3 describes educational strategies designed to broaden student success. The conclusions in Part 4 call for a transformation in the structures of U.S. schooling. While this executive summary follows the general outline of the full text, some subsections have been collapsed or resequenced for the sake of brevity. (Author/JRH)

Executive Summary

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Southwest Educational Development Laboratory
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Funded by The Dwight D. Eisenhower Program
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By Mary Jo Powell
Edited by Martha Boethel

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A project of the Southwest Consortium for the Improvement of Mathematics and Science Teaching (SCIMAST) of the Southwest Educational Development Laboratory (SEDL)

The Southwest Consortium for the Improvement of Mathematics and Science Teaching (SCIMAST) is one of ten Eisenhower Mathematics and Science Regional Consortia established by the U. S. Department of Education. SCIMAST supports systemic reform through a variety of activities and services: by offering and supporting professional development, by helping states develop a vision of mathematics and science education, and by encouraging the use of appropriate instructional materials, methods, and assessments that support educational reform. SCIMAST activities are grounded in the belief that systemic reform requires support from all educational stakeholders and that the critical voice in reform is that of teachers.

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Executive Summary

Equity in the Reform of Mathematics and Science Education

OVERVIEW

The current push for reform in mathematics and science education cannot succeed unless it addresses the critical and persistent issue of equity. This paper reviews the literature regarding that issue; its purpose is to provide a reference tool for those who are working to change educational policy and practice.

Part 1 of the review discusses the importance of equity — the moral, social, and economic imperatives for assuring educational success for all students. This section also describes the multiple meanings of the term *equity* as it is used in the educational literature. **Part 2** explores a range of equity issues, from the structure and financing of schools to teachers' training, expectations, and classroom practice. **Part 3** describes educational strategies designed to broaden student success. The conclusions in **Part 4** call for a transformation in the structures of U.S. schooling. While this executive summary follows the general outline of the full text, some subsections have been collapsed or resequenced for brevity's sake.

Any literature review is limited by the material available. The literature on educational equity is both substantial and meager: We found a great deal of conceptual discussion and descriptions of experience, but limited empirical research, particularly regarding strategies in mathematics and science. We also found far more studies relating to female and to African-American students than to other student populations. In some instances writers used the categories of "minority" and "poor" students as equivalents, an error that compromises their conclusions. The broader literature of mathematics and science reform, which seeks to improve learning for *all* students, seems to address equity issues in promising ways; however it, too, lacks a substantial empirical research base. Finally, it should be noted that these limitations in the literature themselves constitute an equity issue.

PART 1:

What Is Equity?
Why Is It Important to Everyone?

Definitions of equity. Discussions of equity in mathematics and science education tend to focus on specific populations: women, African Americans, Hispanics, Native Americans, and speakers of nonstandard English or with limited English proficiency. Additional groups sometimes included are students in rural schools, in lower socioeconomic groups, and with different physical and mental abilities.

Regardless of the particular groups being addressed, people use the term "equity" to mean different things. The way the term is defined has great implications for the ways in which issues are examined and solutions are devised. Definitions in the literature include:

Equity as physical access. This definition is a common, traditional view of equity; it is essentially negative, requiring only that students not be prevented from gaining access to schools, class, media, or materials.

Equity as inclusion or capacity building. "Inclusion" is a term used by Neil (1992) to move beyond the mere opening of doors. Equity as inclusion involves not only access but transforming instructional content and approaches to address each student's individual interests and needs. Similarly, Payzant and Wolf (1993) see equity as "enabling" students; they use student outcomes as the measure of equity rather than "the simple arithmetic of inputs" such as the racial mix of a class or teaching staff. With this perspective, the focus is on assuring that each student acquires whatever educational tools she or he needs to succeed after graduation.

Equity as multiculturalism or diversity. Much of the literature reflects the belief that equity cannot exist without diversity — among teachers, students, curricula, and instructional approaches. However, people use the term "diversity" with multiple meanings. Both Hilliard and Banks (1991-1992) criticize narrow uses of the term, the token additions of multicultural materials or ideas; they emphasize the need to foster diversity in thought and belief. Their focus extends from specific multicultural content to a way of thinking that perceives knowledge as "constructed" by people and cultures and that encourages thoughtful examination of all ideas and beliefs.

Equity as special services. Some educators equate equity with special services for particular groups, for example children with disabilities or students from specific racial, ethnic, or socioeconomic groups. Such services range from special classes to mentoring projects to extracurricular offerings. The literature, however, makes clear that "special treatment" — tracking, for example — can be used to perpetuate inequities as well as to alleviate them.

SEDL's Southwest Consortium for the Improvement of Mathematics and Science Teaching, which sponsored the development of this literature review, defines equity in the most inclusive terms possible. From this perspective, equity means that each student will be addressed as an individual, with instructional opportunities, content, and approaches that meet his or her specific needs, strengths, and interests. All students will be engaged in meaningful learning, in a school environment that values differences and encourages students to participate actively in the learning process.

The imperatives for equity in mathematics and science education. As a number of sources have noted, mathematics and science education has been structured as a pipeline, designed to filter out the majority of students while channeling those who are perceived as most proficient into advanced classes, university programs, and careers. However, a number of forces have converged to render obsolete the traditional view that science and mathematics education is only for an elite few. In an increasingly complex, technological world, a system that emphasizes the production of physicists at the expense of a mathematically and scientifically literate "laity" is failing in major ways. More and more public policy decisions, from genetic engineering to medical research priorities to the protection of habitats, depend on a knowledgeable electorate. Most observers project that long-term changes in the work force will require skills and understandings for which most students are now unprepared. Finally, equity is a moral as well as a public policy and economic issue. Science and mathematics are culturally valuable components of knowledge that should be available to all.

PART 2:

Issues Involved in Equity

The structure of schooling. By its very structure, schooling denies some students opportunities in science and mathematics. The tracking system used in many schools, other structures influencing course access, and fiscal structures that determine a school's access to resources all affect student opportunities.

High track, low track. Students from minority groups are seven times more likely than white students to be identified as having low abilities and, thus, to be placed in low-track classes. Low-track classes spend more time on class routines and discipline and less time actively learning the subject matter. These classes offer more rote instruction and fewer opportunities to use critical and independent thinking skills; instruction is characterized as "oversimplified, repetitive, and fragmentized" (Oakes, 1990b, p. 89). Students who are shunted to low track courses are generally denied access to so-called gatekeeper courses, which prepare them for college-level mathematics and science classes.

