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The Effects of Single-sex Mathematics Classrooms on African-American Males in the Ninth Grade

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Abstract

High dropout rates and poor academic performance are frequent characteristics of the educational experience for African-American male youths (Bailey & Paisley, 2004). With increased accountability standards to raise the academic achievement levels, single-sex educational environments have taken a central role in school reform agendas and initiatives in many school districts (Herr & Arms, 2004). The incorporation of a single-sex grouping served as a conduit for teachers to deliver instruction based on the varied learning styles of the students.

This study was designed to determine the effect single-sex classroom instruction has on African American males' achievement in ninth-grade mathematics compared to that of the other student groups. The researcher investigated a public school in a North Texas school district that offered alternative educational options for the students. Single-sex classrooms were created in mathematics. Teachers taught single-sex classes of students from varied ethnic backgrounds during at least one double-blocked period each day. *Ex post facto* data were analyzed. An independent samples t-test and a two-way factorial Analysis of Variance (ANOVA) were utilized to test each hypothesis to determine whether significant differences existed in the scale scores of comparison groups on state-mandated assessments over a period of 3 years. The instrument used to measure academic achievement is the Texas Assessment of Knowledge and Skills.

This study found that the mathematics scores of African American males in single-sex classes did not significantly differ from the scores of African American males in coeducational classes. The scores for the males in single-sex classes were slightly higher than that of males in coeducational classes at each grade level throughout the 3-year period. The mathematics scores of African American females in single-sex learning environments were not significantly different than those of African American males in single-sex classes. The scores for the female students were consistently higher throughout the 3-year period. This study identified the need for single-sex instructional opportunities for students as a means of eliminating the achievement gap.

Keywords: academic achievement, achievement gap, African-American males, gender, mathematics, single-sex classrooms

1. Introduction

This research was an investigation of the attempts by a North Texas suburban school district to address poor academic performance on standardized mathematics examinations by specific student subpopulations. According to the Texas Education Agency's (TEA) Academic Excellence Indicatory System (TEA, 2010a), the 2007 Accountability Rating for the research study campus was academically unacceptable due to the mathematics performance of the subpopulations labeled as economically disadvantaged. Of the 590 students who were administered the mathematics portion of the Texas Assessment of Academic Skills (TAKS), 304 students met the standard. The standard for TAKS ninth grade mathematics was a scale score of 2100. The state required at least 45% of the students in each subpopulation to meet the standard in mathematics. Only 38% of the economically disadvantaged subpopulation met this standard. The school's administration chose to offer alternative educational options for the students. Single-sex classrooms were created in the areas of mathematics and English Language Arts since reading is an integral part of mathematics success. Teachers of same-sex classes taught students from varied ethnic backgrounds during at least one double-blocked period each day. A double-blocked period is a class period of 90 minutes instead of the traditional 45 minutes (Godman, 2011). Options in instructional practices are the rights of parents. Single-sex educational environments are catering to the specific need of their clientele.

2. Method

The researcher used a quantitative method to examine assessment data obtained on ninth grade students in public education single-sex mathematics classes and coeducational classes. Data from a public school district in North Texas were used in the study. *Ex post facto* (after the fact) data were utilized. An *ex post facto* study is used when experimental research is not possible. Data from the 2008-2009 and 2009-2010 school years were used in this investigation. Ex-post facto analyses of African American males enrolled in single-sex mathematics classes, coeducational mathematics classes, and African American females enrolled in single-sex mathematics classes were utilized.

Same-sex classes of students from varied ethnic backgrounds received instruction during at least one double-block period each day. An independent samples t-test and two-way factorial analysis of variance (ANOVA) were utilized to test each hypothesis to determine whether significant differences exist in the scale scores of comparison groups on state-mandated assessments over a period of two years. The instrument used to measure academic achievement was the Texas Assessment of Knowledge and Skills (TAKS).

The subjects of this study are a total of 300 ninth grade students from one high school in a North Texas suburban school district who were administered the mathematics portion of TAKS during the spring of 2009 and 2010. The study school district consists of one high school; therefore, the study was limited to one campus. TAKS data were gathered for each student. The data from the 2009 and 2010 administration of the mathematics portion of TAKS were analyzed for each group. There were fifty students from each study group for each year.

