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Mathematics for All Students

Access, Excellence, and Equity

Lucille Croom

DURING the 1980s, numerous national reports documented the underachievement in mathematics of students in American schools. The general sentiment shared by most of these reports was a call for change. In 1989, the National Council of Teachers of Mathematics (NCTM) published its *Curriculum and Evaluation Standards,* which included a new vision for mathematics education. The underlying assumption on which this new vision was based is that changes and improvements in teaching and learning will afford every child equal access to a substantive mathematics education. As NCTM (1989, p. 4) concludes:

> The social injustices of past schooling practices can no longer be tolerated.... Mathematics has become a critical filter for employment and full participation in our society. We cannot afford to have the majority of our population mathematically illiterate: Equity has become an economic necessity.

A proliferation of research documents the lack of achievement in mathematics by disproportionate numbers of African American, Hispanic, Native American, and female students (National Research Council [NRC] 1990, 1989; Secada 1992; Oakes 1990).

As we approach the next century, the mathematics education community is making dramatic changes in curriculum, instruction, and assessment. These changes are the principal components of a concerted effort to create equitable and high-quality learning opportunities for all students, including those groups whose achievement has been impeded because of social injustices in school practices and policies. Both minorities and females must be provided an equal opportunity to acquire the mathematical literacy essential for employment, leadership positions, and social and economic advancement in an increasingly technological society (Oakes 1990). The economic and scientific viability of this nation is influenced by the extent to which all students are empowered with the quantitative literacy required for full participation in today's society (NRC 1989).

A VIEW TOWARD EQUITY

The workforce of the future will be expected to deal with the complexities of the workplace through teamwork, logical reasoning, and the use of problem-solving skills. Underachievement in mathematics must not represent the norm for the majority of students in American schools (NRC 1989). According to Secada (1990), "students from diverse backgrounds are not well served in the mathematics that they are taught" (p. 354). This article examines the critical changes needed in curriculum, pedagogy, policies, and beliefs to promote equity in mathematics education for all students in the nation's schools. Equity in mathematics education implies fairness, justice, and equality for all students so that they may achieve their full potential, regardless of race, ethnicity, gender, or socioeconomic status.

The mathematics education community must help parents and the larger community understand how implementing the *Standards* promotes equity for all students. Furthermore, the general public must know about the new directions currently under way in school mathematics designed to increase students' achievement. The National Research Council (1989, p. 14) warns that if not corrected, innumeracy and illiteracy will increase the likelihood of the United States

> becoming a divided nation in which knowledge of mathematics supports a productive, technologically powerful elite while a dependent, semiliterate majority, disproportionately Hispanic and Black, find economic and political power beyond reach.

Policymakers, administrators, teachers, researchers, parents, and students themselves must not only verbalize but actually believe that it is possible to instill quantitative literacy in every student in the nation's schools.

CULTURAL DIVERSITY IN THE CLASSROOM

Providing student populations that differ in culture, race, gender, and socioeconomic background with an equitable learning environment must become a high priority. In 1990, Steen reported that more than 50 percent of the students enrolled in twenty-three of the twenty-five largest public school systems were minority (p. 130). Demographic trends indicate that by the turn of the century the majority of those persons entering the workforce will be female or from an ethnic-minority group and that half of the students in our nation's schools will come from non-European-American backgrounds (Hodgkinson 1994, 1988).

Beginning in elementary school, policies that track students into low-level classes on the basis of their perceived abilities serve only to diminish students' opportunities to learn and develop higher-order thinking skills (Oakes 1986). The inequitable practice of tracking students affects minority and economically disadvantaged students adversely (Jones 1993; Oakes 1985). As Jones (1993, p. 1) reminds us,

> if we eliminate tracking and create a level playing field—and then provide the support system for *all* students—then all students can succeed.

Students' achievement in mathematics is related to high expectations for educational attainment. Schools and teachers must implement research-based strategies that increase achievement and access, thereby enabling every student to develop mathematical power. Black and Hispanic students' achievement in mathematics in elementary school lags behind that of white children (Dossey et al. 1988). A disproportionate number of students from underrepresented groups drop out of mathematics. Encouragement by teachers, guidance counselors, and parents is essential if African American, Hispanic, Native American, and female students are to remain in mathematics throughout their school experience.

PROMOTING GENDER EQUITY

An increasing number of educators, researchers, and social critics assert that girls and minorities have been shortchanged in school, receive less encouragement, and have fewer opportunities to learn challenging mathematics and science than white males (American Association of University Women [AAUW] 1992; Oakes 1990; National Research Council 1989; National Science Foundation [NSF] 1994). In recent studies, researchers have found that gender differences in mathematics achievement have declined (AAUW 1995; Lee, Bryk, and Smith 1993). However, gender differences still appear in enrollment in upper-level, college-preparatory courses that are considered essential to acquiring the foundation for further study of advanced mathematics (Campbell 1995; Burton 1995; NRC 1989; NSF 1994). Women as well as minorities are underrepresented among those preparing to pursue mathematics- and science-related careers (AMS 1995; NSF 1994; NRC 1989).