Research indicates that high achievers do just as well in a mixed ability class as they do in a high track class, and that heterogeneous groups are more fruitful for teachers and students alike (Oakes, 1990b; NCTM, 1991). There appears to be no valid educational reason for tracking systems. Several educational observers have noted that tracking maintains and reproduces the existing class structure of U.S. society. Joseph Conforti (1992) links tracking to the cultural belief in American society as "a contest society"; whenever a contest is accepted as the basis of interaction, inequality is also accepted.

Access to courses for gifted students. Many schools offer separate classes or groupings within classes for gifted students. However, access is not proportionately distributed across the student population. Educators and parents tend to construct mental images of gifted students — images reflecting the characteristics of white, middle-class students — that can blind them to the actual abilities of children from minority, poor, and other underrepresented groups. For example, one Texas-based study indicates that Hispanic children who are identified as gifted tend to be more acculturated to mainstream U.S. culture than are other Hispanic children (*Education Week*, 26 May 1993). According to most of the literature, educators will more accurately identify gifted students if they move away from traditional criteria, such as standardized tests, and "use multiple assessment procedures, including objective and subjective data from a variety of sources" (Maker, 1989, p. 295). Educators should use culturally and linguistically appropriate assessments and more than one identifying source.

Access to special education. Enrollment in special education is disproportionately high for boys and for African-American and Hispanic students. In 1988, two-thirds of all students in such programs in the United States were male, in spite of the fact that medical reports of learning disabilities and attention-deficit disorders are almost equally divided between boys and girls. Mercer (cited by Mehan, 1992, p. 12) found that students who test the same on objective tests are often treated differentially; she found that "White, female, middle-class students who scored 80 or below were more likely to be retained in regular academic programs than were Black, male, lower-class students who scored the same on the IQ test."

Access to appropriate counseling and advising. The use of vocational-interest tests that have sex-specific norms may help to discourage female students from focusing on mathematics and science. These tests are used by counselors to advise students about courses and career choices. Counselors are more likely to inform a male who does well on such tests about engineering careers than they are to inform females in similar situations. Counselors also tend to steer students with disabilities away from science classes because they often believe the students cannot function in a laboratory. Students from minority and lower socio-economic groups often have less access to counselors; their schools usually have fewer counselors than schools with predominately white, middle-class student populations (Oakes, 1990a).

Resource inequities. Recent studies cast doubt on research conducted in the late 1970s and 1980s, which found that a school district's level of spending had little effect on educational results for each child. A reanalysis of the data used in this older research has led researchers to conclude that, while money may not answer all school problems, "we find that money *does* matter after all" (Hedges, Laine, & Greenwald, 1994, p. 13).

Wealthy school districts often have low tax rates and still spend a higher amount on each pupil than poorer districts with limited tax bases. In Texas, for example, in 1985-86 the 100 poorest districts had an average property tax rate of 74.5 cents and spent an average of $2,978 on each student. The 100 wealthiest districts, in contrast, had an average property tax rate of 47 cents and spent an average of $7,233 on each student (Mauzy, 1989).

Resource problems are often more basic than a need for calculators and balance scales. Many older schools and schools in low-income districts lack adequate electricity, roofs that hold out the rain, adequate sewage facilities, and other basic physical requirements. The use of technology in mathematics and science is not realistic for many inner city and rural schools. How, for example, can a classroom with two electrical outlets and no telephone lines run computers or use telecommunications technology?

Teacher expectations and behaviors. Teachers remain at the core of equity issues; teacher expectations and behaviors are a major influence on equity in U.S. schools. Teacher perceptions of students can be colored by cultural expectations, stereotypes, and inaccurate knowledge gleaned from previous experience. These perceptions and the ways in which teachers express and act upon them influence student learning.

Teachers' fears and expectations. Studies suggest that students' success or failure in the classroom can be strongly influenced by "teachers' beliefs, attitudes, behaviors, and perceptions" (Garibaldi, 1992, p. 31). Teachers often have a white middle-class student's behaviors and goals as their ideal of a good student (DeMott, in Holt, 1992). Teachers often assume that children who have not yet mastered English cannot be taught mathematics or science (Gibbons, 1992a). If a student does not speak English, speaks English in a nonstandard way, or comes from a culture with different behavioral patterns of interaction — such as those regarding eye contact, for example — a teacher may see that student as less capable or less receptive (Garibaldi, 1992; Irvine, 1992). Studies have found that teachers interact differently with students for whom they have higher expectations. For these students they offer more praise for correct answers and less criticism for incorrect answers (Brophy & Good, 1974). Oakes (1990a) reports that teacher expectations also affect the amount of material taught to a class or student.

Studies show that teachers, both female and male, accept cultural assumptions that girls are not interested in science. In all subjects, teachers tend to have lower expectations for girls than they do for boys. They tend to make eye contact with boys more frequently than with girls; in general they show more attention to boys. In their comments about boys' work, teachers tend to focus on the ideas and concepts contained in the work, while their comments about girls' work often center on its appearance (American Association of University Women, 1993).

Teacher education. Teacher education may actually do little to help teachers alter their behaviors and expectations. Most teacher education still neglects issues of equity; preservice classes that do cover these issues appear to do so poorly (Zimpher & Ashburn, 1992; Howie & Zimpher, 1989).

One study (McDiarmid, 1990) of multicultural teacher preservice education indicates that such training made no difference in teachers' rejection or acceptance of stereotypes; another study, however, showed the opposite result. McDiarmid suggests that the problem with training in the classes he studied was reliance on the lecture method. He proposes that multicultural training will be more effective if students interact with each other rather than listening passively to presenters. Similarly, the Holmes Group (1990, p. 37) believes that most mandated courses on multiculturalism "lack coherence, intellectual rigor, and opportunities for follow-up and reflection and practice."

One researcher (Grant, 1991) notes that when teachers do ask for help in understanding students from other cultures, they generally assume some form of deficit in those students. He argues that it is most important that teachers understand themselves, their beliefs and biases, and the processes by which they have absorbed their own cultures.

Many teachers of science and mathematics are not even adequately prepared in the subject matter they teach. This often leads them to become authoritarian in their teaching style (Trumbull, 1990). According to Cummins (1986) and others, instruction that is characterized by dialogue and teacher facilitation, rather than lecture, drill, and other highly structured, teacher-controlled work, is more conducive to success for poor, minority, and female students. Given teachers who are inadequately prepared to teach, students with little or no out-of-school, informal instruction in science and mathematics — frequently true of minority and female students — begin to develop disadvantages in relation to other students who have more out-of-class experience.

