

DISPARITIES IN THE PHYSICS ACADEMIC ACHIEVEMENT AND ENROLMENT IN SECONDARY SCHOOLS IN WESTERN PROVINCE: IMPLICATIONS FOR STRATEGY RENEWAL

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Abstract

The topic of unequal outcomes for men and women in math and science has been in the public domain for some time now. This study however had special interest in physics because it is an optional science subject in most schools and taken by those confident enough to take on a third science subject. It is a key science subject expected to drive Kenya's vision 2030 initiative which aims at making the country a newly industrializing middle income country providing high quality life for all its citizens. The realization of this vision calls for the harnessing of the science and technological ability of both men and women in the country; it is a collective responsibility of both genders. The study adopted a descriptive survey design. This paper presents the findings of the study on disparities in achievement and enrolment in physics in Kenya with a focus in Western Province. This study was conducted in 40 secondary schools in Western Province. Out of the selected 40 schools, responses were obtained from 32 schools giving a response rate of 80%. The data collection instrument was a questionnaire. Data on enrolment and performance on physics was obtained from the respective Heads of Departments. The study revealed that there are disparities in enrolment and achievement among the different school categories and gender disparities as well. Boys' schools have had a steady lead in the enrolment and achievement on physics during the five years. The findings indicate that there is need to have a change in strategies in order to improve performance and enrolment in girls' and co-education schools.

Key words: *disparities, gender, harnessing, industrializing, technological and unequal outcomes.*

Introduction

The topic of unequal outcomes for men and women in math and science has been in the public domain for some time now. A wealth of research has documented differences in the academic achievement of boys and girls (Dwyer & Johnson, 1997; Entswisle et al., 1997; Hyde, Fennema & Lamon, 1990; Kimball, 1989). In science, the gender gap in interest, participation and performance is well known and has been the subject of intense scrutiny. Worldwide, it has been observed that boys show significant greater achievement in science (Gonzales et al., 2004; Martin, Mullis & Chrostowki, 2004). Observations of such differences have been reinforced by the view that boys are "naturally" better equipped to excel in science (Jacobs & Eccles, 1985). Such stereotypes that men are naturally more talented and interested in science are thought to influence the science, technology and engineering aspirations and achievements of boys and

girls, men and women (Frome & Eccles, 1998; Furnham, Revees & Budhani, 2002; Klefer & Sekaqueptew, 2007).

Data on low female achievement has come from the cross-cultural survey of science achievement carried out by International Evaluation of Educational Achievement (IEA). The results of the three IEA science studies namely; First International Science Study (FISS), the Second International Science Study (SISS) and Third International Mathematics and Science Study (TIMMS) reveal that gender differences have been found in every subject area in the written science achievement tests. The gender difference always favoured males. The 1999 and 2003 findings revealed that boys outperformed girls and had a larger variance. In addition, boys outnumbered girls in the top 25% in science performance (Chang, 2008).

The 1986 National Assessment of Educational Progress (NAEP) carried out in the United States had reported that boys had outperformed girls in sciences achievement and that the gender gap continuously increased as students progressed in school. A later assessment by NAEP in 2005 revealed that males outperformed females in science achievement in grades 4, 8 and 12. Females at all levels made relatively little gains in their average science scores since 1996. In most cases by grade 11, the areas of largest male advantage were physics, Chemistry, Earth science and Space science (Kahle & Meece, 1994; Stencamp & Maehr, 1983; Becker, 1989; Lee & Burkam, 1996).