3. Results

In the main analysis, basic descriptive statistics were initially generated. Descriptive statistics were used in this study to describe and summarize the demographic data.

Table 1 presents a preliminary independent samples *t*-test that was conducted to determine the difference in mean scores between the two batches of students in the samples. The two batches are groups that were enrolled in the ninth grade during the 2008-2009 and 2009-2010 school years. The main analyses made use of the combined data of both batches after the homogeneity of the two batches was established. The combined data were used in the succeeding main analysis. The data of test scores came from batches of students. As an initial analysis, an independent samples *t*-test was conducted to determine if the two batches statistically differ in their mean TAKS scores across the eighth, ninth, and tenth grades.

Results of this initial analysis indicated that no significant difference exists between the two batches in the TAKS mathematics scores across the 8th (M = 2189.78, SD = 150.86); $t(298) = .52$, $p = .60$ (two-tailed), 9th (M = 2166.06, SD = 214.69); $t((298) = .31$, $p = .75$ (two-tailed), and 10th grades (M = 2137.28, SD = 144.34); $t(298) = 1.33$, $p = .19$ (two-tailed). Therefore, it is acceptable to combine data of the two batches for the subsequent analyses.

3.1 Demographic Characteristics

The means and standard deviations across the different subgroups of the sample are presented. The analyses revealed that the overall mean scores of the students at the eighth grade level were the highest (M = 2189.78, SD = 150.86) and the overall mean scores of the students at the tenth grade level were the lowest (M = 2137.28, SD = 144.34). The mean results of African American females enrolled in single-sex mathematics classes scored higher at each grade level (M = 2179.02, SD = 130.27) than African American males enrolled in single-sex (M = 2161.49, SD = 180.9) and coeducational mathematics classes (M = 2152.61, SD = 190.8).

Table 1. Independent Samples t-Test of Equality of Means

Grade	T	Df	Sig. (2-tailed)	MD	Std. Error Difference
8th	.52	298.00	.60	9.05	17.44
9th	.31	298.00	.75	7.76	24.83
10th	1.33	298.00	.19	22.10	16.65

Table 1 represents the Independent Samples t-test for T value (*T*), degrees of freedom (*df*), Significance (*Sig.*), Mean Difference (*MD*), and Standard Error of Difference (*Std. Error Difference*).

3.2 Hypotheses

Hypothesis 1: No Significant Difference Exists Between the Longitudinal TAKS Scale Scores of African- American Males from 2008 through 2011, Who Were Enrolled in Ninth Grade Single-Sex Mathematics Classes and African American Males Enrolled in Coeducational Mathematics Classes During the 2008-2009 and 2009-2010 School Years.

For the first hypothesis, which compared the learning environments of African-American males, the results of statistical

techniques to compare groups indicated no statistically significant difference in scale scores (8.88). Therefore, in response to research question 1, the researcher ca suggest that there is very minimally significant difference between, and in favor of, single-sex learning environments for African-American males when compared to coeducational learning environments in relation to mathematics.

An independent samples t test and a two-way factorial ANOVA were conducted to determine the difference in mean scores and to test the main effects of grade level, classroom learning environment, and interaction effect between grade level and classroom learning environment, respectively. In order to test the statistical significance of the observed pattern of differences in the mean TAKS scores across the groups, a mixed two-way within groups ANOVA was conducted. In this analysis, two independent variables were considered: grade level (within groups measure) and type of class (between groups measure). The TAKS scores were the dependent variable. Results indicated that the main effect of grade level was significant, $F(2, 594) = 20.676$, $p<.001$, partial $\eta 2 =.065$.

The first cohort is comprised of 50 ninth grade African American males enrolled in single-sex mathematics learning environments and 50 ninth grade African American males enrolled in coeducational mathematics learning environments. Longitudinal data were collected from grades eighth through tenth. TAKS assessments for the mathematics content area were utilized during this time period. Data analysis was performed to determine mean, standard deviation and standard error of mean. The mean of the mathematics scale scores was the average scores of the grade levels and mathematics learning environment.

