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ABSTRACT

This paper studies successful African American students' perception of their mathematics education, mathematics knowledge, and their interaction with peers. Two female and four male participants attending the same southern four-year university completed courses in calculus 1, 2, and 3. Data was gathered using interviews, surveys, exemplary teacher observations, and autobiographies. It was concluded that the participants in this study generally had positive feelings about their mathematics education and knowledge. They felt that they were successful because they could apply the reasoning and logic skills of mathematics to their everyday lives. (Contains 16 references.) (ASK)

African American Mathematic Student Perceptions of Peers, Education, and Mathematical Experiences

by

Angiline Powell-Mikle

INTRODUCTION

There is a growing body of available research on the academic achievement of African Americans. Several authors have asserted that there is a disparity between the mathematics achievement of African Americans and European Americans (Irvine, 1990; Matthews, 1984; Secada, 1992). Most of the literature, however, focuses on unsuccessful African American students. This narrowing of focus tends to blame African American students for their failure instead of examining their experiences or perceptions to help alleviate the problem.

Blaming the victim for any problem is unproductive and futile. This disparity in achievement is not a problem solely for African American students or their community, but the disparity is a problem for society as a whole because of the changing population of this country. Blaming African American students for their academic failure removes responsibility from society, the schools, and the teachers of these students. A more responsible and productive line of research would be to study successful African American students' perceptions of their mathematics education, mathematics knowledge, and their interaction with peers.

RATIONALE

In order to reform the mathematics education of African Americans, a knowledge base about African American students' development and socialization must be formed. The current lack of knowledge is attributable to the media and the fact that teacher education programs do not draw their pedagogical expertise from the culture, language, and history of African Americans (Murrell, 1994). The theoretical base must include how these students analyze and synthesize their experiences with the curriculum and how they position themselves in the classroom. While there is a growing body of knowledge on the

achievement of African Americans, there are scant numbers of research studies where the perceptions or experiences of African American students are studied. Thus, this research, using a qualitative methodology, adds to the available mathematics education literature on African American students' mathematics achievement.

While we, in the mathematics community, attempt to transform the teaching of mathematics and make it available to every student, we must learn what methodologies work with the burgeoning mathematics student population. We must be careful that we do not make the mistakes of the past researchers and assume that the methodologies that work with one population automatically extend themselves to work with other populations (Grant and Sleeter, 1986). We must not assume that we know what is best for these students; we must let these students speak for themselves (Zinn, 1979). These concerns provided a springboard for conducting this research.

THEORETICAL PERSPECTIVE OF THE PROBLEM

Critical theorists believe that the structure and inequities of American public schools are not accidental. The barriers that African Americans and other children of color encounter are purposeful, deliberate, and meant to maintain the existing social structure. Critical theorists question the meritocratic ideas of schooling for all students of color, including African Americans, females, and lower socioeconomic students (McCarthy and Apple, 1988).

Critical theory, in the context of education, is based on cultural or economic reproduction (Giroux, 1983). In the last decades critical theorists have concentrated on economic reproduction and the work of Bowles and Gintis (1976). These authors asserted that schools are hierarchically structured places. Their patterns of values, norms, and skills mirror the social dynamics necessary for maintaining our capitalist economy. As a result,

schools mirror the social division of labor and the class structure that is evident in American society. These lessons are not overtly taught. They are, however, an integral part of the "hidden curriculum." The term hidden curriculum "refers to those classroom social relations that embody specific messages which legitimize the particular views of work, authority, social rules, and values that sustain capitalist logic and rationality, particularly as manifested in the work place" (p. 263) (Giroux, 1983). I believe that in the mathematics classroom part of the hidden curriculum is the tacit understanding that this is the domain of White males. Females and students of color do not really belong and are subsequently expected not to do well. When they do perform well, their performance is viewed as an anomaly. I wondered how these participants viewed their successes and failures in the mathematics classroom. Who or what contributed to these successes and failures? These concerns guided this research.

Closely related to the economic reproduction model is the cultural reproduction model. As its name implies, this area of critical theory is concerned with how capitalist societies reproduce themselves. A major tenet of this theory is that schools link culture, class, and domination. Cultural reproductionists argue that schools simply mimic the dominant society. They contend that schools are relatively autonomous and only indirectly influenced by powerful political and economic institutions. Schools do not actively support the dominant class by the oppression of others. However, students whose culture and knowledge are valued by the dominant class are deemed successful in schools (Bourdieu and Passeron, 1977).

