Gender Differences in Mathematics and Integrated Science Achievement Among Junior Secondary School Students

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ABSTRACT

Purpose – This study examined gender differences in Mathematics and Integrated Science achievement among the Junior Secondary School students with particular interest on the interaction effect of gender and school type on students' achievement.

Method – The study adopted an ex-post facto research design and generated data from an inventory from the statistics unit, Ministry of Education, Ado Ekiti, Nigeria Public Junior Secondary Schools (JSS). The inventory requested among other things, data on the Junior Secondary School Certificate Examinations (JSSCE) in Mathematics and Integrated Science over a two year period.

Findings – The study revealed that, significant difference was detected in students' Science achievement; no significant difference between male and female students in private and public schools; a strong interaction effect were detected between gender of the students, the type of school attended and achievement of students in Mathematics and Integrated Science; the average achievement gap of male and female students irrespective of the school type is statistically significant in both Mathematics and Integrated Science, also, the strength of relationship between the gender of the students and the type of school attended is slightly stronger in Integrated Science than Mathematics.

Value – The possible implications for the study is discussed and addressed to the government and other stakeholders in education.

Keywords – Gender difference, Junior Secondary Schools, Integrated science, Mathematics.

INTRODUCTION

How to increase female access to education has been a global concern. Male-Female enrolment ratio has become a major educational development thrust. A country is considered to be educational developed if a greater percentage of the school-age female populations are enrolled in schools. The female participation rates in most of the developing nations are low, while both female dropout and female repetition rates are very high. This is due to low academic achievement of the female students, which is as a result of constraining institutional and societal factors (Owolabi & Fabunmi, 1999; Colclough & Lewin, 1993; Brock & Cammish, 1991; Tietjen & Prather, 1991).

In Nigeria, female participation in education is low when compared to that of their male counterparts, the situation was worse in the past, when the girl-child was not given any form of western education. The Nigerian tradition of early marriage did not help the situation. However, more female children are getting enrolled in schools. The existing data on gender differences in Nigeria showed that there was serious discrimination and low access of female students to study science and mathematics related subjects when compared with their male counterparts (Jegede & Inyang, 1990).

In the last few decades, many studies have asserted that male students outperformed female students in mathematics and science, with larger differences in science (Beller & Gafni, 1996); female students outperformed male students in reading and writing, with larger differences in writing (Battistich, Solomon, Kim, Watson, & Schaps, 1995). Boys from various cultures are superior to girls on spatial problems; girls are superior to boys on verbal tasks (Kagan, 1971). Studies of gender sex differences in mathematics achievement (Hedges & Nowell, 1995; Peterson & Fennema, 1985; Randhawa, 1994) found that, in general, males outperformed females in mathematics during the high school years.

Analysis of data from the assessment of the implementation of the integrated science curriculum at the primary school level showed that male students performed significantly better in integrated science than female students (Ayodele, 2001). Kolawole (2002) also reported that male students performed better in all science subjects than female students with larger differences in physics. The studies of Finn, Dulberg, and Reis (1979) found that boys do better than girls in civic education, mathematics and science, with the exception

that, in some countries, girls excel in Biology. Male students demonstrate a higher proficiency in mathematical aspect of science than female students (Pervin, 1978). The evidence reported so far shows that males appear to do better than females in mathematics and science; however, recent studies have challenged this trend by showing that this gap has declined (Barker, 1997; Hyde, Fennema, & Lamon, 1990; Knodel, 1997). And some other studies have shown no gender sex differences in mathematics and science achievement. Bronholt, Goodnow, and Convey (1994) reported no significant differences between male and female high school students in mathematics achievement. The studies of Olajide (1982) showed no gender sex difference in students' performance in Biology tests while Ogunboyede (1996) also reported that there was no gender sex difference in Agricultural Science achievement tests. Research efforts by Leahey and Guo (2001), and Ericikan, McCreikth, and Lapointe (2005) also indicated that there was no significant difference in achievement between boys and girls in mathematics. Subsequent studies on gender sex differences in mathematics also confirmed that there were no significant differences when considering gender (Abe, 2004; Lynn & Jaan, 2008). The National Assessment of Educational Progress (1997) reported that 4th Grade males' average scores in mathematics were higher than scores of 4th Grade females; however, scores for 8th and 12th Grade males and females did not show any significant differences.