In some countries, research shows some decline in gender differences in science achievement but female representation in science related fields is still low (Jacobs, 2005). In many African countries, the number of women enrolled in science-based training and those involved in science-based professions are among the lowest in the world (Frazier, 1999). Males continue to surpass females in the number of undergraduate degrees awarded in science and engineering fields especially in computer science, physical science and engineering (National Science Foundation, 2005). The share of females enrolled in science was below 20% in Botswana, Gambia, Guinea and Nigeria. The proportion in engineering was below 10% in Ghana and Swaziland (UNESCO, 2008). Kakonge (2000) analysed the Kenya Certificate of Secondary Education (KCSE) data for 1990-1996. The findings revealed that at both national and provincial level, the averages of examination scores for boys were higher than those of girls. In physics the national mean score was 45.8% for boys and 42.3% for girls that indicates a gender percentage gap of 4.5%. The study carried out by IPAR on the performance of students in KCSE revealed that in science subjects the percentage gap in physics in the four districts under study was 5% in Kiambu, 8% in Bungoma, 8.7% in Kisumu but no gap was identified for Garissa where no single girl registered for physics (IPAR, 2003).

Both male and female teachers have a negative attitude towards girls' abilities to perform well in mathematics and science. Teachers cite girls' fear of the subjects, lower determination and lower intelligence when compared to boys. Bali (1997) found that the majority of teachers believed that boys would join the university to train as doctors, engineers and architects while girls were only capable of being tailors, teachers and secretaries. Generally, teachers interact differently with boys and girls and some evidence suggests that students benefit academically from having teachers who are of the same gender as themselves (Dee, 2007). In addition, schools, teachers and the curriculum encourage girls to adopt passive and dependent behaviour while boys adopt aggressive and independent behaviour. The differential treatment of boys and girls also affects performance. Girls ask fewer procedural questions; receive significantly less praise, fewer direct questions and little behavioural warning from their teachers (Jones, 1991; Jones & Wheatley, 1990). Teachers hold different expectations for their students based on genders and subsequently treat them differently based on these expectations (Becker, 1981). Thus classroom interaction patterns result in more opportunities for boys than girls to learn science and performance achievement may reflect the higher expectations for boys (Kahle & Meece, 1994; Jones & Wheatley, 1990).

Girls are socialized into characteristics of dependence, nurturance and passivity. They therefore develop a set of attitudes and beliefs that do not promote high levels of achievement and participation in science. Studies have found that females have more negative attitudes towards science. According to (Wasanga, 1997), the majority of girls found science subjects difficult and they perceived science subjects to be more useful to boys. A study by Lee and Lockheed (1990 as cited in Frazier, 1999) on a sample of 1,012 students from single sex and mixed secondary schools from ten southern states of Nigeria found that perceived ability was positively related to higher achievement. Similarly, Aghenta (1989) found that perceived difficulties of science occupations was a significant factor preventing girls from entering Science, Technology and Mathematics (STM) fields.

Males' propensity to enroll in physics had been attributed to higher performance on science achievement tests and subsequent interest in STM careers. Where subject choice is allowed, boys generally choose male-identified pathways and careers-vocational pathways, while girls choose female identified pathways (EU, 2009). Further research relying on Implicit Association Test (IAT) shows that most men associate more easily with science and female with liberal arts than the reverse (Nosek, Greenwald & Banaji, 2006).

Gender stereotyped careers is another limitation to enrolment in science-related courses. Children perceive various activities as masculine or feminine (Kahle & Lakes, 1983). Kelly (1995) explained how the masculine science image is constructed in schools. The masculinity of science is often the prime reason that girls tend to avoid the subject at school. Science is usually seen as a masculine subject because of the disproportionately large numbers of males who study and teach it, the bias towards males and against females in the curriculum material and male- oriented classroom instruction.

In Kenya, low enrolment and high dropout rates in schools have been identified as some of the reasons accounting for the low number of girls enrolling in science. Negative attitude from parents has also been cited as a major cause of low enrolment (Wasanga, 1997).

