A Study of African-American College Students' Attitudes towards Mathematics

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Abstract

This research focuses on the belief that a person's attitude affects the way they view, pursue, and achieve within a subject area. From research using the Fennema-Sherman Mathematics Attitude Scales come Fennema's Theory, which Tapia and Marsh (2004) explain as the belief that performance in mathematics is an interaction of attitudes, mathematics anxiety, and behavior that occur during a learning task.

The participants of the research were African-American students enrolled in college algebra at a Historically Black Colleges and University (HBCU). For the most part, this was the first mathematics course that the majority of the participants had enrolled in while a student at the institution. The Fennema-Sherman Mathematics Attitude Scales were administered to determine the students' attitudes towards mathematics. The Fennema-Sherman Mathematics Attitude Scales has been used over the last three decades to evaluate students of various ethnic backgrounds and gender and at various academic grade levels from middle school to college level students.

This research centered on the hypothesis that there will be a significant relationship between attitude towards mathematics and achievement for African-American students. A multiple linear regression revealed that there was a significant relationship between attitude towards mathematics and achievement for African-American students with 15.3% of the grade being explained by the attitude domain scales. The results of the research found that students would like to be successful in mathematics, but they do not want to put too much effort or work into doing the mathematical problems.

Background

The 2005 National Assessment of Educational Progress (NAEP), The Nation's Report Card, on the progress of fourth and eighth grade students in American schools had bleak and alarming results for African-American students. The 2005 report card on the achievement level result by race/ethnicity indicates that African-American students are the lowest scoring group of all student groups with 59% scoring below basic levels of mathematics understanding compared to 50% of Hispanic students scoring below basic levels of understanding and only 21% of white students scoring below basic levels of mathematics understanding (Perie, Grigg, & Dion, 2005).

With state funding an ever growing concern, successful student articulation in undergraduate education programs in state colleges and

universities has become a primary focus of state legislatures, administrators, faculty, and national associations (Braxton, Eimers, & Bayer, 1996). With diminishing budgets and increased competition from other colleges and universities, Historically Black Colleges and Universities (HBCUs) are now more than ever trying to better understand their student population in order to better serve their students.

Because college algebra is generally classified as the minimum required mathematics course for all students to take towards credit for graduation, it is classified as a "gate keeper" course. A high failure rate in a course such as college algebra results in many students not being able to pursue careers in various science and mathematical oriented disciplines since college algebra is generally the minimum required course in these disciplines (Stage & Kloosterman, 1995).

This research is designed to provide quantitative data that could help determine the attitudes towards mathematics among first year African-American students in a college algebra class in a Historically Black College and University. As a result other researchers, faculty, and administrators may gain a better understanding of their students and be able to put in place the resources and programs that would better serve the students in successfully articulating them through their mathematical classes and through their program of study.

Theoretical Framework

This research focuses on the theory that a person's attitude affects the way they view a subject, pursue, and achieve within that subject area. Early studies conducted by Thurstone (1926) on affective domain paved the way for research on the interaction between attitude and other educational factors. Turner (1981) examined data collected from 1958 to 1978 and found that a student's attitude toward mathematics was a significant factor in whether or not that student pursued a career in mathematics. Numerous studies have focused on attitudes and mathematics (e.g., Fennema & Sherman, 1976; Forgasz, Leder, & Kloosterman, 2004; Pettitt, 1995; Stipek & Granlinski,1991; Swetman 1995; Tapia & Marsh, 2004) and have found that there is a correlation between mathematical achievement, future aspirations in majoring in mathematics, and attitudes towards mathematics (e.g., Greenwood, 1997; Turner, 1981). Guttbezahl (1995) also found that when students believe that they are incapable of achieving in mathematics, their attitude toward mathematics become a self-fulfilling prophesy that results in high levels of failure and lack of interest in any courses involving mathematics. As a consequence, many students find themselves unable to pursue a degree in mathematics or any area that relies heavily on using mathematics, resulting in many different career and academic opportunities being closed for them.

