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RESEARCH ARTICLE

COMPARATIVE STUDY OF SEX DIFFERENCE IN STUDENT'S ACADEMIC PERFORMANC AT THE SENIOR HIGH SCHOOL LEVEL IN GHANA

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Key words:**Abstract**

This paper examines the performance of Senior High School (SHS) students in core Mathematics and Science which are examined by the West African Examinations Council (WAEC)-The only authorized body for conducting external examinations in the whole of West Africa. The study involved six top schools in Central Region of Ghana, of which two are co-education schools, two boys' schools and two girls' schools. These schools admit students from all parts of Ghana. In all, Six thousand, one-hundred and sixty-four (6164) students' results were used. This also excluded the new four years SHS system (which is about to end) and since it stands to be compared with the outcome of this research in the near future. Descriptive statistics and Multivariate Analysis of Variance (MANOVA) was used to test for significant differences in means. Interestingly, the research revealed significant gender difference in academic performance between single-sex schools in favour of females. Conversely, males put up a better performance than their female counterparts in the same co-education schools. The season(s) for which females did better than males when separated (in different schools), and vice versa, is recommended for further research. Also, there were some recommendations for policy makers and others.

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Introduction

The study of Mathematics and Integrated Science in Senior Secondary Schools (SSS) in Ghana gives students firm foundation upon which other subjects (elective subjects) are built. Knowledge in them builds in one the habit of creative thinking and develops the intellectual curiosity. Many review committees on education have been established in the past (the Kwapong Review Committee of 1966, the Dzobo Committee of 1974) to review and implement new policies regarding education in Ghana. They saw its full implementation in 1987, Reviewed in 2002 and implemented in 2007 with the duration of three years changed to four, and now back to the former.

Mathematics and Integrated Science have been made compulsory at the SHS level for all students. Sometimes, the mere mention of these subjects put great fear in some Ghanaians at all levels of learning. Some people in Ghana think that this fear is mostly associated with females. It is not surprising that many students in Ghana shy away from mathematics, science and related courses, at the tertiary level. For example, data produced by the Student Records and Management Information Section of the University of Cape Coast, Ghana, at the 44th Congregation 2012, revealed that students reading BSc/Bed Mathematics or Bed. Science in the year 2012, at various levels revealed that 14.4% (143) were females. The programme of study which recorded the least female representation was Bsc Mathematics (6.3%), followed by Bsc Mathematics with Statistics (8.9%).

The Government's White Paper Report on Education Report Review, (2002) in Ghana reported that on the average, the survival rate from primary grade 1 to primary grade 6 has been only 80.0% for boys and 78.9% for girls. Furthermore, it reported that "the transition between primary grade 6 and Junior High School (JHS) grade 1 has also been less than satisfactory, at 91.4%." Those who manage to complete JHS; the transition rate to SHS 1 was quite catastrophic, with approximately only 40% of JHS graduates managing to gain admission into Senior High

Schools. The report did not mince words on the problem of gender equity across all levels of education and stated that only 42.7% of students at the SHS level are females.

One other method to improve performance was that the Ghana Education Service ranked the schools using the West African Examination results. This met mixed feelings and criticisms from parents, teachers and schools, hence the suspension of the rankings ('Leak Table') in Ghana. Some of the criticisms are:

1. The levels of difficulty of the subjects are not the same and are not read by all students yet schools were compared without subject considerations.
2. Males generally do better than females at all fields of learning in Ghana and hence did not require comparison but assistance for female schools.
3. Teacher-Student ratio varies. Those with large population (50 students in a class) suffer. Thus, efficiency of work cannot be compared with smaller groups (35 students in a class) in this regard.

Many of the technical issues raised above have no simple answers. We therefore wish to consider the above criticisms and introduce some level of fairness by using only Mathematics and Integrated Science (which are related and read by all students) as a basis for comparing performance with special interest in sex difference in academic performance. The Study therefore wishes to find out the following:

1. To find out whether or not significant differences exist between SHS boys and girls with regards to academic performance in mathematics and integrated science.
2. To find out whether significant differences exist in academic performance between SHS boys and girls in the same coeducation school.
3. To establish if sex differences exist in academic performance between single-sex schools and coeducation schools.
4. To help eradicate any form of subordination or marginalization of females at any level of education, should girls be found to be performing well or better.

