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What Factors Contribute to the Success of African American Women in Science and Mathematics: Do Teaching Techniques Matter?

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What Factors Contribute to the Success of African American Women in Science and Mathematics: Do Teaching Techniques Matter?

Abstract

The session content will focus on the author's research about effective teaching techniques that engage and assist African American women (and others) in succeeding in science and mathematics courses. Several case studies will highlight the effective practice focus of this session.

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As most educators know, there are many ways in which African Americans have been excluded from opportunities in science and mathematics learning. The following list of problem areas have been explored, and found to impact the access African American students have to upper level science and mathematics. These areas include 1) teacher expectations, 2) course taking and curriculum, 3) tracking, and 4) teaching methods (Secada, 1992).

In the area of teacher expectations, Oakes (1990) found that teachers' expectations served to limit student access to certain curricula. Teachers evaluated the educability and ability of their students' uniformly. However, their notions of ability were based on biased views of how minority children actually learn.

In addition to teacher expectation, the choice of teaching methods influences the success of minority students. Researchers in science and mathematics have found that cognitively guided instruction (CGI), which links science and mathematics concepts to the thinking and experiences of the student is successful. CGI provides teaching strategies that encourage minority students to actively engage in science and mathematics learning (Carey, Fennema, Carpenter, & Franke, 1995; Cobb, Yackel, & Wood, 1992; Fennema, Franke, Carpenter, & Carey, 1993). CGI contrasts sharply with the traditional approach to teaching science and mathematics used in many classrooms. In the traditional system the teacher lectures and students work problems for homework, or complete labs. Students are in the role of passive learners who strive to memorize algorithms and processes. Typically the problems are not relevant to the students and the actual opportunities for real problem solving are reduced.

Of equal importance to student access is the influence of the pattern of course taking observed among African American students. The course taking patterns show a disproportionate number of African American students taking lower level science and mathematics classes as compared to their White peers (Dossey, Mullis, Lindquist, & Chambers, 1988). While the students make these choices, they are often the result of other forces at work. For example, Dossey et al, (1988) found many African American students expressed reservations about taking upper level science mathematics classes because they would be the only African American students in the class. Thus, the isolation from friends and peer support discouraged many from enrolling.

The above information formed the motivation to explore the experiences of 206 African American women who enrolled in upper level science and mathematics courses at the high school level.

The study discussed is an interpretive research project describing the efforts of a team of science and mathematics educators to recruit and retain African American women in upper level science and mathematics courses. A total of 206 African American women were followed for four years. The program of recruitment and retention included: student centered curriculum; tutoring services, cohort group recruitment; summer research program in science and mathematics for juniors and seniors, special career emphasis in science and mathematics.

Methodology

The theoretical perspective is a constructivist one, whereby the views of the participants and their interpretations are most important. Classrooms are complex units of culture that encourage teachers and students to strive and make sense of their environment and to integrate personal knowledge and beliefs with new information. Interpretation and re-evaluation are on-going epistemological processes (vonGlaserfeld, 1989).

The assumptions guiding this research are taken from an interpretive/qualitative perspective, which assumes that perceptions are mediated by an individual's interpretations of experience. Erickson (1986) and Lincoln and Guba (1985) outline the techniques used in this research project, which employed a set of qualitative methods to collect data. Most data was collected in the form of interviews with participants and field notes taken during classroom observations. Additional data was obtained in document form regarding the school's demographics, recruitment records and student enrollment figures.

In this research it is the individual participant's perspective of the issues that is the focus. And, of course, the teachers and students are immersed in the cultural milieu of a school and a classroom that must be considered, because the school and the classroom form the context for action. In order to make sense of the participants' perspectives the researchers have chosen an interpretive research methodology involving the use of participant observation.

Research Context

The research project took place in an urban high school located in the southeast portion of the U.S.. The school is referred to as South High for the purposes of this discussion.

Research Questions The research questions addressed were: 1) What were the constructs teachers found useful when teaching mathematics in a multicultural setting? 2) What components of the program designed did teachers and students find most effective in recruiting and retaining African American female students in upper level mathematics courses? 3) What aspects of practice, beliefs, and interaction patterns changed? 4) What impact did these changes have on student retention/performance?

Researcher's Role

The researcher in this study was a participant observer. She was involved in the field with teachers and students for four years. The prolonged engagement in the field allowed the researcher to access the "back-stage behaviors" and attitudes that best represent the true perspectives of the participants.

The Participants

The research involved the participation of fifty-two African American females in the first cohort; followed by seventy-two African American females in the second cohort, and eighty-two African American females in the third cohort, all enrolled in upper level science and mathematics grades 9-12 at an urban high school. Also participating in the study were five science and mathematics teachers at the same high school, all committed to increasing the participation and success of African American students.

Findings/Conclusions

The following assertions represent a summary of the findings. The program enacted by the teachers to target African American women required that a number of changes be made in their approaches to teaching mathematics. The types of changes in practice and beliefs occurred are the major focus of the paper. It is the change in practice, perspective, attitude and beliefs on the part

of the teachers and students that made the program a success. The following assertions summarize the findings of the study:

Assertion I: Teachers had to project themselves into the new future. Many issues impacting South High had to be addressed. Each teacher had to reconceptualize his or her roles and attitudes about teaching and learning science and mathematics.

Assertion II: Major changes in the classroom culture were noted in classes most successful in retaining African American women in their classes.

Assertion III: Changes in teaching practice were extensive and involved the addition of group-based instruction and project-oriented curriculum. Projects were tailored to student interests and abilities, including the integration of technology into most science and mathematics lessons.

Assertion IV: Participation increased when students were recruited in cohort groups

Assertion V: Students found it beneficial to interact with role models whose careers required advanced science and mathematics

A survey was completed at the end of the third year of the program. The survey asked African American women students to rank the aspects of the program they felt were most successful in helping them to succeed in upper level science and mathematics courses. After compiling the results for all three cohort groups we found that the rankings show student centered curricular changes as the first choice. The overall results are displayed below.

Assertion VI: Program components most successful, as reported by African American female students were: (1) small group projects, and student centered science and mathematics curriculum, (2) peer and teacher supported homework help line and center, (3) cohort group recruitment (4) University/school partnership for student participation in research (involving science, math, and technology), and the (5) the career focus program designed to acquaint students with careers and professionals in mathematics, science and technology.

Impact

The literature is replete with information about the failure of schools to adequately provide for the education of African American students in science and mathematics. What is missing in the literature is the research documenting the successful programs. This research project provides a beginning for other schools or projects targeting African American students to consider the components of the South High Project. And in doing so, adapt these ideas into new contexts.

References available upon request

Presenter

Dr. Sheryl McGlamery is an Associate Professor of Science Education at the University of Nebraska at Omaha and research director of the CADRE project. Currently, Dr. McGlamery is involved in a number of research projects focusing on the achievement of students of color in science and mathematics, most notably the CEMS/Bannker project with Omaha Public Schools and UNO.