There has been much research documenting the difficulties of African-American students in doing well in mathematics (e.g., Perie, Grigg, & Dion, 2005; Stage & Kloosterman, 1995; Walker & McCoy, 1997). Mancini, Billson, and Tiberius in Braxton et al. (1996) stress the importance of faculty learning

about their students, and Gaff (1991) writes "Unless teachers know their students reasonably well, it is impossible for them to know whether or how any given idea will be understood, integrated into the mind, or used by the student" (p. 183). Stanic and Hart (1995) found it essential that the attitudes and behaviors of minorities needed to be studied over time in order to gain a better understanding into how attitudes and behaviors affect academic performances and achievement.

The Fennema-Sherman Mathematics Attitude Scales were developed in 1976 and over the past three decades have become one of the most popular instruments used in research in attitudes towards mathematics (Tapia & Marsh, 2004; Forgasz, Leder, & Kloosterman, 2004). The Fennema-Sherman Mathematics Attitude Scales have been used over the last three decades to evaluate students of various ethnic backgrounds and gender and at various academic grade levels from middle school to college level students. From research using the Fennema-Sherman Mathematics Attitude Scales comes what Tapia and Marsh (2004) call Fennema's Theory which explains the belief that performance in mathematics is an interaction of attitudes, mathematics anxiety, and behavior.

Setting and Population

The study was conducted at a public historically black college or university (HBCU) located in the southern part of the United States. The focus of the research will be on African-American students enrolled in College Algebra. College Algebra is the minimum required course in mathematics that all students must take in order to graduate from the university. A total of 239 surveys were administered to students enrolled in 12 separate college algebra classes at the HBCU. The classroom size ranged from 20 to 40 students per class. Two hundred and twenty-four (N = 224) were able to be used in the analysis.

All of the participants in the study were African-American. Of the 224 participants, 42% were male, 57.6% were female, and 0.40% did not indicate their gender. By age, 54.9% of the participants were 18, 15.2% were 19, while the remaining students ranged from 20 to 54. By state residency, 64.7% of the students came from Mississippi, 8.9% from Illinois, while the remaining 26.4% came from various other states.

The majority of the participants, 69.2%, were classified as college freshman. The majority, 76.8%, indicated that this was their first time to enroll in College Algebra with 19.6% indicating that this was their second time to have been enrolled in College Algebra. The percentage of the students that indicated that they are currently unemployed was 54.9% with only 13.4% of the students indicating that they are employed full-time. The majority, 87.5%, indicated they currently do not have children.

Many of the participants indicated that they did take Algebra I (93.8%), Algebra II (84.3%), and Geometry (90.1%) as part of their high school curriculum. The participants also indicated that their grades in their high school

math courses were high, with only 4% obtaining a D or an F and 60% obtaining a grade of an A or B. One may conclude that such high grades in their high school math courses would have resulted in a high rate of achievement in college algebra. It was found that 44.6% of the participants in this study either received a D or an F with an additional 8% of the students receiving a W. This could be a sign of possible grade inflation in their high school mathematics courses. Almost one quarter of the participants did not take the final exam and finish the class even though they were still registered students within their college algebra section. As a result, they received a final grade of F in the course.

Design

To determine the relationship between attitude towards mathematics and achievement for African-American students, The Fennema-Sherman Math Attitudinal Survey was administered by the researcher, following IRB guidelines and procedures, during one regular classroom meeting at the beginning of the semester. The students finished the survey between 30 and 50 minutes. For data analysis, each instrument also asked for information such as gender, race, classification, nationality, and age. Final grades were also collected from each teacher at the end of the semester.