General Performance of Boys and Girls in Mathematics

According to Nenty, (1995), citing Forsyth and McMillan, (1981), sex – an organismic variable which cannot be manipulated – is a significant factor in mathematics performance, with males generally performing better than females. Findings of studies on sex influence tend to imply that females, more than males, tend generally to attribute their failure in mathematics to lack of ability, ill-luck and task difficulty. Other writers who share similar sentiments are; Hensel, (1989), "School Science and Mathematics" Vol. 89 (8) Dec., 1989 on the topic: "Mathematical Achievement – Equating the Sexes"; "Hormones Cause", (1986); Kolata, (1983); Fennema, (1977), 1983; and Restak (1979). Some said that girls in America and Britain tend to see mathematics and science as hard, difficult, intellect-based, complex and masculine.

Jeffrey, (2010); and Susan, (2008) citing Vander, (2007), indicated that studies to find out whether or not boys and girls differ in general intelligence have not yielded consistent findings. They, therefore, concluded that no significant difference exist between boys and girls when general intelligence is measured.

In a study conducted in the Central and Western Regions of Ghana on 1528 Secondary School Students, Eshun, (1999) realized that females in single-sex schools performed better than the females in the mixed schools. He explained that the experiences and activities that go on in the mixed schools are different from that of the single-sex schools. Usually, these experiences and activities tend to favour the boys, and that explains why girls perform poorly in the mixed schools.

Gender Difference in Academic Achievement in Science

According to Anamuah-Mensah, (1995), 'because of the importance of science to every nation, Ghana has embraced science and technology after independence as the penances for overcoming problems of poverty, disease, illiteracy, unsanitary conditions, and the like which have plagued the country for years'. He said further that government's effort has not yielded the anticipated results because of the neglect of the female citizenry which constitutes about 50% of the population. There is always low participation of women in selected employments because of the notion that girls are low academic achievers in science than boys. He identified General Science, Chemistry and Physics as the areas where girls perform better than boys in the G.C.E 'O' Level examinations from 1981 to 1991. Meanwhile boys seemed to have better edge over girls only in Biology.

Anamuah-Mensah, (1995), however, maintains that the results of the G.C.E. 'A' Level is entirely different from the 'O' Level results. Generally, boys performed far better than girls in all the science subjects (Physics, Chemistry, Biology) from 1981-1991.

Anamuah-Mensah, (1995), said also that studies carried out in Nigeria, Swaziland, Kenya, and Mauritius by Lockheed and Komenan, (1988); Eshiwani (1985), and Chinapah, (1983) revealed that boys perform better than girls in science subjects.

Hamilton, (1985) conducted a study in Jamaica which revealed that girls in single-sex schools performed better than boys in co-education schools in the science subjects. The logical conclusion one can draw from the above researchers is that a lot of them support the view that boys perform better in science than girls. On the other hand, there are a few instances where girls have performed better than boys in science especially in the single-sex schools.

Methods

The data was collected from six selected Senior Secondary Schools in the Cape Coast Municipality. It was made up of their SSSCE results from 2003 to 2005, conducted by the West African Examination Council (WAEC). The total number of students considered was 6164 with the breakdown as follows:

School A (single sex – Boys only)	1674
School B (single sex – Boys only)	1524
School C (single sex – Girls only)	1179
School D (single sex – Girls only)	712
School E (co-education or boys & girls)	587
School F (co-education or boys & girls)	488

Since the raw scores were not provided by WAEC but in a qualitative form (A1, B2, B3, C4, C5, C6, D7, E8, F9), we regrouped as follows: A1 for A; B2, B3 for B; C4-C6 for C; D7 for D; E8 for E; and F9 for F. The data were then weighted (coded) in descending order from 5 to 0 for A to F. These data were then re-grouped according to subjects and the number of students obtaining grades A, to F in a tabular form for use. Since students' academic grades were obtained from the various institutions which fall within this research area and were conducted by a certified and reliable body (WAEC), they are therefore credible, reliable and non-manipulated.

The grades of each student were coded as follows: 5 for A, 4 for B, 3 for C, 2 for D, 1 for E and 0 for F, respectively.