An independent samples t test was conducted to compare the TAKS mathematics scores for African American male students enrolled in single-sex mathematics classes and African American male students enrolled in coeducational mathematics classes. There was no statistically significant difference in scores for single-sex learning environment students ($M = 2161.49$, $SD = 180.9$) and coeducation learning environment students ($M = 2152.61$, $SD = 190.8$).

Hypothesis 2: No Significant Difference Exists Between the Longitudinal TAKS Scale Scores of African American Males from 2008 through 2011, Who Were Enrolled in Ninth Grade Single-Sex Mathematics Classes and African American Females Enrolled in Single-Sex Mathematics Classes During the 2008-2009 and 2009-2010 School Years.

For the second hypothesis, which compared African-American males in single-sex classes to that of African-American females in single-sex classes, the results of statistical techniques to compare groups indicate no statistically significant difference in scale score (17.53). Therefore, in response to research question 2, the researcher can suggest that there is minimally significant difference between, and in favor of, single-sex learning environments for African-American females when compared to single-sex learning environments for African-American males in relation to mathematics.

The second cohort is comprised of 50 ninth grade African American males and 50 ninth grade African American females all enrolled in single-sex mathematics learning environments. This cohort began with the ninth grade classes of 2008-2009 and 2009-2010. Longitudinal data were collected from grades 8 through 10. TAKS assessments for the mathematics content area were utilized during this time period. Data analysis was performed to determine mean, standard deviation, and standard error of mean. The mean of the mathematics scale scores were the average scores of the grade levels and mathematics learning environment.

An independent samples t test was conducted to compare the TAKS mathematics scores for African American male students enrolled in single-sex mathematics classes and African American female students enrolled in single-sex mathematics classes. There was no statistically significant difference in scores for single-sex learning environment male students ($M = 2161.49$, $SD = 180.9$) and single-sex learning environment female students ($M = 2179.02$, $SD = 130.27$).

The conclusions of research questions 1 and 2 held true across the different years considered in the study. The correlation of grade level with the type of class was not significant, $F(4, 594) = 1.109$, $p=.351$, partial $\eta 2 =.007$. Results also indicated that the main effect of type of class was not significant, $F(2, 297) = .777$, $p =.461$, partial $\eta 2 =.005$. The post hoc comparison using the Bonferroni adjustment for multiple comparisons indicated that, eighth grade scores ($M = 2189.78$) were significantly higher compared to scores during the ninth ($M = 2166.06$, $MD = 23.72$), and tenth grade ($M = 2137.28$, $MD = 52.50$); ninth grade scores ($M = 2166.06$) were statistically higher compared to tenth grade scores ($M = 2137.28$, $MD = 28.78$). The Bonferroni adjustment is a technique for controlling the overall probability of a false significant result when multiple comparisons are carried out.

Table 2. Two-way Factorial Analysis of Variance Summary for Within Groups and Between Groups

Source	SS	*df*	MS	F	Sig.	η^2
Within Group Factor						
Grade Level	414771.869	2	207385.934	20.676	.000	.065
Grade Level x Type of Class	44480.211	4	11120.053	1.109	.351	.007
Error	5957866.587	594	10030.078			
Between Group Factor						
Type of Class	108,352.816	2.000	54,176.408	0.777	0.461	0.005
Error	20,705,040.823	297.000	69,713.942			

Table 3. *Pairwise Comparisons Between Grade Level Scores*

Grade Levels		Mean Difference	Std. Error	p value
8th grade	9th grade	23.720	8.818	.023
	10th grade	52.503	6.774	.000
9th grade	8th grade	-23.720	8.818	.023
	10th grade	28.783	8.773	.003
10th grade	8th grade	-52.503	6.774	.000
	9th grade	-28.783	8.773	.003

Note: Bonferroni adjustment for multiple comparisons was applied

Table 2 presents the Test of Between-Subjects Effects for Sum of Squares (*SS*), degrees of freedom (*df*), Mean Square (*MS*), f statistic (*F*), Significance (*Sig.*), and partial eta squared (η^2). Table 4 represents the Mean Difference (*MD*), Standard of Error (*Std. Error*), and p value (*P*).