There are currently nine scales, described in Table I, in which all questions use a Likert Scale to measure the students' attitudes within nine separate domains: Attitude toward Success in Mathematics Scale (AS), Mathematics as a Male Domain Scale (MD), Mother Scale (M), Father Scale (F), Teacher Scale (T), Confidence in Learning Mathematics Scale (C), Mathematics Anxiety Scale (A), Effectance Motivation Scale in Mathematics (E), and the Mathematics Usefulness Scale (U). Each of the domain scales consist of twelve questions: six questions stated positively and six questions stated negatively with the following possible responses: strongly agree, sort of agree, not sure, sort of disagree, and strongly disagree. Each of the Likert responses is given a value of 5 to 1 respectively for the positively stated questions and 1 to 5 respectively for the negatively stated questions. The reliability results for both the Fennema and Sherman (1976), Mulhern and Rae (1998), and this current study are found in Table II.

Results

The mean scores for each of the nine measured attitude scales (Attitude toward Success in Mathematics Scale (AS), Mathematics as a Male Domain Scale (MD), Mathematics Usefulness Scale (U), Teacher Scale (T), Confidence in Learning Mathematics Scale (C), Mother Scale (M), Father Scale (F), Mathematics Anxiety Scale (A), and the Effectance Motivation Scale in Mathematics (E)) are reported in Table III. The minimum possible score was 12 and the maximum possible score was 60. A lower score indicates a more negative attitude while a higher score indicates a more positive attitude.

It was found using a repeated measures ANOVA that there was a significant difference between the Fennema-Sherman Mathematics Attitude Scales, $F(8,1768) = 92.30$, $p < .001$. In addition, pairwise comparisons using Tukey's LSD Post Hoc procedure revealed the rank order of importance mirrors the order of the mean scores.

The researcher was surprised to find that none of the scales had a mean value indicating an overall negative attitude given the high failure rate of the participants enrolled in the college algebra sections surveyed. The mean values of the nine domain scores ranged from a slightly above average or neutral attitude to a positive attitude. The Attitude toward Success in Mathematics Scale had the highest mean score and the Effectance Motivation Scale had the lowest overall mean. In rank order, the Attitude toward Success in Mathematics Scale was followed by the Mathematics as a Male Domain Scale, the Mathematics Usefulness Scale, the Teacher Scale, the Confidence in Learning Mathematics Scale, the Father Scale, the Mother Scale, the Mathematics Anxiety Scale, and the Effectance Motivation Scale in Mathematics which received the lowest score.

The Attitude toward Success in Mathematics Scale received the highest score indicating that the students had a positive attitude, and, thus, see the importance of being successful in mathematics. On the other hand, The Effectance Motivation Scale received the lowest score indicating a neutral attitude when it came to the enjoyment of doing mathematical problems and the willingness to keep working on a math problem that they do not know how to solve. This indicates that even though the students would like to be successful in mathematics, they do not want to put too much effort or work into doing the mathematical problems.

One would think that with over 50% of the participants earning a D, F, or W in the college algebra course that there would be more negative results in the nine domain scores instead of scores ranging from a neutral attitude to a positive attitude within the various domain scores analyzed in this study. There may be a connection to what Catsambis (1994) reported, that despite low test scores in mathematics, approximately seventy percent of the African-American male high school students stated that math was one of there better subjects and that they always received good grades in math class. This leads to the question of why these students, despite low test scores, still have such positive attitudes toward a subject in which they are not performing well. This could be a factor of grade inflation which may have led to a development of overconfidence in one's ability to perform well within a mathematics class.

A multiple linear regression analysis (MLR) was done using the domains as the independent variable and the college algebra grade as the dependent variable. The MLR revealed that the relationship was significant, $F(9, 212) = 4.24$, $p < .001$, $R^2 = .153$. This implies that only 15.3% of the grade can be explained by the domain scales. The only domain scale with a significant beta weight was the confidence domain with Beta = .329, $t = 2.541$, $p = .012$, thus having the strongest overall effect on student achievement.