Research shows that gender differences related to ability in mathematics persist in girls' and boys' perceptions throughout their schooling. Females reported more often than males that they had less confidence in their ability to do mathematics and expressed feelings of dislike for the subject as they got older (Hyde et al. 1990). The differential treatment females and minorities experience in the mathematics classroom may account for their lack of interest in, and understanding of, mathematics (Campbell 1995; Secada 1992; Oakes 1990). Researchers stress the importance of offering early intervention programs for underrepresented groups. These programs would emphasize career preparation, improve mathematical skills, and develop interest and positive attitudes (Oakes 1990).

Teachers and educators face a formidable challenge: to increase female and minority students' continuance in mathematics and science. This will require (1) modifying deep-rooted beliefs about who can learn mathematics, (2) making mathematics and science instruction more attractive, and (3) developing effective strategies to stimulate students' interest in these areas as college majors or as career choices.

EXPLORING A MULTICULTURAL PERSPECTIVE

An equitable learning environment affirms the richness of cultural diversity and creates an opportunity to engage all students in an interactive learning process. Efforts to introduce higher-level concepts must emanate from an appropriate cultural context or experience in which the student has some familiarity. In line with this belief, NCTM (1989) urges integrating students' cultural experiences into the learning process (p. 68). Banks (1989) reminds us that multicultural education is an ongoing process whose major goal is to improve the academic achievement of students from all racial, gender, cultural, and social-class groups (p. 3).

The curriculum for a multicultural approach to teaching mathematics should be organized around historical and cultural perspectives. This approach allows students to connect the historical sequence of mathematical developments with varied contributions of ancient civilizations. When teachers emphasize the roles different cultures have played in the evolution of mathematics, students' pride in the accomplishments of their people is enhanced and they begin to value mathematics as a human activity (Ascher 1991).

A multicultural mathematics curriculum emphasizes both the mathematical and the sociocultural aspects of the topics under consideration. The link between a concept and how it is used in the student's culture is an important part of learning mathematics. Equally important is how mathematics is perceived in that culture (NCTM 1991).

CREATING OPPORTUNITIES TO LEARN

An equitable learning environment engages students as active participants in mathematics instruction. Research shows that students cannot learn mathematics effectively by passively listening, disengaged from the learning process. Teachers must provide opportunities for students to construct their own understanding of mathematical concepts (NCTM 1989). Multiple learning situations must be provided that build on students' prior knowledge and cultural backgrounds.

Mathematical World Views

Diverse student populations have diverse world views of mathematics. Linguistic, cultural, and environmental factors determine a person's mathematical world view; "vestiges of other world views persist in some families for several generations" (Council of Chief State School Officers [CCSSO] 1995). Teachers' awareness of differences in students' mathematical world views enables them to develop strategies for dealing effectively with students' multiple perspectives of mathematics. The Council of Chief State School Officers (1995, p. 32), in its resource document

for teacher licensing and development in mathematics, contrasts the mathematical world views used by other cultures with those found in the United States:

> The United States uses base ten counting … but some societies use base-20 or base-60.… Many others incorporate place value into their counting (5234 is read five thousands two hundreds three tens four) … the United States views fractions through a part-whole lens. A whole is divided into equal parts.… However, some languages do not even contain words for dividing things up … they build fractions up (take one object, quadruple it, and then take three of the resultant objects).

In order to create an equitable learning environment among a growing diverse student population, it is important for teachers to understand the relationship between learning mathematics and the linguistic and cultural backgrounds of the students (CCSSO 1995; NCTM 1991). Teachers who understand the interrelatedness among topics in mathematics and acquire the facility to operate using different mathematical world views can help students develop their ability to understand mathematics and to build on their own mathematical world views (CCSSO 1995).

Opportunity to Learn

Diverse ethnic groups and females must be afforded the same chance to learn higher-level mathematical concepts as their upper- and middle-class white male counterparts. It is imperative that classroom teachers examine their own assumptions and beliefs about who can learn mathematics. Mathematics should not be considered valuable only for those students who will pursue careers in science, engineering, or technology. Mathematics affects every aspect of life; therefore, all students deserve an opportunity to develop their reasoning and analytical skills and to achieve their full potential. The classroom should be a nonthreatening, supportive place that encourages students to explore, conjecture, reason, and make decisions. Learning activities should present mathematics as alive, exciting, and a useful human endeavor in society, using pedagogical approaches that build on the full range of students' prior knowledge and understanding of mathematical ideas. Classroom teachers must use a variety of teaching and assessment strategies to promote the development of reasoning and problem-solving skills. Teachers need support, however, through professional development workshops on how to link these strategies with content and how to organize instruction in a way that promotes the learning of higher-level mathematical concepts for all students.