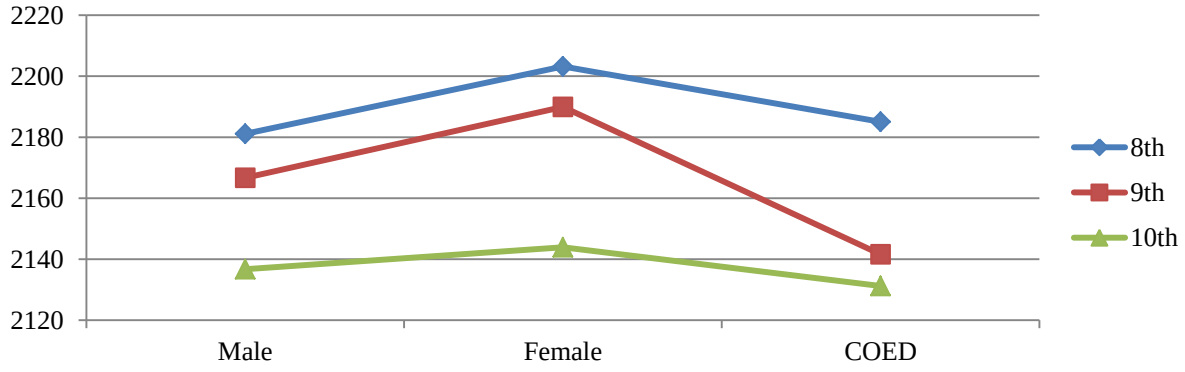

Figure 1. Graphical Representation of Profile Plots on Mathematics Assessments for All Male, All Female, and Coeducational Learning Environments

Descriptive data analysis resulted in the conclusion that students had higher mean TAKS scores during the grades 8, 9, or 10. The descriptive data analysis also resulted in the conclusion that TAKS mean scores in grade 10 were the lowest. Furthermore, the data analysis resulted in the conclusion that mean score of African American females in single-sex mathematics classes were higher than that of African American males in both single-sex and coeducational mathematics classes. While the mean scores of the African American females were higher than the males, no significant difference existed. Further, with regard to validity, the data across each of the two batches held true across the different years considered in the study.

4. Conclusions

High performing school districts are those that combine quality and equity that give all students opportunities for a good quality education. Providing support to disadvantaged students as a means of improving education can benefit the educational system and society as a whole. Alternative instructional approaches are key components to ensuring that all students have access to an excellent education. School districts must offer varied educational settings that allow parents to select the most appropriate learning environment for their children. Single-sex learning environments offer students

alternatives in teaching styles, content, and learning opportunities based on their specific needs.

The findings from this research support the benefits of single-sex learning environments for African-American males. Progress has been made in closing the achievement gap in the past decade. The graduation rate has increased by 10 percentage points for African-American males from 42% in 2001-2002 to 52% in 2008-2009 (Holman, 2012). More than half of the African-American males in the ninth grade graduated on time with regular high school diplomas.

The findings from this research seem to support the findings of other research on the benefits to female students enrolled in single-sex learning environments. The results from this indicated that there was a slight gain in the academic achievement of African-American females that school administrators would be content to obtain. The results of this study support the use of single-sex learning environments in mathematics as an option for students who are considered at-risk of academic failure.

It is evident that students who enroll in single-sex classes would benefit from a continuation of single-sex instruction in the following grades to continue the positive progression on state-mandated tests.

Ensuring a quality education for all students is an international challenge for educators. School districts should create new schooling models that promote meaningful innovation and improvement for all schools thus eliminating the achievement gap, increasing the graduation rate, and empowering parents through school choice.

There are various views of the effectiveness of single-sex learning environments. There are claims that single-sex learning environments enhance female education due to the absence of social interactions with males that divert attention from academic activities and the absence of competition from males for the teacher's attention (Mael, Smith, Alonso, Rogers, & Gibson, 2004; Riordon, 1990).

This information is encouraging enough to warrant further research on the impact of single-sex learning environments on other demographic groups. Additional research should be conducted on other alternative in instructional environments that support the educational desires of students such as career academies, magnet schools, charter schools, virtual schools, and controlled open enrollment schools. Parents should be given the option to select learning environments for their children that reflect family and community values.

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