Teachers' culture. A number of researchers (summarized by Davis, 1990) have identified characteristics of a teachers' culture that appears to be international: Teachers share a belief in individualism that leads them to cultivate the abilities of individual students. Teachers share the belief that they lack control over their own work, that initiatives and orders come from the top down; this belief is reinforced in the classroom, where the teacher becomes the "top" and students the "down." Teachers also seem to share a "practicality ethic," constructing recipes for transmitting knowledge out of their practical daily experience and common sense. Innovations threaten this recipe, and any change must be viewed by teachers as **practical,** useful in their daily work, **congruent** with the way they work, and **cost-effective** in terms of the effort involved in making the changes.

Curriculum. In 1989 the editors of *Scientific Literacy* found "existing scientific curricula socially, culturally, and cognitively outdated" (Hurd, 1989, p. 21). Curriculum must reflect the state of knowledge in the content area and be relevant to students.

Standardized tests drive curriculum. A recent study (Romberg, Zarrinia, & Williams, 1989) found that most teachers of eighth-grade mathematics made their teaching decisions based on the content of the standardized tests their districts administered to its students. This circumstance is common in other subjects and other grade levels as well, even though standardized tests are generally not aligned with student needs (Chambers, 1993). While the goals of mathematics, as articulated by the National Council of Teachers of Mathematics, are to include higher order thinking and a knowledge of topics other than arithmetic, researchers found that in six widely used standardized tests, 11 percent of the mathematics test items were conceptual and 89 percent were procedural. More than 70 percent of the questions dealt with arithmetic (Romberg & Wilson, 1992).

Approaching a fair curriculum. Current efforts at curriculum reform in mathematics and science generally focus instructional activities on topics and concerns that affect students' daily lives, and that develop higher-order thinking skills and problem-solving abilities. There are, however, few guidelines for assuring that curricula address the needs of all students.

Gretchen Wilbur, a curriculum researcher, has found six attributes of a gender-fair curriculum: It **affirms variation** by showing similarities and differences among and within groups; it is **inclusive,** allowing both males and females to find positive messages about themselves; it is **accurate** in the information and data it presents; it is **affirmative** in acknowledging and valuing individual and group worth; it is representative in **balancing perspectives;** and it is **integrated** in presenting the experiences, needs, and interests of various groups. Wilbur can name no major curriculum reform effort to date, including the NCTM standards and Project 2061, that fulfills all six of these criteria (AAUW, 1992).

While Wilbur's criteria have relevance to more than gender equity, the literature surveyed for this review reveals no explicit criteria for a culture-fair curriculum, though many proposals at least implicitly aim in that direction. Without defining "at-risk," the National Center for

Improving Science Education (1989) suggests criteria for addressing the needs of at-risk students. NCISE recommends that curriculum focus on students' **immediate environment** in order to relate to their daily lives; use biography and history to emphasize that science is **not the "exclusive province of white males"**; use **out-of-school resources** such as zoos, hospitals, and museums; use **cooperative learning** approaches, which can "significantly affect the achievement level and social skills of poor and minority children"; and employ instruction based on **experience and inquiry** that is "informed by the knowledge that children from various cultures view the natural world differently and approach learning accordingly" (p. 46).

Less is more — sometimes. Many researchers believe that the interests of all students will be best served by a curriculum that covers fewer topics in greater depth rather than many subjects superficially. Advocates of a less-is-more curriculum argue that it will give students time to test their ideas and link their learning to real-world experiences. "Less is more" is not the same as the spare "dumbing-down" curriculum that is often foisted on students labeled at-risk or forced onto the low track. Students engage in fewer topics but actually learn much more, because what they learn is clustered around "major organizing concepts" (NCISE, 1989, p. 10). Rural and low-track students, however, are often faced with curriculum that is stripped down yet offers no emphasis on concepts or developing understanding. This narrow, spare curriculum emphasizes disconnected facts, without the organizing principles that help students to "develop the mental structures that make the factual information memorable and useful" (NCISE, 1989, pp. 4-5).

Instructional approaches. The traditional lecture-dominated mode of teaching science and mathematics does not hold the attention of many students, especially not the attention of those who perceive themselves as "unscientific" or "unmathematical" in their intellectual makeup. Changing instructional methods for all students is an indirect approach to equity issues, but research suggests that such changes will benefit poor, minority, and female students while also engaging the traditional high achievers in science and mathematics.

The disembodied learning of mathematics and science. Elementary school children are seldom taught the content of science; rather they are drilled in discrete facts and "disembodied skills" (NCISE, 1989, p. 2). Students are given "textbook science" that offers them neither enough time nor experience to connect facts with the natural world or to make sense of the principles that underlie the facts. When these children enter secondary school they are expected to apply the facts and terms they were taught and to "memorize as many new terms as are required in foreign language classes" (NCISE, 1989, p. 2). The same process occurs in mathematics. This emphasis on memorization of isolated facts and formulas discourages learning.

Those involved in major reform initiatives in mathematics and science — for example, the National Science Teachers Association and the National Council of Teachers of Mathematics — advocate that teachers reduce the amount of material being covered, presenting key scientific and mathematical concepts in appropriate sequences within the context of the problems and needs of daily life. Such approaches can have fruitful results for students who have traditionally been denied success in science and mathematics. However, if concepts are not embedded within the curriculum in ways that allow them to be expanded and deepened rather than merely revisited, the idea of teaching concepts will degenerate into "a curriculum that goes around in circles" (McKnight et al., 1990, p. 99).

The NSTA also recommends that science and mathematics instruction occur *not* within tracked classrooms but within a heterogeneous classroom. Students of different ability levels then can "exchange ideas and learn from each other" (NSTA, 1992, p. 15). Similarly the NCTM (1992a) argues against tracking students.

Mainstream teaching or alternative methods? Teaching in most classrooms today more closely resembles that of 50 years ago than it does any instruction envisioned by educational reformers. The process is teacher centered. Curriculum is supposed to proceed in linear fashion from simple basics to advanced material in an environment controlled by the teacher; the instructional repertoire concentrates on "teacher explanation and independent seatwork" (U.S. Department of Education, 1993, p. 59).