Conclusion

This research began as a search for a better understanding of African-American college students at a HBCU that are enrolled in a typical college algebra class. Through this research, information on the attitudes in mathematics that these students have was collected along with demographic information to provide a better picture and understanding of the typical African-American college student that is enrolled in a college algebra classroom. The study revealed a significant relationship between attitude towards mathematics and achievement for African-American students with only 15.3% of the grade being explained by the domain scales. In this study, none of the domain scores had an overall negative score.

This is in line with research conducted by Guttbezahl (1995) which found that when students believe that they are incapable of achieving or have a low confidence level in mathematics, then the result is high levels of failure, bad attitudes towards mathematics, and a lack of interest in any courses involving mathematics. Surprisingly
Catsambis (1994) similarly reported, that despite low test scores in mathematics, approximately seventy percent of the African-American male high school students stated that math was one of their better subjects and that they always received good grades in math class. It seems that low test scores and low achievement levels do not necessarily impact the confidence level that a student has in his or her ability to do well in a mathematics classroom. This sense of overconfidence in their own abilities may be a cause for many students to not properly study the subject manner and to do the necessary activities that may result in the students enhancing their achievement levels and doing well in a mathematics classroom.

A study such as this one may help other researchers, faculty, and administrators gain a better understanding of African-American college students and allow them to put into place the resources and programs that would better serve the students. Successfully articulating students through their mathematics classes and their programs of study his would allow them to have a better opportunity to succeed in today's global workplace.

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Table I
Fennema and Sherman Domain Descriptions

Domain	Description
Attitude toward success in mathematics scale (S)	Measures the degree to which students anticipate positive or negative consequences as a result of success in mathematics.
Mathematics as a male domain scale (MD)	Measures the degree to which students see mathematics as a male, neutral, or female domain.
Mother scale (M)	Measures the students' perception of their mother's interest, encouragement, and confidence in the student's ability.
Father scale (F)	Measures the students' perception of their father's interest, encouragement, and confidence in the student's ability.
Teacher scale (T)	Measures the students' perception of their teacher's attitudes towards them as learners of mathematics. It includes the teacher's interest, encouragement, and confidence in the student's ability.
Confidence in learning mathematics scale (C)	Measures the confidence in one's ability to learn and perform well on mathematical tasks.
Mathematics Anxiety Scale (A)	Measures feelings of anxiety, dread, nervousness, and associated body symptoms to doing mathematics.
Effectance Motivation Scale in Mathematics (EM)	Measures Effectance as applied towards mathematics. This scale measures the interest and enjoyment of mathematics.
Mathematics Usefulness Scale (U)	Measures student beliefs about the usefulness of mathematics currently and in their future education, vocation, or other activities.

Table II
Fennema-Sherman Split-Half Reliabilities and CronBach's Alpha

Fennema-Sherman Scales	FSMAS Split-Half Reliabilities	FSMAS CronBach's Alpha	Current CronBach's Alpha
Attitude Toward Success in Mathematics Scale (AS)	.87	.84	.69
Mathematics as a Male Domain Scale (MD)	.87	.85	.69
Mother Scale (M)*	.86	.84	.65
Father Scale (F)	.91	.91	.93
Teacher Scale (T)	.88	.83	.83
Confidence in Learning Mathematics Scale (C)	.93	.91	.95
Mathematics Anxiety Scale (A)	.89	.90	.94
Effectance Motivation Scale in Mathematics (E)	.87	.86	.89
Mathematics Usefulness Scale (U)	.88	.88	.93

* The Cronbach alpha coefficient of 0.65 for the mother scale is bit low and could indicate that the mother scale may not be reliable.