Varieties of issues have been discussed regarding the effect of school type on students' achievement. The reports of the National Association of Independent Schools (2005) provided evidence that an average private school students outperformed public school students. Coleman, Hoffer, and Kilgore (1982) found that, even after taking into account key background characteristics of students, students attending private high schools, on average, outperformed students attending public high schools. However, research has consistently shown that these differences are insignificant and primarily attributable to the fact that parents of private school students tend to have higher level of education and higher level of personal wealth (Levin, 1990). Murray (1999) reported that scores on the National Assessment of Educational Progress did not indicate that private schools are superior to public schools. The study pointed out, that privileged students do marginally better in public schools, while underprivileged students do slightly better in private schools. Murray affirmed that, in either case, the differences are insignificant.

The major problem with the previous research on gender differences is its failure to address the interaction effect of gender, and school type on students' achievement in mathematics and integrated science, most especially at the junior secondary school level. This present study focused primarily on gender differences in mathematics and integrated science achievement among the junior secondary school with particular interest on the type of school attended by the students in Ekiti-State, Nigeria. In addition, the achievement of the gender differences was examined over a two-year period.

Research Hypotheses

The following hypotheses were formulated to guide this study:

1) There is no significant difference between the mean scores of male and female students in mathematics and integrated science.
2) There is no significant difference between the mean scores of students from private and public schools in mathematics and integrated science.
3) There is no significant interaction effect of gender and type of school on students' achievement in mathematics and integrated science.

MATERIALS AND METHODS

This study adopted an ex-post facto research design. The population was made up of all the Junior Secondary School Students in Ekiti State, Nigeria while a sample of 840 students of both sexes were drawn from 2006 and 2007 Junior Secondary School Certificate Examinations (JSSCE) in Ekiti-State, Nigeria. The selection was done using stratified random sampling technique, taking into consideration, the gender of the students and the type of school attended (private or public) from 20 Junior Secondary Schools. The sample was made in such a way that it cut across all the three senatorial districts of the Ekiti State, the which are: Ekiti North, which comprises five local government areas, Ekiti Central which comprises five local government areas, and Ekiti South which comprises six Local Government Areas. In all, 280 students were purposively selected from each of the three senatorial districts. The

instrument used was an inventory from the statistics unit, Ministry of Education, Ado, Ekiti-State, Nigeria. The inventory requested among other things, data on students' results in mathematics and integrated science for the year 2005/2006 and 2006/2007 academic sessions. The JSSCE is a State examination, prepared and administered by the Ministry of Education for all the third year Junior Secondary School students in all the subjects taught at this level. The data collected were analysed with the use of ANCOVA using SPSS version 15.0 package at 0.05 alpha level of significance.

RESULTS AND DISCUSSION

Table 1 shows the means and standard deviations for the dependent variable and independent variables.

Table 1

Mean and Standard Deviation of the Students' Achievement by Gender and Type of School in Mathematics and Integrated Science

	Type of School	Gender	Mean	SD	N
Students Achievement (Science)	Private	Male	50.29	10.28	306
		Female	55.48	10.72	176
		Total	52.18	10.73	482
	Public	Male	51.08	9.27	165
		Female	51.96	8.61	193
		Total	51.56	8.92	358
	Total	Male	50.57	9.94	471
		Female	53.63	9.82	369
		Total	51.96	9.99	840
Students Achievement (Maths)	Private	Male	51.05	8.54	306
		Female	49.32	9.28	176
		Total	50.42	8.85	482
	Public	Male	50.31	8.80	358
		Female	51.40	9.29	193
		Total	50.31	8.80	358
	Total	Male	50.34	8.41	471
		Female	50.41	9.33	369
		Total	50.37	8.82	840