According to the U.S. Department of Education (1993), children from low-income districts who were engaged in alternative teaching practices that emphasize meaning and understanding — for example, cooperative learning, use of manipulatives, peer coaching — usually had a greater grasp of advanced skills at the end of the school year than did their peers in traditional classrooms. When low-achieving and high-achieving students from low-income districts are both involved in such alternative instructional methods, each group strengthens its grasp of advanced skills.

Constructivist learning. Constructivism presumes learning to be an active process in which each student creates rather than receives knowledge. By the time they start school, students have already "constructed" ideas about mathematical and scientific principles. By analyzing students' preconceived ideas and helping students to build from those ideas in meaningful ways, teachers can promote learning. From this perspective, teachers become facilitators of experiential learning rather than transmitters of knowledge. Students are encouraged to explore new ideas in ways that have meaning and relevance for their own lives, to test their theories and beliefs and to compare their results with those of other students.

Constructivism requires a change in many teachers' assumptions about how children learn. "If one subscribes to a constructivist view of learning, then the goal is no longer one of developing pedagogical strategies to help students receive or acquire mathematical knowledge, but rather to structure, monitor, and adjust activities for students to engage in" (Koehler & Grouws, 1992, p. 119). The constructivist classroom is interactional and social rather than structured and hierarchical. The social nature of constructivist learning often engages students who before felt isolated by the abstract nature of the subjects.

Cooperative learning. Research consistently finds that students of all ability levels benefit from cooperative learning. Johnson and Johnson (1987) found that for all age levels, subject areas within mathematics, and tasks, cooperative learning promoted higher achievement than did competitive classes, in which students were to complete problems faster and more accurately than other students, or individualistic classes, in which students were expected to reach a preset criterion. Cooperative learning also may increase the group identity of children and help them to feel a part of the school. However, cooperative learning does not consist merely of placing students into small groups and assigning each student a role, such as recorder or materials manager; it requires carefully structured activities that cannot succeed without meaningful input from every student in the group.

Learning styles. Asa Hilliard (1989, p. 67) defines learning style as the "consistency in the behavior of a person or a group that tends to be habitual — the manifestation of a predisposition to approach things in a characteristic way." Some research on learning styles suggests that teaching may be more efficient if it takes into account the different ways in which individuals approach learning. While some researchers argue that poor and minority-group students tend to have learning styles that are different from those of other children, Hilliard cautions that learning styles are not innate but learned. He also notes that learning style does not of itself explain lack of academic achievement among minority students; other systemic factors are more important.

Opportunity to learn. The concept of "opportunity to learn" is used to ascertain what teachers actually present in the classroom, comparing that presentation to the "intended curriculum," or what students are expected to learn, and the "attained curriculum," or what students actually do learn. Generally opportunity to learn is measured by surveying classroom teachers. Some researchers (Stevens & Grymes, 1993) believe that opportunity to learn involves equity issues because students who have not had access — whether in their homes or in their schools — to the skills and subject matter considered average for their grade levels cannot obtain average scores on norm-referenced tests. Low grades on such tests are then interpreted to mean that the students did not work hard or were not capable of learning the subject matter. Frequently, however, their poor performances on standardized tests may be the result of classroom instruction.

Assessment. Assessment could have important positive effects on equity, but as presently practiced it appears to have a negative effect. Assessment in the United States mainly uses standardized tests to judge students, their teachers, the administration of their schools, and the school districts themselves — despite the fact that standardized tests generally encourage rote memorization and that scores on these tests have a weak relation to actual learning.

The testing culture of schools. The National Center for Fair and Open Testing (cited by Zessoules & Gardner, 1991) estimates that each child in the U.S. takes three standardized tests each school year. While standardized tests may not be intended for comparing one child with another, that is the common use between students and, too often, among teachers, parents, and schools. For children the stakes are high, and those who score low on standardized tests are often publicly labeled as failures (Jervis, 1991).

A major problem with standardized tests is that the questions asked on the tests are proprietary secrets. In most areas of intellectual endeavor, a public and available literature reports, discusses, and debates findings (Schwartz, 1991). However, standardized tests are prepared and administered with no oversight from the community that will be most affected by the results. In the Netherlands, by contrast, the national mathematics tests consist of many extended problems that must be worked out in context. Tests are published after they have been used, and they become part of materials available for school use.

Authentic assessment. Concern about standardized tests has led to the development of "authentic assessments," which are based on students' entire performances rather than on individual tasks. Most current attempts at authentic assessment consist of portfolios and performance-based tests that use science or mathematics centers or stations with manipulatives, measuring devices, or other instruments. At these stations students manipulate objects to explore concepts and to demonstrate their understandings.

Assessment is integrally linked with instructional methods, ideas about how children learn and what constitutes ability, and conceptions of valid knowledge (Singh, 1987). Changing assessment approaches, then, requires rebuilding the classroom culture. According to Zessoules and Gardner (1991), a culture supporting authentic assessment would nurture complex understanding, develop reflective habits of mind, document the evolution of student understanding, and use assessment as an opportunity for learning rather than merely as a test. The mechanical nature of assessment as a task that begins when learning stops would be ended by incorporating assessment into teaching and learning.

Many observers believe that individualized authentic assessments will especially benefit female students and those from minority group or low socioeconomic backgrounds, but at present this belief has not been rigorously tested. One study has found that low-income kindergarten children performed addition and subtraction problems better on nonverbal formats than they did on any of three verbal formats (Jordan, Huttenlocher, & Levine, 1992). Interactive teaching, attention to cultural diversity, and an emphasis on conceptual and contextual thinking seem to be more amenable to authentic assessments than with traditional forms (NCTM, 1991).

Unless alternative assessments include a large number of tasks they may be poor indicators of student achievement. In deciding what a student knows or can do, "determining a student's abilities in a variety of situations is more important than obtaining a single score on a highly reliable test" (Webb, 1992, p. 668).

Different assessments for different students. Traditional assessments administered to groups of children are unlikely to identify gifted children who are poor readers or underachievers or students whose first language is not English. The ideal in such situations, according to Hooker (1993), is individual tests administered by people with experience with learning disabilities, bilingual children, underachievement, or reading problems. In the end, no single assessment is adequate for identifying "the multifaceted nature of giftedness" (p. 54).

The use of alternative assessments will particularly benefit students whose facility in English is limited, those who speak or write nonstandard English, and special education students. According to the authors of *Assessment Alternatives in Mathematics* (1989), students with limited English proficiency should be provided with translators; special education students should be given the opportunity to display their abilities through portfolios, performance tasks, and other assessments.