These ideas of cultural and economic reproduction have profound implications for African Americans. The political and economic forces in schools as described by critical theorists are road blocks to African Americans' success with school in general and mathematics in particular. Educators who are aware of the discrepancies in achievement and

who are committed to eliminating these discrepancies must be ever vigilant of the hidden curriculum. They must link theoretical research to practice by real people in real institutions (McCarthy and Apple, 1988).

DATA COLLECTING AND METHODOLOGY

Data were collected over a period of 12 weeks beginning in February of 1999 and continuing until April of the same year. The data included interviews, surveys, exemplary teacher observations, and autobiographies. Criterion sampling guided the selection of participants for this study. All the participants were African Americans, attending the same southern four-year university, who had completed the Calculus I, II, and III courses in college. Since completion of calculus is prerequisite for continuing in upper-level math courses, I recruited six participants. I stood outside upper-level math classrooms and enlisted these participants. Each participant named an exemplary mathematics professor and signed a consent form. After signing the consent form, the participants completed an initial survey to begin the study.

After the completion of the initial survey, which queried the participants about their school experiences, specifically their mathematical experiences, the participants participated in a follow-up interview based on information obtained from the survey. Interview protocol questions were used during this interview. The participants then wrote an autobiography of these experiences in mathematics education with particular emphasis placed on their mathematics teachers. Subsequently, another interview was conducted to gather more information. Like the first interview, the second interview was based on protocol questions. After the second interview, a member check was conducted whereby the transcribed interviews and documents were reviewed with each participant. In order to clarify some statements, two of the participants, Lou and Jarrell, were contacted by e-mail during the

mini-session in May of 1999. The participants received a small remuneration for completing the study.

PARTICIPANTS

Two female and four male participants completed this study. Christa, a 22-year-old senior mathematics education major, attended high school in a small rural town. Emily, a 22-year-old senior majoring in computer science engineering, was valedictorian of her high school class and was accustomed to excelling in mathematics. Lou, a 21-year-old, computer science major was from a suburban public high school. Jim, a 29-year-old mechanical engineering attended a public rural high school. Byron was a 25-year-old statistical mathematics major from a large southern city. Jarrell was 23-years old and the only participant previously enrolled in a historically Black college. His major was statistical mathematics.

DATA ANALYSIS

Perceptions of Mathematics Education and Knowledge

Christa was fairly confident in her mathematical ability. When I asked her directly whether she was successful in math, she said yes because she endured when the classes became difficult, especially the calculus series. She failed Calculus I two times and passed it on the third attempt. She said of this experience,

> It wasn't that I didn't understand it. I took on too much, too many classes, cause I was in pharmacy school. I was in education, I switched to pharmacy and I was trying to get in pharmacy school and I had to have calculus and I took on too many classes and that was the reason why I failed it. I failed it three [two] times. The second time I took it, I was just real discouraged, cause I was like oh my God I made an 'F' and then finally I passed it the third time. So I should have passed Calculus I the first time, I should have passed it. (Interview 1, 2-24-99)

Despite these failures, Christa continued in math because she loved the subject. She wrote that her love for the subject diminished during the calculus series. Christa said that

her calculus teachers taught at a level that was above her head. She felt they did not explain well and they were unable to break the mathematics down to an understandable level. Christa believed that many of the students in the calculus classes had the same troubles she did.

Christa's love of mathematics began to return in spite of the difficulties she had in calculus. She attributed this to the probability course in which she was currently enrolled. She said it was the only college math course that she truly loved. She said "I like it cause you have to think, you have to . . . you know kind of like what's the probability that such and such happened" (Interview 1, 2-24-99). Christa also liked the fact that the students came to the class early and worked on the homework problems together.

When I asked Christa what would she change about her mathematics education she said, "I wish I would not have done so bad in calculus. So I wish I could go back and do better and make a higher grade" (Member check 4-16-99). I asked Christa if there was anything else and she said, "I wish I would have enjoyed it more cause it seemed like it got to a point to where I was just doing it; I just wanted to hurry up and graduate and I stopped really enjoying math and college" (Member check 4-16-99).