Problem Statement

In most secondary schools, physics is an optional subject and it is taken by those confident enough to take on a third science subject after the compulsory chemistry and biology. It is very important for students to be proficient in physics, because it plays an important role in many career choices and professional development. Poor scores in physics limit students' opportunities in competitive professional courses like engineering and information technology among others. The girls are the most affected, because they enroll in small numbers and their performance is relatively low. This may limit their representation in science-oriented courses. Yet Kenya's Vision 2030 initiative aims at making the country a newly industrializing middle income country, providing high quality life for all its citizens. The realization of this vision calls for the harnessing of the science and technological ability of both men and women in the country; it is a collective responsibility of both genders. However, this vision may not be fully realized if girls continue to underachieve in subjects that determine their placement in science-oriented fields, which are expected to spur industrialization. It is against this background that this study seeks to establish the disparities in academic achievement and enrolment in physics and the factors contributing to these patterns.

Research Objectives

1. To identify the disparities in performance on physics among secondary schools in KCSE during 2005 – 2009, in the Western Province, Kenya.

2. To identify the disparities in enrolment in physics among secondary schools during 2005 -2009, in the Western Province, Kenya.
3. To investigate the factors influencing differential enrolment in physics in secondary schools, in the Western Province, Kenya.

Research Questions

1. What are the disparities in performance in physics among secondary schools in KCSE during 2005 – 2009, in the Western Province, Kenya?
2. What are the disparities in enrolment in physics among secondary schools during 2005 - 2009, in the Western Province, Kenya?
3. What factors influence differential enrolment in physics in secondary schools in Western Province, Kenya?

Research Hypothesis

H₀₁- There is no relationship between school performance in physics and enrolment.

Methodology of Research

Research Design

The study adopted a descriptive survey design. Descriptive research is concerned with conditions or relationships that exist, practices that prevail, processes that are going on, attitudes that are held or trends that are developing (Best, 1970). The design facilitated the collection of information on the current disparities in enrolment and achievement in physics. It yielded information which was analyzed using descriptive and inferential statistics. The design also permitted an assessment of the factors influencing achievement in physics.

Participants and Settings

The sampling frame was secondary schools in Western Province. The schools were stratified into three categories of Boys' boarding, girls' boarding and co-education schools. The study used Heads of Science Departments (HoSDs) in schools. There were 40 HoSDs chosen as respondents, representing the administrative authority in their respective departments of their schools. Responses were received from 32 schools. The study covered schools which were ranked in the 2009 KCSE provincial merit ranking list. A multi-stage sampling method was used at two levels. The first level of sampling was stratification according to school categories based on their performance in the 2009 KCSE examination results. This was to ensure that homogenous sub-sets that share common characteristics were in one group. It also ensured the equal representation of the population in the sample. The second level was random sampling involving each stratum.

Instrument

The main data collection instrument in this study was a questionnaire that asked the respondents to fill in information on their gender, the school type, mean scores in physics during each of the five-year period and factors contributing to the indicated performance trends. For consistency, the questionnaire had questions which were closed-ended. The choice of this

instrument of data collection is suitable, because it is free from bias and hence reliable. It is also easy to administer to a large group and allows adequate time for well thought out answers.

Data Analysis

Data collected from the field was checked to ensure that data was accurate, consistent with other facts gathered and well arranged to facilitate coding and computer keying. Both descriptive and inferential statistics were used in the analysis with the aid of the SPSS package. Since this study was comparing performance among different school categories, Analysis of Variance (ANOVA) was used to test the difference between groups (boys' boarding, girls' boarding and co-education schools during the five year period). To establish any significant statistical differences in gender performance, the t-test was used.

Results of Research

This section presents the findings of the study on disparities in achievement and enrolment in physics in Kenya with a focus on the Western Province. This study was conducted in 40 secondary schools in the Western Province. Out of the selected 40 schools, responses were obtained from 32 schools translating to 80% response rate. Of the 32 secondary schools, 16 were provincial while 16 were district schools. Further classification grouped the schools into boys' boarding (8), girls' boarding (8) and co-education schools (16). Data on enrolment and performance on physics was obtained from the respective HoDs. **Disparities are examined** at the level of the different categories of schools and gender. The findings were presented in the order of the objectives of the study.

Disparities in the Performance of Physics from the Year 2005 to 2009

Performance on physics by the different categories of schools during the five years is presented in Table 1.