In addition to presenting tests in children's native language, alternative methods of presenting questions and assessment procedures include using manipulatives, videotaping, computer-based presentations, and teacher-taught introductions to performance tasks. Students can present responses by constructing objects, creating patterns on computer screens, or explaining solutions orally rather than in writing.

Alternative assessments in themselves cannot be treated as answers to equity problems. Unless such assessments are part of larger changes in schooling, they may actually be detrimental.

Culture inside and out of school. Many observers of education believe that problems in achieving equity are embodied in the very culture of schools and in the cultures of the larger society and the various groups within it. Attitudes toward mathematics and science — and those who pursue those fields — are part of our national culture. Race, ethnicity, gender, and class are categories laden with cultural beliefs and biases, often unconscious. To consider equity, then, is to wade into complex cultural waters.

Caste stratification and cultural inversion. John Ogbu (1978) has proposed that the poor school performance of many African-American children results from the American caste or racial stratification system. He defines a group as a *caste* if it is seen as "inherently inferior" by the majority and is stigmatized and excluded. Training and ability, he notes, will have no bearing on the roles society assigns to members of such a group. Ogbu holds that many African-American students have not succeeded in school because they see that, historically, effort expended in schoolwork has not benefited African Americans. An example bearing out his argument is the fact that, in the early 1980s, high school dropouts from wealthy white New York neighborhoods were more likely to be employed than were high school graduates from poor black neighborhoods (Tobier, 1984).

In a 1990 update of his views Ogbu added that involuntary minorities — groups whose ancestors did not voluntarily migrate to what is now the U.S. but who were either already here or were brought here against their wills — often practice "cultural inversion." In this process, members of the minority cultures, in order to survive as a cultural group, reject symbols, events, and behaviors that are characteristic of the dominant culture. Such survival techniques, developed over long periods, may be difficult to change, even if members of the majority culture begin to change their beliefs and behaviors. His ideas are supported by Fordham (1993), who did an anthropological field study in a Washington, D.C. high school. She identified a force she calls "fictive kinship" among African-American students, which she says symbolizes peoplehood in opposition to the prevailing white society. Fictive kinship, she holds, leads students instead to see their own chances of success as linked with the chances of their peers and their community. Fordham (quoted by Schmidt, 1993, p. 14) says of this peer pressure, "I never believed it would be so pervasive and so pronounced, and so academically stifling."

Students' competing worlds. Phelan, Davidson, and Hanh (1991) have developed a generic model of the interrelationships among a student's family, peer, and school worlds. These worlds are congruent for some students; in these situations all transitions between these worlds will be smooth. For other students, however, these worlds are not congruent. For some students the worlds are totally impenetrable and no crossings can be made. The research of Foster (reported by Mehan, 1992) has found that classroom participation among African-American students increases when teachers use language and participation structures that are congruent with those of the students' homes.

While mainstream education is teacher-centered and emphasizes continual evaluation of right and wrong answers from the student, socialization in most Native American and Hispanic cultures emphasizes cooperation and peer relationships. Native American children often will not answer a question until all other children in the class are ready to answer, are uncomfortable in situations that require them to interact with adults rather than other children, and may "have great difficulty with direct questioning techniques employed in most school situations" (Charbonneau & John-Steiner, 1988, p. 92). These cultural preferences may carry over into other situations, such as teacher-parent conferences, in which direct questions seldom reveal the actual thinking of the parents.

The U.S. Department of Education (1991, p. 16) has found that "schools that adjust their curriculum to accommodate the variety of cultures served are more successful than schools that do not." Respect does not merely involve incorporating famous names and ethnic holidays into the classroom, but creating a match between the meanings, processes, and behaviors encouraged by schools and those valued within the student's culture. "A widening of the range of acceptable meanings is a signal by the school that it accepts cultural diversity as a real, normal, and permanent feature of society" (González, 1993, p. 259). González believes that such changes cannot be made through materials or the adoption of new district policies, but only through classroom activity: "The change that is needed is chiefly in the professional behavior of school personnel" (p. 260).

The importance of language. Language may be another key, for "the language providing the greatest potential for intellectual development is the language reinforced in both the school and the home" (U.S. Department of Education, 1991, p. 16). Much research indicates that performance in mathematics improves when students are instructed in their first language. When Hispanics who were Spanish dominant received mathematics instruction in Spanish, their performance equaled that of non-Hispanics. Student errors increased, however, when the language of performance and the dominant language were not the same (Cocking & Chipman, 1988, p. 35).

Nonremedial culture-based teaching. T.L. McCarthy and colleagues (1991, p. 43) have warned that research into the differences among ethnic learning styles and cultural preferences should not be used to justify "remedial, nonacademic and nonchallenging curricula" for students from minority groups. Teachers who have been trained to expect that certain types of children will be passive or will not ask questions may never give those children an opportunity to engage in "active, open-ended discussion" (p. 54). If teachers have only a shallow understanding of their students' cultures and then use that partial understanding to form or reinforce stereotyped ideas about learning styles, their simplifications will result in a pedagogy that debilitates children.

Female students and cultural expectations. Social conditioning and stereotypes about both science and women help to keep young women away from mathematics and science. Mexican-American parents studied by MacCorquodale (1988) tended to stress the importance of education for all their children, but also were more likely than Anglo parents to discourage girls from pursuing nontraditional careers. A 1987 study by Campbell and Connolly indicated that parents supported European-American girls in avoiding mathematics and science; Asian-American parents, however, did not practice this "over-protective" behavior. Bernice Sandler has found that in the general U.S. culture scientific or mathematical success by men is attributed to talent while women's success is attributed to luck or hard work (both studies cited in *Dwight D. Eisenhower Mathematics and Science Education Newsletter,* 1993).

Religion and the scientific culture. Phelan, Davidson, and Hanh (1991, p. 232) point out that for many students the "family world may be dominated by an all-encompassing religious doctrine in which values and beliefs are often contrary to those found in school and peer worlds." In the U.S. official conflict between students' religious worlds and school worlds often focuses on the teaching of evolution in the public schools. The use of science to obtain control of the physical environment is often threatening to traditional Native American tribal beliefs; among Native Americans who have totem animals, dissection of that animal or handling of its bones also may be unacceptable (Caduto & Bruchac, 1988). Other religious groups will have still different philosophies regarding the natural world, and science teachers must deal with these views in the classroom. If teachers "teach the truth of their disciplines," can they also "respect the beliefs and values of students and their parents"? (Garcia, 1991, p. 57).