Table III
Descriptive Statistics

	Mean	SD	Min	Max
Attitude toward Success in Mathematics Scale (AS)	53.94	5.11	12	60
Mathematics as a Male Domain Scale (MD)	52.21	5.12	12	60
Mathematics Usefulness Scale (U)	50.63	10.20	12	60
Teacher Scale (T)	50.28	7.32	12	60
Confidence in Learning Mathematics Scale (C)	45.60	13.22	12	60
Father Scale (F)	45.52	10.39	12	60
Mother Scale (M)	45.51	6.29	12	60
Mathematics Anxiety Scale (A)	40.72	13.56	12	60
Effectance Motivation Scale in Mathematics (E)	39.61	11.67	12	60

References

Braxton, J.M., Eimers, M. T., & Bayer, A.E. (1996, November-December). The implications of teaching norms for the improvement of undergraduate. The Journal of Higher Education, 67(6), 603-625.

Catsambis, S. (1994, July). The path to math: Gender and racial-ethnic differences in mathematics participation from middle school to high school. *Sociology of Education*, 67(3), 199-215.

Clewell, B.C., Anderson, B.T., & Thorpe, M.E. (1992). *Breaking the barriers: Helping females and minority students succeed in mathematics and science.* San Francisco: Jossey-Bass.

Fennema, E., & Sherman, J.A. (1976, November). Fennema-Sherman mathematics attitudes scales: Designed to measure attitudes toward the learning of mathematics by females and males. *Journal for Research in Mathematics Education*, 7(5), 324-326.

Forgasz, H.J., Leder, G.C., & Kloosterman, P. (2004). New perspective on the gender stereotyping of mathematics. Mathematical Thinking & Learning, 6(4), 389 – 420.

Gaff, J.G. (1991). *New life for the college curriculum.* San Francisco: Jossey-Bass.

Greenwood, L. (Dec., 1997). Psychological and contextual factors influencing mathematics achievement. Paper presented at the 1997 Australian Association for Research in Education Annual Conference in Brisbane. Retrieved October 26, 2005 from http://www.aare.edu.au/97pap/greel292.htm

Guttbezahl, J. (1995). How negative expectancies and attitudes undermine females' math confidence and performance: A review of the literature, *Information Analysis-General.*

Mulhern, F. & Rae, G. (1998, April). Development of a shortened form of the Fennema-Sherman mathematics attitude scales. *Educational and Psychological Measurement*, 58(2), 295 – 306.

Perie, M., Grigg, W., & Dion, G. (2005). The Nation's Report Card: Mathematics 2005 (NCES 2006–453). U.S. Department of Education, National Center for Education Statistics. Washington,D.C.: U.S. Government Printing Office.

Pettitt, L. (1995). Middle school students' perception of math and science abilities and related careers. Paper presented at the 61st Biennial Meeting of the Society for Research in Child Development. Indianapolis, IN.

Stage, F. K., & Kloosterman, P. (1995, May/June). Gender, beliefs, and achievement in remedial college-level mathematics. *The Journal of Higher Education*, 66(3), 294-311.

Stanic, G.M.A., & Hart, L.E. (1995). Attitudes, persistence, and mathematics achievement: Qualifying race and sex differences. In New Directions for Equity in Mathematics Education edited by W.G. Sedada, E. Fennema, and D.L.B. Adajian, 258-278. New York: Cambridge Press.

Swetman, D. (1995, Spring). Rurel elementary students' attitudes toward mathematics. *Rural Educator*, 16(3), 20-22.

Tapia, M., & Marsh II, G.E., (2004, Summer). An instrument to measure mathematics attitudes. *Academic Exchange Quarterly*. 8(2), 130-143.

Turner, N.D. (1981). Twenty years later: High school students who showed promise in mathematics. *The American Mathematical Monthly*, 99(6), 432-435.

Thurstone, L.L. (1926). Attitudes can be measured. *The American Journal of Sociology*, 33, 529-554.

Walker, E.N., & McCoy, L.P. (1997). Students' voices: African-Americans and mathematics. 1997 Yearbook for National Council of Teachers of Mathematics, pg. 71-80.

Wood, J.B. (1992). The application of computer technology and cooperative learning in developmental algebra at the community college. Paper presented at the 9th Annual Computer Conference of the League for Innovation in the Community College in Orlando, Florida.