Table 2

Summary of 2x2 ANCOVA Showing the Main and Interaction Effects of Gender and Type of School on Student's Achievement in Mathematics and Integrated Science

Source	Dependent Variable	Sum of Square	df	Mean Square	F	Sig
Corrected Model	Student's Achievement (Science)	3133.43(a)	3	1044.48	10.82	.000
	Student's Achievement (Mathematics)	839.70(b)	3	279.90	3.63	.013
School type*	Student's Achievement (Science)	361.71	1	361.71	3.75	.053
	Student's Achievement (Mathematics)	.203	1	.203	.003	.959
Gender	Student's Achievement (Science)	1811.70	1	1811.70	18.78	.000
	Student's Achievement (Mathematics)	20.27	1	20.27	.263	.608
School type* Gender	Student's Achievement (Science)	911.68	1	911.98	9.45	.002
	Student's Achievement (Mathematics)	835.75	1	835.75	10.84	.001
Corrected Total	Student's Achievement (Science)	83803.83	839			
	Student's Achievement (Mathematics)	65310.37	839			
Total	Student's Achievement (Science)	2347682.00	840			
	Student's Achievement (Mathematics)	2196727.00	840			

Table 2 displays the 2x2 ANCOVA results. These results indicate that the overall model is statistically significant ($F = 10.82$, $p = 0.000$).

Hypothesis 1: There is no significant difference between the mean scores of male and female students in mathematics and integrated science.

Table 2 shows that $F(1,839) = 18.78$; $p < 0.05$, and it also shows that female students ($\bar{X} = 53.63$, $SD = 9.82$) had higher mean scores than male students ($\bar{X} = 50.57$, $SD = 9.94$) in science. The table further reveals that the mean scores of male in mathematics ($\bar{X} = 50.34$, $SD = 8.41$) did not differ significantly from the mean scores of female students ($\bar{X} = 50.41$, $SD = 9.33$).

Hypothesis 2: There is no significant difference between the mean scores of students from private and public schools in mathematics and integrated science.

Table 2 also reveals that $F(1,839) = 3.75$; $p < 0.05$ and $F(1.849) = 0.003$; $p < 0.05$ which indicates that the achievement of male and female students in private and public schools were not significant, but female students ($\bar{X} = 55.48$; $SD = 10.72$) in private schools did better in science than male students ($\bar{X} = 50.29$; $SD = 10.28$). Therefore, hypothesis 2 is upheld. Thus, there is no significant difference between the mean scores of students from private and public schools in mathematics and integrated science.

Hypothesis 3: There is no significant interaction effect of gender and school type on students' achievement in mathematics and integrated science.

Table 2 further shows that the interaction between the type of school attended by the students and gender is statistically significant, since $F(1,839) = 9.45$; $p < 0.05$ and $F(1,839) = 10.84$; $p < 0.05$. Thus, hypothesis 3 is rejected, which implies that, there is a significant interaction effect on gender and school type on students' achievement in mathematics and integrated science.

The overall interaction effects on gender and school type on students' achievement in mathematics and integrated science is graphically shown in Figure 1 and 2.

Figure 1. Estimated Marginal Means of Students' Achievement (Science)