Table 1. Physics performance (2005 - 2009).

School category	Year					
	2005	2006	2007	2008	2009	Average
Boys Boarding	6.960	7.491	7.372	7.410	7.178	7.281
Girls Boarding	5.982	6.115	5.812	6.113	5.553	5.915
Co-education	4.326	4.211	4.016	4.515	3.939	4.201

Source: Field data

Table 1 reveals that generally, all the school categories experienced some fluctuations in physics performance as indicated by the mean scores. Table 1 also indicate disparities in physics performance in the school categories. Boys boarding schools have a better performance with score averaging at 7.281 (C+) followed by girls boarding schools with an average mean score of 5.915 (C). Co-education schools had the lowest performance on physics with an average mean of 4.201 (D+). The results reveal that performance in physics seems to favour boys than girls and those in boys' boarding schools.

Further analysis by ANOVA was used to establish the difference in the means in the physics performance among the different categories of schools during the five years. The findings are presented in Table 2 below.

Table 2. ANOVA results on achievement in physics among different schools in five years.

	Sum of squares	df	Mean squares	F	sig
Between groups	53.457	2	26.728	12.569	0.0001
Within groups	61.671	29	2.127		
Total	115.127	31			

Source: Field data

The ANOVA findings indicate that there was a difference in the physics achievement among the different categories of schools. The F observed value of 12.569 is greater than the F critical of 3.33 (p value = 0.0001, at 0.05 level of significance).

To determine if there was any statistical difference in the mean achievement of boys' and girls' boarding schools, the t-test was used. The t observed value of 13.656; p value = 0.0001 at 0.05 level of significance; is greater than t- critical of 2.131. In both cases, the statistical tests reinforce the findings that there were significant differences in the performance of the different categories of schools and among boys and girls.

Disparities in the Physics Candidature from the Year 2005 to 2009

Table 3 presents the mean of candidates who registered for physics in the three categories of schools during the five years.

Table 3. Average enrolment in physics in the sampled schools (2005–2009).

School category	Year						
	2005	2006	2007	2008	2009	Average	%
Boys Boarding	97.88	95.50	102.25	122.25	131.0	109.78	62.56
Girls Boarding	46.50	48.25	52.63	58.75	51.88	51.60	29.40
Co-education	15.13	11.50	13.94	13.69	16.31	14.11	8.04
Total	159.51	155.25	168.82	194.69	199.19	175.49	100.0

Source: Field data

From Table 3, it can be discerned that boys' boarding schools had a higher number of candidature in physics during the entire five year period, as compared to girls boarding and co-education schools. The number of male students averaged at 109.78 representing 62.56% of the total number of candidates who sat for physics in the sampled schools.

Further analysis entailed the use of ANOVA to determine whether the differences in enrolment were statistically significant. The results are presented in Table 4.

Table 4. ANOVA results on enrolment in physics.

	Sum of squares	df	Mean squares	F	sig
Between groups	48995.167	2	24497	11.717	0.0001
Within groups	60632.913	29	2090.790		
Total	109628.1	31			

Source: Field data

Analysis by ANOVA shows that there was a significant difference in average enrolment among the different classification categories. The F observed value of 11.717 is greater than the F critical of 3.33 (p value = 0.0001, at 0.05 level of significance).

The Effect of Performance on Enrolment in Physics

The relationship between performance and enrolment is presented Figure 1.