Jim was placed in mathematics class for the learning disabled when he was in middle school. When I asked him how this happened he responded, "I couldn't see the board in eighth grade... .This is what really happened. I couldn't see the board in eighth grade, I kept breaking my glasses or something; my parents weren't rich" (Interview 1, 3-19-99). This experience appeared painful for Jim. He held his head down and his usual jovial nature was not present at this point in the interview. He continued,

> After getting in there, I was just bored with it. We did the same thing. What it was was a first grade class you did every day. They say you work at your own pace; they gave you these little books where you add five or six numbers up, in that stack, you know, in that row, whatever purpose that had. And you had, maybe, about a thousand problems to do like that, you know what I mean. I'm not--I'm serious, the whole book was that. And you, never got to do anything else. You couldn't get there [finished]. I ended up wasting the whole year. (Interview 1, 3-19-99)

Jim was persistent with his parents and his teachers; he begged to get into another class. He tried to convince them it was just that he needed glasses. They finally agreed to let him out to try general mathematics. Jim said at this point he was really angry, but if general mathematics was the only way he could get out, he would take that way out. Jim was determined to show them what he could do. He said,

> I did real good [sic]. It wasn't even-- it wasn't no [sic] problem, you know. And then, I went on to I think it was like pre-algebra whatever. And did that. Made an 'A' in there and then and 'A' in algebra, you know. "You're doing real good Jim, you know [talking to himself]." It was just like I didn't have a problem in the first place, the only problem was that I couldn't see the board, you know. And just was you know, I was too embarrassed to want to, too embarrassed to say I need to sit on the front row, but I still couldn't see it you know. (Interview 1, 3-19-99)

It was at this point in his mathematics education that he encountered Mrs. Watt. She made him feel special and gave him a sense of belonging in her class. Jim did not take any math courses above Algebra I in high school. He graduated from high school and went to work for his brother in Mississippi. After the work slowed, his brother suggested that he enroll in the community college. During our second interview it came to light that Jim had not ever had a geometry course. When I asked if he had any difficulty in the subject he said,

> Geometry? You know, I never had geometry. But (laughs), and everybody keeps referring to geometry and everyone else in my classes here [say] "you should have learned this probably in geometry in high school." And I'm sitting there like "I never had geometry." And I'm probably the only one (laughs). But anyway, from what I picked up, you know, from just looking at geometry myself, I guess I have a problem with like, you know, relating the angles. You know what I mean? (Interview 2, 4-9-99)

Because Jim did not take advanced mathematics courses in high school, it affected his view toward being successful in mathematics. When asked if he was successful he replied he was about average. To be successful, Jim thought one had to be able to pull from the trigonometry and geometry courses that one had in high school because college professors assumed that you knew about similar triangles, supplementary angles, and complementary

angles. When I asked him what would he change about his mathematics education he indicated he would increase the number of courses that he had in high school.

On one occasion Jarrell described himself as a semi-successful mathematics student. On another occasion he said that based on his definition of success, he sometimes was and sometimes he was not successful. He defined a successful person as someone who easily grasps the concepts and gets through the class the first time. In his initial survey, Jarrell stated that he liked mathematics classes that he perceived as useful. During our first interview I asked him to elaborate on that concept. He said,

> I perceive the probability class, the theory of probability, as useful because the homework problems we have seem to be real world related. What is the probability that this family will have a son after they have had two daughters previously. What's the probability that the next one would be a son; things like that. I guess I could actually see where it would apply somewhere. What's the probability if you draw three aces, what's the probability that out of the next five cards that you draw, one of them will be an ace. Things like that. (Interview 1, 3-12-99)

Jarrell indicated that he did not plan on using mathematics his entire life. In his initial survey he wrote that he really did not like mathematics. During another conversation, he clarified that statement by saying he liked it when he understood it, but when he had to sit down and concentrate on the problem and could not get anywhere, he did not like it anymore. Jarrell described himself as a "fair weather friend."

Jarrell felt his high school mathematics education was good. The faculty was helpful and wanted him to learn. His college level mathematics education was not as positive. He felt the professor's expectations at his former college were low. Jarrell said "I wouldn't say they expected less, they accepted less. They accepted things that the instructors here [four year university] would not accept" (Interview 1, 3-12-99).

Jarrell indicated that if he could change his mathematics education, he would get into more study groups with other students in the classroom and go and visit the professors

more often when he was having difficulty. While visiting the professors, he would tell them the problems he was having and ask them if they could slow down a little without falling too far behind.