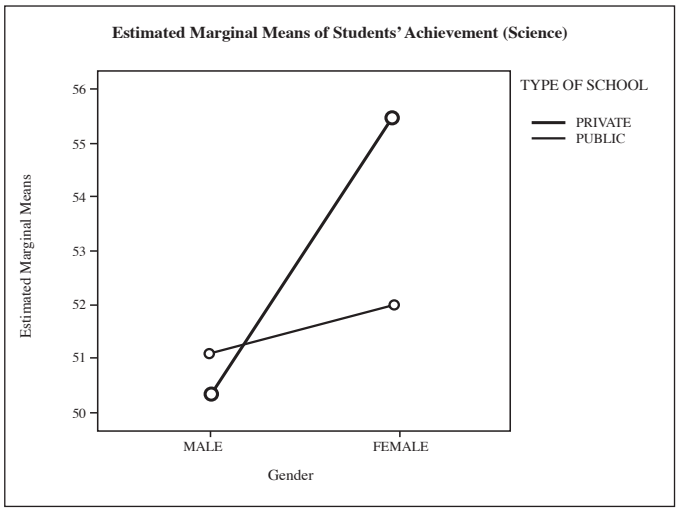
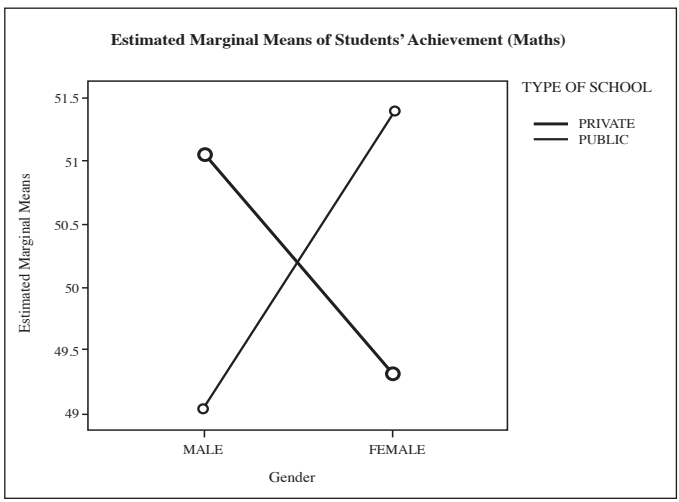


Figure 2. Estimated Marginal Means of Students' Achievement (Maths)



The result of Figures 1 and 2 shows that, the plotted profile of the interaction effect of gender and school type on student's achievement is slightly stronger in integrated science than mathematics.

The findings from the study revealed that female students outperformed male students in science. This finding does not concur with the findings of Finn et al., (1979), Beller and Gafni (1996), Ayodele (2001) and Kolawole (2002). The findings further showed that the achievement of male students did not differ from female students in mathematics. The findings corroborated with the report of NAEP (1997) which found that the average scores for 8th and 12th Grade males and females did not show any significant difference. The findings also revealed that the type of school attended by students has no significant effect on their achievement in mathematics and integrated science, but female students in private schools do marginally better in integrated science than male students. However the difference is not statistically significant. The findings tend to support the findings of Murray (1999) that scores on the National Assessment of Educational Progress did not indicate that private schools are superior to public schools, but the advantaged students do marginally better in public schools, while disadvantaged students do slightly better in private school. Further analysis of the results showed that, there are strong interactions between gender of the students, the type of school attended and achievement in mathematics and integrated science. That is, the average achievement gap of male and female students irrespective of the school type is statistically significant for both in mathematics and integrated science at varying percentages. The analysis further pointed out that the strength of relationship between the gender of students and the type of school attended is slightly stronger in integrated science than mathematics. The findings tend to corroborate with the findings of Coleman, et al., (1982) and NAIS (2005).

CONCLUSION

From the study, it could be concluded that, (1) when gender is considered, significant differences were detected in students' science achievement; (2) when school type is considered, taking into account the gender of the students, no significant difference appears between male and female students in private and public schools; (3) when the interaction effects of gender and school type on students' achievement were considered, significant effects were detected. The fact that there was no noticeable differences in the achievement of male and female students in private and public schools in mathematics and integrated science does not indicate that there is

no gender imbalance in the educational attainment of students at the junior secondary schools in Ekiti State, but stakeholders in education should make concerted efforts to motivate and increase female student participation in science and mathematics by providing early counseling that could change gender-stereotyping attitude concerning science and mathematics.

Based on the findings of this study, it is recommended that a coordinated effort be made to help students improve their achievement in mathematics and integrated science by using supplementary aids and frantic efforts should also be invoked to re-build school facilities and provide sufficient trained mathematics and integrated science teachers in schools.

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