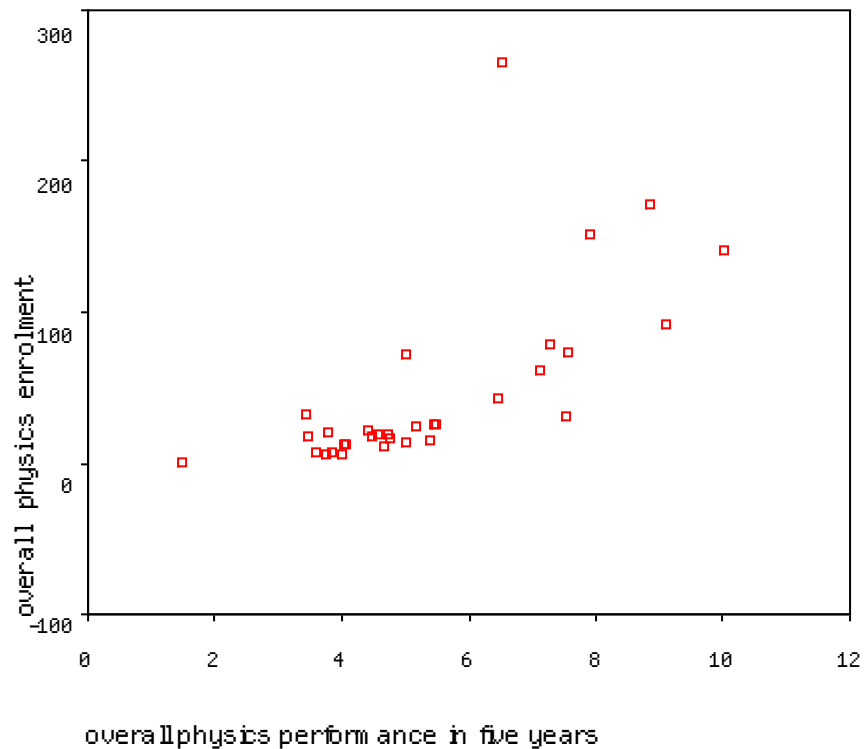


Figure 1: Scatter plot for enrolment and performance.

In dealing with the effect of performance on enrolment in physics, the Pearson Product Moment Correlation Coefficient, One way Analysis of Variance (tested at 0.05 level of significance) and Single Linear regression were the statistical tools used to test the null hypothesis H_{01} - There is no relationship between school performance index in physics and enrolment.

The scatter plot shows that there is a positive relationship between performance and enrolment such that enrolment increases with improved performance. The Pearson Product Moment Correlation Coefficient value of $r_{xy} = 0.689$ further reinforces the finding that there is quite a strong linear relationship between performance and enrolment. This high correlation between enrolment and achievement in physics shows that a good mean score in physics leads to high enrolment in the subject.

Further analysis by linear regression was used to determine the strength of the relationship and the findings are presented in Table 5.

Table 5. Linear Regression Model.

Model	B coefficient	S.E	t	Sig
Intercept	-67.33	23.38	-2.880	0.007
Overall performance mean index	21.25	4.09	5.200	0.0001

Source: SPSS output

Note: Dependent variable- overall physics enrolment in a 5-year cycle

There is a strong significant relationship between performance and enrolment (p value 0.0001) in that for a unit improvement in performance index, there is 21.25 times unit increase in enrolment as shown by the B-coefficient for the linear model. This is summarised in the equation below.

$$Y = -67.33 + 21.25x$$

Where 'Y' is the enrolment mean and 'x' is the performance index. An improvement in performance leads to an increase in enrolment. These findings are supported by the average enrolment figures given in Table 1 and 3, which show that there is better performance and high enrolment in physics for boys' boarding schools than girls boarding and co-education schools. The results of PPMCC, One way ANOVA and Linear regression show that there is a relationship between the school performance and enrolment. Consequently, the null hypothesis, H_{01} : There is no relationship between the performance index in physics and enrolment is rejected.

Factors Influencing Achievement in Physics

Respondents were asked to indicate whether the performance on physics in their respective schools could be regarded as improving, declining, fluctuating or constant during the five year period. Table 6 below shows the rating by respondents from the different categories of schools.

Table 6. Rating of physics performance.