Interactions with Teachers and Peers

Emily had very positive experiences with her peers. She worked with them in middle school, high school, and in college. In her high school calculus class, Emily and her friends frequently studied together, usually at their homes.

While in college, Emily worked in groups with other students. She specifically mentioned matrix theory and discrete math. Emily described her summer course in matrix theory as a small group "and everybody basically got along, and we would meet everybody in the big conference room over at the library. And ah, studied for a test or either ah, worked the examples like everyday" (Interview 1, 3-19-99). In discrete mathematics all of the tests were take-home, so Emily and the other students worked on the problems together. Emily emphasized that she did not take the tests with anybody else.

> Cause I don't trust nobody to do math stuff, I have to work through it myself anyway. Unless, it was something that I really totally didn't understand, I would probably get help from somebody else. But other than that, I worked it myself. (Interview 1, 3-19-99)

Emily's discrete mathematics professor was Dr. Dyson, whom she named as one of her least favorite professors. Emily's first reason for naming him her least favorite was because he did not encourage student interaction. According to Emily, he only stopped lecturing when there was a raised hand. There was no student input in his classroom. Her second reason was that the two of them disagreed on the amount of credit she should receive for the math problems on the test. She said of this situation,

> I could argue with him about how I decide to work the problem, I think it is correct and I should get more credit for whatever. But he was, like, adamant about not

> changing grades or anything and, you know, scaling was not an option, it was just awful. (Interview 1, 3-19-99)

Emily did not have personal relationships with her mathematics teachers. She did not tell about going back to visit any of her high school teachers, nor did she tell of warm fuzzy feelings about any of her college professors. Her relationship with her mathematics teachers seemed strictly professional. She said of her favorite mathematics teachers,

> Ah, basically, I mean they was [sic] good teachers or whatever, but I never--other than outside of meeting them in office hours and getting help with my homework--I really didn't involve myself with my teachers too much at all, especially if they didn't have that kind of personality. I just asked for help with my problems and, ah, that's it. Beyond that I wouldn't say it was a relationship at all. (Interview 1, 3-19-99)

Judging by his positive responses in his autobiography, Lou had warm relationships with many of his elementary and secondary teachers. He described his fourth-grade teacher as someone "whom everyone enjoyed... .She had quite a nice personally and would help you along with your studies if she saw that you needed it some way" (Autobiography 4-27-99). He repeatedly said of Mrs. Burns that they had a close, personal relationship; he now visits her when he goes home. Lou mentioned that he did not like his Algebra I and geometry classes because the teachers did not have control over their classes, which made it difficult for him to learn the mathematics. He said in his Algebra I class there were two students who the teacher begged and pleaded with to behave, but they did not.

Even though Lou described himself as a loner, and a lover of video games, according to his written and verbal responses he fit in with all of his peers. Lou reported that he liked the interaction with other students when his mathematics classes were small. He said, "Small classrooms give you more space to communicate with each one of your classmates, who in turn push you to do better... .No one wants to be that one student who does poorly in class" (E-mail correspondence, 5-28-99). Lou said that he and his peers got along fine for the most part but he did not study with other students. When I asked him specifically

about the take-home math tests in Dr. Dyson's discrete mathematics class, he admitted that he met with other students to work on those tests.

Byron's feelings about his teachers were very positive overall. He stated that he had exceptional high school and college mathematics teachers. He elaborated on his bad teachers,

> Well, I won't say that, I won't say anything like I hate them or I dislike them. Not necessarily them; it's just the way that they taught. Cause you have those people that are not quite as engaging as other people. And you have a question or something that seems obvious to them, yet they tend to think that it should be obvious to everybody, you know. Cause I've had, I've had experiences where I've actually heard, you know, people, you know, I've had teachers that would actually say things along the lines like, "What are you stupid?". (Interview 1, 2-24-99)

When I asked Byron if he fit in with his peers in math classes he indicated,

> I usually didn't feel like out of place. There really weren't like any cliques, groups that you have sometimes.... You know, those people that just do well in math and all that kind of thing, and only stick with those people that can get those things right off. I never really saw anything like that. In every class I've had everybody--regardless of ah, ah, performance level in the class; was always helpful, willing to study. If you didn't understand something and they understood it, you know, we'd help each other to get the concept together. Ah, so yeah, I always felt like I fit in there, never felt out of place. (Interview 1, 2-24-99)