Analysis of Results

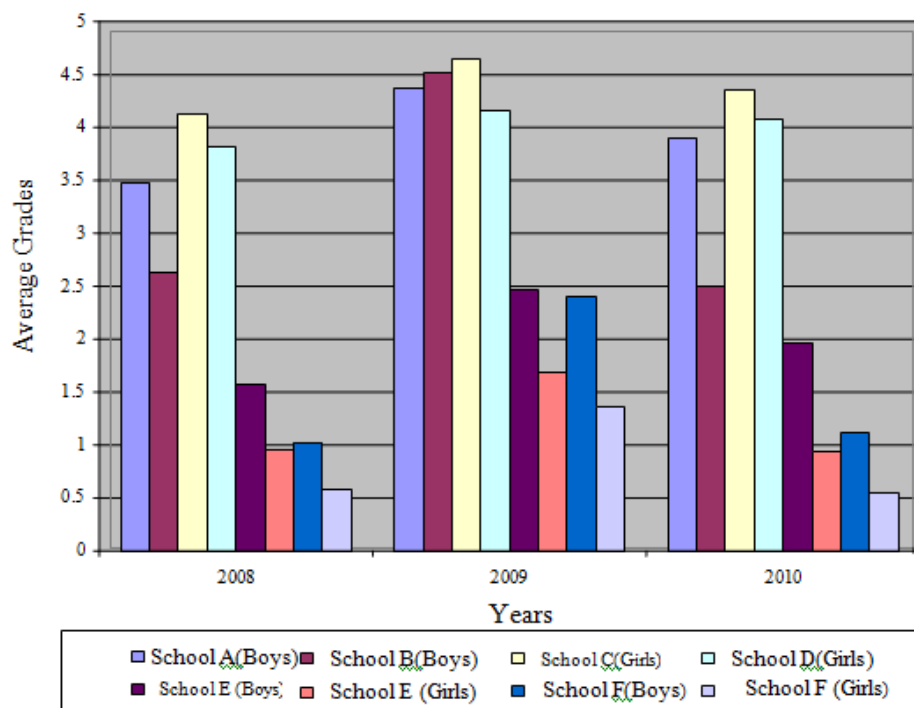


Figure 1: Average Performances in Mathematics from 2008 to 2010

Figure 1 reveals that in 2008, the average performance of Schools A, B, C, and D is commendable. Here, it is clear that the single sex schools are relatively doing well with the girls in the lead. However, co-education schools like Schools E and F have not performed well. Whilst boys in School E had an average of 1.57 (approximately grade D), girls of the same school were struggling to make grade E. The situation is not too different in School F. It is also clear that boys are slightly ahead of girls in the co-education schools in 2008.

In 2009, there was a massive improvement over the previous year's results. School C and School B had approximately grade A with mean values 4.64 and 4.51 respectively. School A and School D scored grade B each with mean scores of 4.37 and 4.16 respectively. The six schools can be ranked in descending order as; School C, School B, School A, School D, School E and School A, respectively.

The performance of the six schools in 2010 was generally similar to that of 2008, but showed a downward trend in performance in 2010. However, only Schools C and D showed some improvement averagely from 4.13 to 4.35 (5%) and from 3.81 to 4.07 (7%) respectively. Furthermore, girls from school F had the lowest average score of 0.55 (approximately grade E) with standard deviation 0.58 in 2010. This means that almost every girl in School F had as low as grade E.

Test of Significance

It was realized that in all the tests performed, School C's performance was significantly different from all other schools and categories.

Table 1: Test of Significance –Mathematics (2008)

Groups	All Schools	School E (Boys vrs. Girls)	School F (Boys vrs. Girls)
p-value	0.000	0.009	0.030

The multivariate significance tests indicates that at an alpha level of 0.05, with $p\text{-value} = 0.00 < 0.05$, the test is highly significant. We therefore have sufficient evidence to believe that the treatment means are different. Hence, we conclude that there are differences in performance between the various groups in Mathematics in 2008.

Furthermore, with $p\text{-value} = 0.009$, we conclude that there is sex difference in performance in mathematics in School E. Also, we have enough evidence to say that there is sex difference in performance in mathematics in 2008 in School F. This is because, the $p\text{-value} = 0.03 < 0.05$. This confirmed the preliminary analysis. Hence, the positions remain that "the single sex schools are relatively doing well with the girls in the lead. However, the co-education schools have not performed well."

Table 2: Test of Significance –Mathematics (2009)

Groups	All Schools	Sch. E (Boys vrs. Girls)	Sch. F (Boys vrs. Girls)	Sch A vrs. Sch D	Sch A vrs. Sch B
p-value	0.000	0.002	0.000	0.026	0.027

There is no doubt that with the $p\text{-values} < 0.05$ we cannot fail to admit that statistical difference in academic performance exist for all groups. With reference to Table 2, we conclude that School C came first, School B second, School A third, School D fourth, School E fifth, and School F sixth. Meanwhile, the boys performed better than girls in the co-education schools. It was a mixed-performance in the Single-Sex Schools In 2009.