Physics Rating	Boys Boarding	Girls Boarding	Mixed Day	Total
Improving	3	2	3	8 (25%)
Declining	1	2	2	5 (15.6%)
Fluctuating	4	4	10	18 (56.3%)
Constant	-	-	1	1 (3.1%)
Total	8	8	16	32 (100%)

Source: Field data

The majority of the respondents felt that performance on physics in their schools was fluctuating as indicated by 18 respondents representing 56.25% of the total respondents. Of these, half of the respondents from boys' and girls'- boarding schools rated achievement on physics in their schools as fluctuating. The majority of the respondents from co-education schools also rated their achievement in physics as fluctuating. This implies that performance in the subject was not steady. Only 8 (25%) of all the respondents reported performance on physics in their schools on an upward trend during the five years.

Since this study sought to identify factors influencing achievement in physics, respondents were asked to indicate the extent to which a number of given factors influenced performance in their schools. To begin with, they indicated how lack of, or the availability sufficient science facilities, influence performance on physics in their schools. The findings are presented in Table 7.

Table 7. Effect of science facilities on physics performance

Sch. Type	Lack of facilities			Availability of facilities			Total
	L.Ext	S. ext	No eff	L.Ext	S Ext	No.eff	
Boys boarding	-	2	1	4	1	-	8
Girls boarding	2	3	1	2	-	-	8
Mixed	8	5	-	2	-	1	16
Total	10	10	2	8	1	1	32

Legend: L. Ext=Large Extend, S. Ext= Small Extend, No eff= No Effect
Source: Field data

Table 7 indicates that lack of science facilities is one factor that negatively affects performance on physics in girls' schools and co-education schools. Two respondents from girls' schools and 8 from co-education schools to a large extent attributed low achievement to lack of science facilities. On the other hand, 5 respondents from boys' boarding schools felt availability of sufficient science facilities positively influenced performance on the subject. These findings suggest that most boys' schools are better equipped with science facilities as compared to girls and co-education schools.

Respondents were also asked to indicate the extent to which attitude affects performance on physics. The findings are presented in Table 8.

Table 8. The effect of learners' attitude on performance.

Sch. Type	Negative attitude			Positive attitude			Total
	L.Ext	S. ext	No eff	L.Ext	S Ext	No.eff	
Boys	3	1	-	2	2	-	8
Girls	5	1	-	1	1	-	8
Co-education	10	3	-	2	1	-	16
Total	18	5	-	5	4	-	32

Source: Field data

Most respondents had rated physics performance as fluctuating and from Table 8 this could be as result of the students' attitude. Negative attitude here refers to the students disliking the subject while positive attitude refers to their liking the subject. Co-education schools seem to have a serious attitude problem as indicated by the fact that at least 10 (62.25) of their total respondents to a large extent linked poor performance on the subject to negative attitude. The boys and girls boarding schools are not free of this problem because 3 respondents from boys' schools and 5 from girls boarding schools identified negative attitude as a factor contributing to low achievement in the subject. Generally, it can be deduced that most students have a negative attitude towards the subject and this affects achievement. A respondent from a girls' school pointed out that some of the students had low self esteem and were also unwilling to do challenging tasks.

Table 9 shows respondents' assessment of the effect of the teachers' attitude on performance on physics.

Table 9. The effect of teachers' attitude on performance.

Sch. Type	Negative attitude			Positive attitude			Total
	L.Ext	S. ext	No eff	L.Ext	S Ext	No.eff	
Boys	-	-	1	4	1	2	8
Girls	-	-	3	3	1	1	8
Co-education	3	4	6	2	1	-	16

Source: Field data

The teachers' attitude was found to have minimal influence on physics performance. Of those who felt negative attitude by teachers to a large extent affected performance on physics, none were from boys and girls schools. However, a small percentage 9.8% in co-education schools did indicate that teacher's attitude affects physics performance. However, 13 (40.6%) of the total respondents felt teachers' attitude whether negative or positive, did not affect performance on physics.

Information was also sought on the effect of learners' practice on performance. The results are presented in Table 10.

Table 10. The effect of learners' practice on physics performance.