CONCLUSIONS

Interactions with Teachers and Peers

Contrary to popular notions, the six participants interacted well with their peers and teachers. The participants, excluding Lou, actively sought out their peers for additional help with mathematics. These participants reported that they worked with their peers so that they could better understand math. Based on these participant responses, it appeared that they learned better in group settings. Slavin (1987) suggested that all students achieve significantly more when they work together rather than alone. Specifically, he found that African American students achieve more in a cooperative environment. Irvine (1990)

suggested that African American students were more "relational than analytical in their learning styles" (p. 98). This relational learning style has been "characterized by freedom of movement, variation, creativity, divergent thinking approaches, inductive reasoning, and a focus on people" (p. 31). Schools however emphasize an analytical style, "characterized by rules and restriction of movement, standardization, conformity, convergent thinking approaches, deductive reason, and a focus on things" (p. 32). Harris (1995) contended that peer groups were the most powerful influence in students' lives, even more powerful than parents. The findings of this study partially supports this literature; these participants' peers were positive and helpful influences in their lives.

It is my contention that these participants, though probably not schooled on various learning styles, were aware on some subconscious level of this aspect of their learning styles and consequently sought out their peers to help them learn mathematics. Peers contributed to the participants' understanding of mathematical concepts and provided them emotional support. Jim felt that he learned a lot from the study groups that he formed although some members talked too much in them. He said "I realize that if can help somebody else then I already done [sic] helped myself a whole lot, you know" (Interview 1, 3-19-99).

Perceptions of Mathematics Education and Knowledge

The participants in this study generally had positive feelings about their mathematics education and knowledge. They felt that they were successful because they could apply the reasoning and logic skills in mathematics to their everyday lives. Many of the participants specifically mentioned that they liked for their exemplary teachers to connect explanations to science classes or to some other practical aspect in their lives. Ladson-Billings (1994) suggested that teachers who practice culturally relevant pedagogy connect their students' real life experiences to classroom curriculum. Five out of the six participants in this study

mentioned their love of the subject. In fact, Christa noted that her love for mathematics returned because Dr. Woods willingly and patiently answered his students' questions.

Conversely, Jarrell seemed to view mathematics as the means to an end; he did not enjoy math for math's sake. All of the participants attributed much of their success in mathematics to exemplary teachers, specifically noting their clear explanations. In all cases except Emily's, these students thought their exemplary teachers demonstrated a caring ethic with their students. If one looks at the mathematics culture of power using traditional values, these participants would not necessarily be described as successful. However, they are successful because they endured and this endurance aided them in achieving their academic goals.

Persistence

Generally, the participants had a positive feeling about their mathematics education and knowledge despite experiencing some difficulties along the way. These difficulties exemplified their persistence. All of the participants had already spent at least 4 years in college, with the earliest anticipated graduation date 2 semesters away. These findings were consistent with the work of Stanic and Hart (1995) in their qualitative study of seventh graders. They found that the African American mathematics students in their study scored higher on their measurement of persistence than the European American students. At some point in their lives, Christa, Byron, Jim, Lou, and Jarrell all reported either failing or dropping one or more college math courses, but they continued their studies with renewed determination.

After interpreting the data, I concluded that these participants were resilient, persistent, and goal-oriented; they wanted to complete their college degree. In order to realize this goal, they had to complete advanced math courses. They persisted in spite of

some poor teachers and disappointing grades. While it would be easy to say that we need to encourage persistence in African American students in order for them to attain educational goals, persistence does not exist in a vacuum. We must ask ourselves why these participants were able to persevere. Ross (1998) suggested that her participants persisted because someone cared about them, noting that that caring person could be a family member or an educator. She believed that her participants listened to this caring individual and learned how to "conduct themselves in order to survive their obstacles" (p. 65). This caring individual taught survival skills and taught how to make good choices. All of the participants in this study mentioned being close to someone who wanted him or her to succeed, thereby bonding these participants to a caring individual.

I conducted this study to add to the knowledge base about African American mathematics students, specifically their perceptions. I wanted knowledge of their interactions with teachers and peers as well as their perceptions of their mathematics education and knowledge. Peer and teacher interaction was an integral part of these participants' commitment to education and the successes they achieved. These interactions enhanced their mathematics knowledge and education, which in turn made the participants successful. Educators need to utilize these results to improve the quality of mathematics education for African American students.

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