Table 3: Test of Significance –Mathematics (2010)

Groups	All Schools	School E (Boys vrs. Girls)	School F (Boys vrs. Girls)
p-value	0.000	0.000	0.000

From Table 3, it is highly significant at $p\text{-value} = 0.000 < 0.05$. By this, we cannot but conclude that there is significant gender difference in performance in mathematics in 2010 for all the groups. We also have every reason to agree that sex difference in mathematics achievement in the co-education schools (Schools E and F) in 2010 is significant. This difference is in favour of boys (See Figure 1). Since all cases show some significant difference in performance, the mean differences give room to position the schools in order of first to sixth (Refer: Figure 1) as follows; Schools C,D,A,B,E and F respectively.

Furthermore, in the co-education schools, the boys were leading their female counterparts. It was the reverse in the case of single-sex schools in 2010 (Refer: Figure 1)

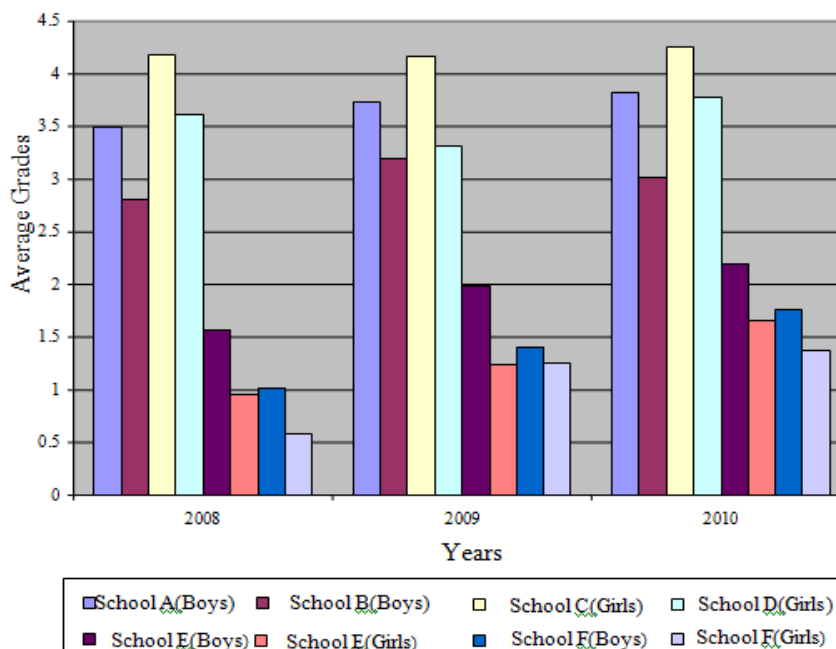


Figure 2: Average Performance in Integrated Science from 2008 to 2010

From Figure 2, the average performance of the single-sex schools is grade B (mean = 3.6), whilst that of the co-education schools is grade E (mean = 1.0) in 2008, in Integrated Science. The general performance in Integrated Science is similar to that of Mathematics except that the averages are higher in Integrated Science. The best and least performing schools over the years are still School C and School F, respectively. Generally the single-sex schools are still doing better than the co-education schools. This time, School A performed slightly better than School D in 2009 and in 2010. It was also realized that in the co-education schools, boys put up a better average performance than their female counterparts over the three (3) years. Again, the general performance in 2010 was better than that of 2009.

Table 7: Test of Significance –Integrated Science (2003)

Groups	All Schools	School E (Boys vrs. Girls)	School F (Boys vrs. Girls)	School A vrs. School D
p-value	0.000	0.000	0.000	0.203

With $p\text{-values} = 0.00 < 0.05$, we conclude that the means of the groups are statistically different. The positions of the schools with reference to Figure 2, still remain valid, in 2008. Furthermore, there is evidence that sex differences in performance between schools and within schools exist except Schools A and D. Contrary to the preceding analysis, the means of the two schools are of no statistical difference because it has a very high $p\text{-value}$ of $0.203 > 0.05$.

Table 8: Test of Significance –Integrated Science (2009)

Groups	All Schools	School E (Boys vrs. Girls)	School F (Boys vrs. Girls)	School B vrs. School D
p-value	0.000	0.000	0.260	0.299

From Table 8, we conclude that differences exist between the treatment means for all schools and between boys and girls in School E. On the other hand, we agree that (a) No sex difference exists in academic performance in School F, in 2009. (b) The means of boys and girls in School B and School D are not statistically different. Both sexes had approximately the same grade. By this, their positions in the preliminary analysis still hold.