Sch. Type	Negative attitude			Positive attitude			Total
	L.Ext	S. ext	No eff	L.Ext	S Ext	No.eff	
Boys	2	1	-	4	1	-	8
Girls	4	1	1	1	1	-	8
Co-education	8	4	1	2	1	-	16
Total	14	6	2	5	3	-	32

Source: Field data

Concerning the effect of learners' practice on performance, 2 (6.3%) of the respondents from boys', 4 (12.5%) from girls' schools and 8 (25%) from co-education schools felt that lack of practice contributed to low achievement. Only a total of 5 (15.6%) respondents attributed good achievement to practice by their students and the majority were from boys' schools. This implies that in all the categories of schools learners hardly do their own practice.

Information was also solicited on the effect of interest by students on performance. The results are presented in Table 11.

Table 11. How the learners' interest affects performance on physics.

Sch. Type	Negative attitude			Positive attitude			Total
	L.Ext	S. ext	No eff	L.Ext	S Ext	No.eff	
Boys	2	2	-	4	-	-	8
Girls	6	-	-	1	1	-	8
Co-education	10	3	-	2	1	-	16
Total	18	5	-	7	2	-	32

Source: Field data

Table 11 does show that interest in the subject also influenced performance as indicated by 5 respondents from boys' schools, 6 from girls' schools and 13 from co-education schools.

The findings in Table 11 also show that among the boys' schools, most learners are interested in the subject as compared to girls and co-education schools. The majority of the learners in girls and co-education schools have no sustained interest in the subject and this affects performance negatively. However, still 4 respondents from boys' schools mentioned lack of interest in the subject indicating that it is still an issue that affects both genders, but the difference lies in the magnitude.

Discussion

The findings of this study agree with those of Gonzales et al., (2004) and Martin, Mullis and Chrostowki, (2004) who observed that boys show significantly greater achievement in science. The boys' schools have an average mean score of 7.281 for the five years while girls are at 5.915. This translates into a gender performance gap of 1.336. This means that boys perform better than girls on physics. The higher mean scores achieved by boys' schools during the each of the five years clearly indicates that boys have a lead in the sciences and this agrees with Chang (2008) whose study revealed that boys outnumbered girls in the top 25% in science performance. These findings also concur with Kakonge (2000) who analysed the Kenya Certificate of Secondary Education (KCSE) data for 1990-1996. The findings revealed that at both national and provincial level, the averages of examination scores for boys were higher than those of girls. In physics the national mean score was 45.8% for boys and 42.3% for girls indicating a gender percentage gap of 4.5%. Similarly, a study carried out by IPAR on the performance of students in KCSE revealed that in science subjects the percentage gap in physics in the four districts under study was 5% in Kiambu, 8% in Bungoma, 8.7% in Kisumu while no gap was established for Garissa where no single girl registered for physics (IPAR, 2003).

This study also found that few girls enrolled for physics and this would definitely affect their participation rate in science-oriented careers. Only 29.2% of the candidates who sat for KCSE between 2005 to 2009 were females. This observation concurs with that of Jacobs (2005) and Frazier (1999), who reported a decline in gender differences in science achievement in some countries but female representation in science-related fields was still low. In many African countries, the number of women enrolled in science-based training and those involved in science-based professions are among the lowest in the world. This situation echoes the situation in many African countries, as other studies have revealed. For example, literature shows that the share of females enrolled in science was below 20% in Botswana, Gambia, Guinea and Nigeria. The proportion in engineering was below 10% in Ghana and Swaziland (UNESCO, 2008).

On other factors affecting performance on physics, it has been observed that both male and female teachers have a negative attitude towards girls' abilities to perform well in science. However, this study found that the teachers' attitude had very minimal effect if any, on physics performance. Still a remark by one teacher from a girls' school that girls were reluctant to take up challenging tasks in the subject agrees with the finding that teachers cite girls' fear of the subjects, lower determination and lower intelligence when compared to boys. This is likely to affect their interaction with the students and agree with Dee (2007) who reported that teachers usually interact differently with boys and girls. In addition, schools, teachers and the curriculum encourage girls to adopt passive and dependent behaviour while boys adopt aggressive and independent behaviour. The differential treatment of boys and girls also affects performance. Thus classroom interaction patterns result in greater opportunities for boys than girls to learn science and may reflect performance achievement expectations for boys (Kahle & Meece, 1994; Jones & Wheatley, 1990).