The creation of at-risk students. The label of "at-risk student" is applied to a student who is "at risk" of not doing well or staying in school because of various social, economic, and psychological factors. Equity concerns necessarily involve this concept since many students who do not do well in school and who come from poor or ethnic minority backgrounds end up with this label.

The concept *at risk* is borrowed from epidemiology, the study of patterns of disease distribution and the factors affecting those patterns. The job of the epidemiologist is to identify people in the greatest risk categories. Two limitations must be observed in using the term in medicine: First, when a population is labeled, the condition for which they are at risk must always be identified. Second, being at risk is a relative concept, since everyone may be at risk for a condition, such as heart disease, to a greater or lesser degree. However, when the concept is used in education these two limitations are often ignored. When the model is moved into education, identification of students based on social characteristics becomes not only inexact but controversial (Richardson et al., 1989).

Social constructivist model of at risk. Richardson and her colleagues (1989) have devised an alternative model of at-risk factors based on social constructivist thought rather than medicine. In this interactive model, the student who is at risk, the reasons for this labeling, and the responses of school personnel are all seen as constructed within the culture of the classroom and the school. In this model the focus is not on the child alone, but on interaction within a series of contexts.

Teachers' lack of understanding about the way their own perceptions and behaviors shape the identification process can lead them to assign all causes of at-risk behavior to students' home life and family members. Teachers work from their own ideas of what a "good" family is — an ideal that has much in common with their construction of the ideal student. While such approaches may result in inaccurate labeling of children as at risk, or of homes as deleterious to their children's learning abilities, they also may deprive other students of needed attention. Children whose behaviors fit within the teacher's classroom expectations may not be recognized as being at risk and may never receive the help they need. For example, a 1986 dissertation (Goldenberg, cited in Richardson et al., 1989) found that Hispanic girls generally are not diagnosed as having learning problems because they are skilled at covering up such problems.

Instructional strategies for at-risk student. Richardson and her colleagues (1989) found that when students fall behind in their studies, remediation is more successful if it accelerates the pace of instruction rather than slows it down. Although this idea appears to be counter-intuitive, slowing down of instruction generally breaks the material into pieces that are so small they become boring and meaningless. As instruction is slowed, the gap between the student and the rest of the class becomes wider, expectations are reduced even further, and mechanics are emphasized over substance. Merely accelerating the traditional curriculum, however, is not the solution; presenting material in new, challenging, and meaningful contexts is essential. Pull-out programs, which are often used as a remediation strategy, often create more problems than they solve. The most insidious problem of pull-out programs is that they relieve the classroom teacher and the school from making systemic changes that can benefit all students (Richardson et al., 1989).

PART 3:

Strategies for Achieving Equity

In schools, university research projects, and public arenas across the country various strategies have been tried in an attempt to equalize opportunities for educational success for all students. Some strategies have been tested using rigorous research methods; others have been recounted in impressionistic reports of what some educators perceive to be working in the classroom. Strategies targeted to specific populations and those aimed at improving instruction for all students have been tried.

Strategies and programs specifically targeted to female students. Some data suggest that female students may learn science and mathematics best in an all-female environment. Emphasis on hands-on work and cooperative learning also seems to attract more female students to science; several successful programs for young women use mentoring strategies.

Hands-on classroom work. In a study of eight fourth-grade classrooms in Boston, researchers found that boys and girls appear to benefit from hands-on methods of science instruction, and that girls perform as well as boys when classroom instruction emphasizes active learning (Dalton et al., 1993). The practice of using same-sex pairs also may have improved performance; girls who worked in same-sex pairs were more active in class discussion than they had been previously.

Young women from the fourth through tenth grade are targeted by the EQUALS Teacher Education Program, developed by the Lawrence Hall of Science. Female students are introduced to the language and tools of science, mathematics, and technology. Students then design several construction projects. Where the EQUALS program has been in effect for two or more years, the interest of young women in advanced mathematics classes has increased slowly but steadily (Lawrence Hall of Science, 1982).

The University of Michigan sponsors two hands-on summer programs to interest precollege girls in science. In Summerscience for Girls, eighth-graders come to campus for two weeks, attend seminars, and participate in projects in specific disciplines. In Science for Life, high school girls intern in the laboratories of women scientists for six weeks; interns work on their own research projects and participate in a symposium at the end of the program (Travis, 1993). A similar program is Careers in Engineering for Women, held at The University of Texas at Austin. The program brings seventh and eighth graders to campus for two one-week summer sessions; they complete laboratory activities that are designed to develop mathematics, science, observational, problem-solving, and critical thinking skills (TEA, 1993).

Extracurricular activities. Many programs aimed at female students use extracurricular activities to supplement traditional classroom instruction. These activities tend to emphasize learning in a same-sex environment. Several programs are targeted to the junior high years, since many observers believe this to be a crucial period when young women begin to feel pressured to hide their intelligence and allow boys to better them in the classroom (Travis, 1993). Information on extracurricular programs is anecdotal.

A fourth-grade girls' science club in Boston emphasized hands-on work during camping trips, field trips, and other activities. The club competed in the seventh annual battle of LEGO robots sponsored by MIT; the girls placed well in a field that included college students and teams from high-technology firms in the area. Traditional extracurricular organizations, such as Girls Incorporated and the Girl Scouts, also have begun programs that encourage science activities among their members. Girls Incorporated offers Operation SMART, a hands-on and mentoring project for elementary and junior high girls; a survey of the girls in one urban club found that their occupational goals had changed from secretary, nurse, and teacher to scientist and engineer (Travis, 1993). The Girl Scouts offer Girls and Science, another hands-on and mentoring project developed by the American Association for the Advancement of Science. In participating troops, the number of science-related merit badges the girls earned increased by 57 percent.

Strategies targeted to students from minority groups. Experience suggests that role models and mentors for African Americans, Hispanics, and Native Americans help to counteract the low expectations of authority figures in the schools. Cooperative learning in small study groups, emphasis on challenging work, good study habits, culturally relevant materials, peer support groups, and involvement with the student's family and community are features of several programs. Most of the programs emphasize building support for students with academic interests; these programs use study groups, clubs, other peer-age groups, and mentoring to foster interest and ability in mathematics and science. Several programs, rather than focusing on innovative teaching methods, emphasize preparing students to cope with existing structures, such as standardized tests, that might filter them out from a college education. Information on classroom results is sketchy and often involves students' improvement on standardized tests.