Table 9: Test of Significance –Integrated Science (2010)

Groups	All Schools	School E (Boys vrs. Girls)	School F (Boys vrs. Girls)	School A vrs. School D
p-value	0.000	0.001	0.002	0.593

With reference to Table 9; (a) We conclude that there exist differences in treatment means between the six schools. (b) There is significant gender difference in academic performance in schools E and F. (c) However, between Schools A and D, there is no statistical gender difference in academic performance.

Finally, in the co-education schools, the boys performed better than the girls in 2010 in integrated science results (Also see Figure 2).

Discussion

The results revealed that differences in performance was highly significant over the three years between the six schools and even, between boys and girls of the same co-education school in mathematics. The two girls' schools have been leading in performance except in 2009 where the two boys' schools were second and third respectively to School D (a girl's school). The co-education schools were also consistent with their positions – fifth and sixth, respectively, over the three years. However, the boys have been performing better in mathematics than girls in the same co-education school.

Furthermore, boys in single-sex schools have continuously performed better than both boys and girls in the co-education schools from 2008 to 2010 in mathematics.

Our findings did not support that of Restak, (1979), and Fennema, (1983), (1974). They are of the view that girls begin to fall behind boys during the high school years. However, the research supported findings that say that students in single-sex schools do better in mathematics than their counterparts in the co-education schools. For example, Eshun's (1999) research found that females in single-sex schools performed better than females in co-education schools in mathematics. There was also some inconsistency in the performance of boys and girls in mathematics – girls did better in single-sex schools than their counterparts and even those in mixed schools. Boys in single-sex schools did better than students in the mixed schools, and in the mixed school, boys did better than girls. Perhaps, certain experiences and activities take place in the girls' schools which account for their excellent performance, and in the mixed schools, it may not favour girls.

What generally accounted for the weak performance in mathematics in the mixed schools is left unanswered. Activities that go on in the girls' schools which perhaps gave them such a lead are yet to be known.

It is enough to conclude that even though the performance in the co-education schools is not good relatively, boys did better than girls in the coeducation school throughout the three years (that is, 2008, 2009, and 2010) in Integrated Science. However, in the single-sex schools, girls were slightly ahead of boys in Integrated Science.

If boys performed better than girls in science as said by Lockheed and Komenan, (1988); Eshiwani, (1985), and Chinapah, (1983) in their research conducted in Nigeria, Swaziland and other countries, in Ghana, girls have generally performed better than boys over the years considered in this research. On the other hand, Hamilton's (1985) assertion that girls do better in single-sex schools than boys in co-education schools in science is being supported by this research findings. The secret behind girls in single-sex schools doing better than all others is yet

to be investigated. According to this research finding, boys also did better than girls in the same co-education school in Integrated Science.

Conclusions

The general performance of students over the years with reference to the research was satisfactory except that the general performance in 2010 was a retrogression of the previous year's results. In general, in the single-sex schools females performed academically better than males. However, in the co-education schools, males performed better than their female counterparts. We can by this research say that the girls' schools performed better than the boys' schools and all the co-education schools.

Furthermore, there was no single occasion where a co-education school performed better than a single-sex school. These categories of schools (co-education schools) were found to have performed far below that of the single-sex schools. It is worth mentioning that though there were a number of times sex difference in performance was negligible statistically in the same school (co-education school), generally, sex difference in academic performance was frequently in favour of boys.

Finally, we say that when females are separated from males, they put up a better performance than their male counterparts in the Central Region of Ghana and vice versa.

Recommendations

The wide sex differences in academic performance identified in the findings indicated that effort should be made to encourage and assist boys in the single-sex schools to improve their performance and most especially students in the co-education schools. This needs national support and effort. Therefore, intervention programmes should be organized for both boys and girls in their own school settings, especially in the co-education schools to tackle some of the root causes of the sex differences in academic performance.

Females should not be marginalized in Ghana since they have proved to be performing better in many instances than males in the two subject areas.

Teachers should do everything possible, to encourage both boys and girls in their classes to improve their performance. They should provide students with role models of both males and females who have excelled in the various disciplines. They should also encourage students to read the biographies of women/men mathematicians, and scientists.

Further research into the reasons why females do better than males when they are separated (in single-sex schools) and vice versa, is yet to be established.

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