In addition, equitable treatment of all students requires that schools and teachers devise strategies that support and encourage family involvement in school matters as well as in mathematics instruction. When teachers form partnerships with families and their communities, mathematics education becomes more meaningful.

PROMOTING EQUITY THROUGH PROFESSIONAL DEVELOPMENT

Improving the opportunity to learn, along with higher teacher expectations, improves student learning and achievement in mathematics (Oakes 1995). In its *Professional Standards for Teaching Mathematics,* the National Council of Teachers of Mathematics (1991) urges mathematics teachers and schools to focus on new ways for improving the quality of mathematics instruction. Therefore, schools and teachers must organize instruction to accommodate diversity in ways that are beneficial to students and compatible with their interests and needs. To help schools and teachers accomplish this goal, the following issues must be considered:

- *Is the curriculum organized to accommodate the learning styles of culturally diverse students?* Are students assigned to work cooperatively in groups using the students' own cultural or personal experiences? Does the classroom environment generate complex problem-solving situations that promote active engagement and improve motivation?
- *Are professional development activities organized to enhance teachers' knowledge of different mathematical world views and cultural perspectives?* Are teachers helped to understand how learning mathematics is influenced by the students' ethnic, cultural, socioeconomic, and linguistic backgrounds and gender?
- *Is equity in mathematics education promoted by ensuring that minority and female students have an equal opportunity to learn substantive mathematics?* Is there an attempt to end the sorting of elementary school students into low-level tracks? At the secondary school level, are minorities and females encouraged to enroll in upper-level, college-preparatory mathematics courses?
- *Is the achievement of limited-language-proficiency students promoted?* Are language-based barriers to learning mathematics removed from the curriculum? Is support provided to teachers who offer instruction to second-language learners?
- *Have strategies been devised to form partnerships with families?* Have families been helped to understand the critical role they can play in influencing their children's mathematics achievement, through such things as participating in school-sponsored family activities and offering support to their children in developing thinking skills in the home?
- *Are the richness and strength of cultural diversity affirmed?* Is a climate created that encourages sensitivity and respect for oneself and others?

CHANGING PEDAGOGICAL PRACTICES

Lee and Smith (1995), using the results from the National Assessment of Educational Progress (NAEP), found that in schools that implemented

nontraditional "restructuring" practices—including interdisciplinary teaching teams, mixed-ability classes in mathematics and science, and cooperative learning—students had higher achievement scores in mathematics than students in more traditional schools. Integrating such restructured practices into a multicultural curriculum promotes the student's total development by providing learning opportunities that support the belief that all students are expected to learn and achieve their human potential (Banks 1989).

Cooperative Learning

Small-group, cooperative-learning experiences help students explore mathematical concepts in an interactive problem-solving setting. Research reveals that group interaction or cooperative learning promotes female and minority students' self-esteem, motivation, and achievement. Group interaction also promotes the development of mental operations or processes in children, since children tend to internalize the talk heard in the group (Vygotsky 1978). Research shows that when students participate in cooperative learning, their attitudes toward their classmates, particularly those from different ethnic backgrounds, improve (Slavin 1986). Students learn to respect other students' points of view and differences.

CONCLUSION

NCTM notes that equity is a critical factor in the nation's economic viability. By the year 2000, the workplace will require all Americans, including minorities and women, to have the mathematical skills needed to meet the demands of the global marketplace. Eliminating the social injustices of past schooling practices will require the support of policymakers, administrators, teachers, parents, and others concerned about excellence and equity in mathematics education. The ideals of a democratic society require that all students be given an equal opportunity to acquire the quantitative literacy essential to compete for employment and leadership positions in today's society. The mathematics education community must expand its efforts to galvanize broad-based support for changing school mathematics in ways that increase opportunities to learn challenging mathematics and, in turn, increase the achievement of minority and female students. All children can learn challenging mathematics with appropriate support and an equitable learning environment, irrespective of ethnicity, race, gender, or social class.

A multicultural approach to mathematics instruction builds a foundation for promoting academic excellence and equity for all students. The challenge to change confronts all of us. Effective innovations in mathematics education require extensive modification of practices, school structures, policies, curriculum, pedagogy, and assessment in order to deal with the rigorous demands of a technologically advanced society.

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