Mentoring. A nationally recognized program, the Incubator Scientist Program, identifies promising young people from minority groups in St. Louis schools. Students attend a five-week summer academy, then choose a research topic and are assigned a mentor who works in area industries. In the second year, students participate in another workshop, continue work on their research projects, and become mentors to the next crop of ISP students. Out of the program's first group of 11 students, 10 attended college (Allen, 1993).

The Texas Alliance for Minorities in Engineering also offers summer enrichment and tutoring programs and assigns mentors from industry to work with each student. Mentors tutor students, advise them about career choices, and help them find summer employment. Between 1976, when the program began, and 1991, minority enrollment in engineering programs in Texas increased by 55 percent (TAME, n.d.).

Group studying. The Mathematics, Engineering, Science Achievement program, which operates in New Mexico and California, emphasizes study groups and academic advising. It offers enrichment programs, career counseling, scholarships, and family involvement programs for secondary school students and workshops, orientation, summer jobs and other aids for college-legel students (Gibbons, 1992b).

Academic enrichment. The Texas Prefreshman Engineering Program identifies high-achieving middle and high school students from sixth through eleventh grade. These students attend eight-week mathematics-based academic enrichment programs, held in the summer on college campuses. Students may participate for up to three years. While the program is open to any high-achieving student, female students and students from minority groups are specially targeted. Of the former TexPREP participants who responded to a 1992 survey, 74 percent of the science and engineering majors were from minority groups (TexPREP, 1993; Berriozabal, 1992).

Test preparation. Several programs try to ensure that average students from minority groups stay in school, take more science and mathematics courses, and eventually obtain a postsecondary education. Venture in Education began with high school students in Brooklyn, Harlem, and rural Alabama and now includes 39 schools across the country. VIE sets specific high school course requirements for participating students, who also attend summer academic programs and SAT preparation classes. Minority VIE graduates tend to enroll and major in science disciplines to a greater extent than do the general population of minority students (Gibbons, 1992b).

Partnership to Improve Minority Education, administered by Arizona State University, has developed strategies that reached 22 high schools and 60 elementary and middle schools in 1992. Algebridge, a PRIME program, teaches junior high students to achieve well on traditional assessments. In one community, the average mathematics scores on the eighth-grade Iowa Test of Basic Skills moved from the 29th to the 48th percentile after one year of the program. PRIME also offers a 25-hour course in test-taking skills to familiarize students with college entrance examinations and test-taking strategies; it trains teachers in teaching advanced placement courses, and offers enriched science and mathematics activities to schools.

Teacher development. Another approach to nurturing educational success for minority students is to focus on training their teachers. A Texas program, the Minority Mathematics and Science Education Cooperative, offers elementary school teachers training to increase their conceptual knowledge of mathematics, earth or life science, and physical science; their teaching practices; and their knowledge of their students' cultures. MMSEC uses an annual institute, with nine-month sessions based in the individual schools, and annual summer courses to provide teachers with in-depth training and follow-up. The program, which targets schools in which a majority of students come from minority groups and low-income families, uses a training-of-trainers approach and works with schools over a four-year period (Texas Higher Education Coordinating Board, n.d.).

Strategies targeted to specific language groups. Students with limited English proficiency appear to benefit from programs that use collaborative learning and hands-on activities. Improvement in science and mathematics learning can have positive effects on other domains as well.

The Program for Complex Instruction at Stanford University has developed science activities for younger children, primarily from low-income, Spanish-speaking families. Working in small groups, the children perform science tasks related to everyday life. Researchers found that students improved not only in their scientific and mathematical abilities but also in their ability to read and speak English (Gibbons, 1992a). The program has now published a curriculum and added material for middle-school grades (Larson, 1993-94). Language is also an important part of the approach to science and mathematics education in Kids Investigating and Discovering Science, a program based in Irvine, California (Gibbons, 1992a).

Staff at the Hawthorne School have devised mathematics lessons that also focus on the language patterns of speakers of Black English Vernacular. The object of the lessons is to force students to push the limits of their own language and then to use new language tools to open new areas of thought (Orr, 1989, p. 211).

Maker and her colleagues at the University of Arizona have developed a series of problem-solving tasks to identify gifted students whose potential may be hidden by their limited English proficiency. Others also have developed similar tests. Raven's Progressive Matrices is a nonverbal test that calls on children to solve problems using abstract figures and designs. A test developed by Edward DeAvila uses cartoon-like illustrations; it is used as a preliminary screening device for young children (*Education Week*, 26 May 1993).

Strategies targeted to rural students. Few programs are particularly aimed at children in rural schools, though rural schools can be among the most neglected and poor schools in the country. Most projects focus on teacher training.

In Texas the Rural Elementary Science Improvement Project emphasizes workshops for rural teachers, offering two-week summer programs and day-long workshops throughout the school year (Texas Governor's Office, 1991). In Oklahoma a program jointly funded by the University of Tulsa, the National Science Foundation, and cooperating school districts sponsors workshops to strengthen rural teachers' understanding of basic physics and chemistry; the program introduces them to hands-on methods to increase their confidence and enjoyment of science (SCIMAST, 1993). Since 1990 the Northwest Regional Educational Laboratory has administered the Science and Mathematics Academy for Rural Teachers, a two-week regional academy (*Dwight D. Eisenhower Mathematics and Science Education Newsletter*, 1993).

The Indiana-based Project SPRING looks for gifted students among Appalachian children in the southern part of the state. Students in the program complete projects, such as designing a dwelling for the night, that tap different kinds of intelligences and use rural knowledge (*Education Daily*, 13 May 1993).

Remote learning technologies offer some rural schools access to a more challenging curriculum. Since 1987, Oklahoma State University has sponsored a program that uses live instruction via satellite to bring advanced placement chemistry classes to small rural schools in the state. The program attempts to preserve as many of the benefits of live teaching as possible; students can question the video instructor and respond to instructor questions (SCIMAST, 1993).

Reaching all children with reform in mathematics and science education. Children come to school with an informal, home-based understanding of the natural world and of numbers. Once in school they must try to connect this informal learning with the formal contexts of the classroom. Ginsburg and Russell (1981) have pointed out that all children enter school with backgrounds that enable them to cope with these systems; it is traditional schooling that changes this disposition. Schools must help students to make connections between their informal learning and the classroom; many observers believe that this can best be accomplished through programs that affect all children, programs that go beyond textbooks to emphasize experiential learning that draws from the communities in which children live (Charbonneau & John-Steiner, 1988).