This study found that the attitude problem was more prevalent in girls' and co-education schools. Nevertheless, it was not absent in boys' schools either. This could agree with studies which have found that girls are socialized into characteristics of dependence, nurturance and passivity. They therefore develop a set of attitudes and beliefs that do not promote high levels of achievement and participation in science. Studies have found that females have more negative attitude towards science. According to (Wasanga, 1997), the majority of girls found science subjects difficult and they perceived science subjects to be more useful to boys. In this study, the girls' perception of the subject is likely to have contributed to their under-achievement. A study by Lee and Lockheed (1990 as cited in Frazier, 1999), using a sample of 1,012 students from single sex and co-education secondary schools from ten southern states of Nigeria found that perceived ability was positively related to higher achievement.

Since negative attitude impacts learners practice and interest, it is not surprising that more boys than girls practice the subject and have more sustained interest. The girls on the other hand and students from co-education schools already have negative attitude which affects their interest in the subject. This then restricts the very enrolment in physic, and, as Kelly (1995) explained, science image is usually constructed in schools. The masculinity of science is often the prime reason that girls tend to avoid the subject at school. Science is usually seen as masculine because of the disproportionately large numbers of males who study and teach it, the bias towards males in the curriculum materials and male-oriented classroom instruction.

Implications for Strategy Renewal

1. Demystify the subject

This study reveals that performance on physics has remained fairly average in many schools even those deemed to be posting good results. It is recommended that the physics teachers should demystify the subject right from Form I, when innocent and enthusiastic pupils from primary school join secondary school. Physics teachers should operate at a level suitable to the learners instead of shrouding the subject in mystery in order to reduce demand and consequently enrolment, when the students have to officially choose their subjects.

2. Intensify practical lessons and make them learner-centred

Practical lessons should be emphasized right from form I. In many institutions, practical lessons are treated seriously in upper secondary school and, most of the time, even when lower classes go to the laboratory, it is to take theory lessons. Teachers forget that the foundation is laid in Form I. Teachers of physics should also come up with interesting learning activities that sustain the learners' attention and engage them.

3. Exposure

Learners should be engaged in contests, inter and intra school symposia, field trips science congresses and so on. Any opportunity and forum that enables learners improve their knowledge in the subject should be utilized. This practice should begin with the form I level.

4. Tagging low and high achievers

Schools should create both internal and external links. Internal links should involve schools tagging their low achieving students to high achieving ones in the subject across classes

both vertically and horizontally, so that students in the same class can assist each other, but still those in lower classes could help those in upper classes with lower level concepts. Externally, schools could team up with high achieving schools in the subject for combined contests, examination and even establish collegial communities.

5. Concerted effort to campaign against negative attitude

Girls should be sensitized on the importance of physics in career choice in science oriented courses like engineering and information technology. There is also need to make girls aware of the benefits of enrolling and performing on physic, so as to tap on the opportunities prescribed in the attainment of Vision 2030.

6. TSC should improve the staffing of schools in science subjects

Many schools lack qualified physics teachers due to TSC in ability to post this trained teachers. There is need for TSC to post physics teachers as per the school establishment so as to improve on the delivery of the physics curriculum.

Conclusion

Research results indicate that there are significant disparities in achievement and enrolment in physics among the different categories of schools as well as between boys and girls. For a nation targeting to become a newly industrialized middle income country, the imbalance in achievement as well as enrolment in physics is likely to be a drawback. The foundation for representation in science and technological fields that enable the country realize the 2030 vision is laid at the secondary school level. The government should therefore put measures in place to correct the imbalance.

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Received: *May 01, 2011*

Accepted: *June 10, 2011*

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