Developers of a number of widely publicized programs believe that transforming science and mathematics teaching for all students is the best way to improve the academic performance of traditionally under-represented groups. The drive to establish standards in mathematics and science, national programs such as Project 2061, Scope, Sequence, and Coordination, and Equity 2000, and state and regional efforts at "systemic" reforms are all targeted to entire student populations rather than to specific groups. All are relatively new and have little to report as yet regarding effects on student achievement.

The standards movement. In 1989 the National Council of Teachers of Mathematics released the first major document in the recent movement for "standards" in education. The NCTM standards emphasize heterogeneous classrooms, active learning, collaborative student work, and an in-depth focus on major topics and concepts. With extensive input from teachers across the country, NCTM has developed a detailed series of publications outlining standards for student knowledge and skills, teacher behaviors, and assessment, as well as supporting documents describing learning sequences and activities that address the standards (NCTM, 1989; 1992; 1992a). The National Research Council is working to produce a similar set of standards in science (NCESA, 1993a).

Some observers express concern about the standards movement, from funding issues to the mechanics of their implementation to equity issues (Brown & Borko, 1992; Apple, 1992).

National reform projects. Project 2061, sponsored by the American Association for the Advancement of Science, and Scope, Sequence and Coordination (SS&C), sponsored by the National Science Teachers Association, are two major national projects that share many similarities. Both propose alternatives to the traditional structure and content of science courses, and both advocate depth of coverage rather than the teaching of isolated science facts. Each program has sites scattered throughout the country that are developing and testing approaches. Equity 2000, sponsored by the College Board in six school districts across the country, is a program aimed at increasing enrollment in algebra classes. The program restructures mathematics programs to eliminate tracking and works to change the attitudes of teachers and counselors regarding students' capacity to learn algebra. The work of the National Center for Research in Mathematical Sciences Education focuses on general restructuring of mathematics.

Regional, state, and local efforts. Several states have developed models of systemic reform. South Carolina, for example, has adopted goals and supporting mechanisms focused on gains in graduation rates, standardized test scores, and college entrance rates; increases in academic courses taken; and greater teacher satisfaction, among others (Clune, 1991). Roots and Wings is a state-level school restructuring program in Maryland, designed with participation by researchers from Johns Hopkins University. An integrated, thematic approach to science education, the program makes each school a family development center that provides federal, state and local services to families in need as well as providing new educational approaches for students (*Education Week*, 4 August 1993).

The National Science Foundation is funding Statewide Systemic Initiatives in 25 states, with the idea that mathematics and science education can be improved for all children only if isolated reform efforts are replaced by reforms that affect the entire educational system (SRI, 1993). The NSF has left a great deal of latitude for states in implementing their reforms, and different states have followed divergent paths.

Local school districts and individual schools throughout the country also are developing their own initiatives to improve mathematics and science education. Their focus includes assessment; creation of magnet schools; changes in instructional approaches such as interactive teaching, cognitively guided instruction, and a focus on cultural contexts; and uses of technology.

Efforts to achieve equity in school financing. All states — except Hawaii, where the state fully funds all education — finance their public education systems through some combination of state and local tax revenues (Walker & Kirby, 1988). In recent decades this finance structure has been challenged in the courts and legislatures of several states. For example, Texas has been dealing with the equity of school financing for more than 20 years; consolidation has emerged as the best solution for both courts and legislature, although it has many problems, mainly political, too. Michigan has taken the more radical step of banning property taxes as a method for funding public schools beginning in January 1994. Some U.S. senators have suggested creating a federal fund to help states equalize the imbalance between rich and poor districts; other public figures have suggested a federal value-added tax to aid education.

Many states are turning to lotteries and various forms of legalized gambling to solve financial problems. As supports for education, however, these carry some grave problems; in practice, lottery money does not supplement regular school funding but supplants it.

Court cases since the 1960s have established a body of legal principles regarding educational finance equity. Two standards of equity have emerged. **Expenditure equity** requires that districts spend similar amounts on each pupil; **fiscal neutrality** requires district expenditures to be independent of district wealth.

PART 4:

Conclusions

To achieve equity in science and mathematics education, the structure of U.S. schooling will have to be transformed. Such a transformation will involve more than changes in classroom configurations or funding distribution; it will have to involve "a structural change in the ways in which. . . voices are incorporated" into the classroom (Wallace, 1994, p. 186). It will have to involve valuing differences while inviting all to share in the whole (McLaren, 1994). This whole, however, will not be the "harmonious whole" of the melting pot, but rather a "difficult whole" that accommodates varying and sometimes contradictory realities within its totality (Murphy, 1991, p. 126). Equity can be achieved only if all voices are valued and subjected to the same processes of critique and investigation.

If instruction is to be transformed, science and mathematics teachers will have to move from their positions in the center of the classroom to allow children to investigate with their own tools. Students and teacher will together critique their ideas and methods and arrive at findings. Hands-on, collaborative, and constructivist methods will help children to use their natural interests in the world around them to create new understandings of mathematics and science. To achieve equity in the classroom, teachers will have to be self-aware — to acknowledge their conceptions of students and cultures and to understand the shape culture has given to their own learning. In the final analysis, the true transformation of education will arise from classroom respect for individuals and the learning that is being offered.

Educators will need to take care not to make new approaches as unthinking and stereotypical as traditional ones. If, for example, students spend their time making Jell-O molds of dinosaurs and everyone calls the result "hands-on science," no improvement over the lecture system will have been realized. If teachers deal with children in stereotypical ways in the name of cultural diversity, inequities will continue.

Inequities in schools are a reflection of inequities in the larger society. If attempts at achieving equity in science and mathematics education are not part of strategies "to eradicate the uneven impact of privilege and oppression" in education and in society at large, they cannot fully succeed (Hilliard, 1988, p. 42). For Hilliard, "it is politics, not pedagogy, that prevents school people from doing their best with all pupils" (pp. 42-43).

Schools cannot solve the problems of society on their own, but schools are an integral part of any answer that will work. And no matter what society at large does, schools must critically rethink and transform their purpose within that society.

The table of contents of the complete version of *Equity in the Reform of Mathematics and Science Education* follows. Copies of the complete version may be obtained from SEDL. Write to SCIMAST, Southwest Educational Development Laboratory, 211 East Seventh St., Austin, Texas 78701 or call (512) 476-6861.

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