

# **Influence of Classroom Practices on Girls' Attrition from Physics in Embu County, Kenya**

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## **Abstract**

This study investigated the influence of classroom practices on girls' attrition from physics in Embu County, Kenya. Science subjects taught in secondary school curriculum in Kenya are physics, chemistry and biology. The three science subjects are compulsory in forms one and two. In form three, students are required to choose a minimum of two science subjects. The Kenya National Examinations Council (KNEC) secondary schools examination reports indicate that almost an equal percentage of boys and girls choose biology, and chemistry in form three. However, the enrollment levels in physics differ greatly with almost twice as many boys as girls enrolling for physics. Therefore, there is need to establish factors that make girls drop out of physics classes in secondary schools in Embu County. Cross-sectional survey was used. Multi-stage sampling technique was used to select 6 classes from 6 schools. A total of 297 form two girls participated in the investigation. A questionnaire was administered to the girls who intended to pursue physics after form two as well as to those who did not intend to pursue physics after form two. The relationship between classroom practices and attrition of girls from physics learning in secondary schools was analyzed by descriptive statistics and chi square statistic ( $\chi^2$ ) at  $\alpha=0.05$  level of significance. The findings of the study indicated that, teaching/learning activities, physics theory and practical have significant influence on girls' attrition from physics. These results are expected to inform education planners and teachers of the factors that influence girls' attrition from physics in secondary schools.

**Key words:** Influence, classroom practices, girls' attrition from physics

## Introduction

Physics subject is viewed as an instrument that can help in the attainment of vision 2030. According to Abacha, Biyoyo and Musasia (2012), physics plays an important and dominant role in spearheading technological advancement, promoting national wealth and health and accelerating industrialization. Physics taught in secondary schools enables learners to apply acquired knowledge and skills to solve everyday problems. In Kenya, the participation of girls in science and technology based programs is quite low (Kithyo & Petrina, 2002). This could be attributed to the low number of girls taking physics in secondary schools. Science subjects taught in secondary school curriculum in Kenya are physics, chemistry and biology. The three science subjects are compulsory in forms one and two. However, in form three, students are required to choose a minimum of two science subjects.

The Kenya National Examinations Council (KNEC) secondary schools examination reports of 2012, 2013 and 2014 indicate that almost an equal percentage of boys and girls choose biology, and chemistry in form three. However, the enrollment levels in the three science subjects differ greatly with almost twice as many boys as girls enrolling for physics. The Embu East district education office records of 2012 show that the low enrollment of girls in physics in form three is a true picture of the situation in Kenya.

The KNEC Reports of 2012, 2013 and 2014 also indicate that the mean of girls' performance in physics is not significantly different from boys' mean performance. According to Linn and Hyde (1989) sex associated differences in cognitive abilities relevant to performance in physics include verbal, quantitative and spatial abilities. Results from their studies indicate that verbal differences are negligible while spatial and quantitative differences are not consistent with sex. Therefore, the performance in physics cannot be attributed to differences in cognitive abilities.

Hilderbrand (1996) argues that the attributes that give physics its value are its norm. According to him physics is abstract, quantitative and deals with outcomes that are competitive, hierarchal and value – free. The competitive nature of a physics classroom suppresses the girls and this makes them display “learned helplessness” (Dweck, 1986). This makes them attribute their failure to put up with competition as an inability, thus their preferences of co-operative learning (Owen & Barnes, 1982).

### *Relevance of Classroom Practices to Learning of Physics by Girls*

Physics is characterized as abstract and quantitative and deals with outcomes (Parker, Rennie&Harding, 1995). Most of the teachers' delivery of the content is considered as a closed, abstract system. This is mainly brought about by association of physics with word problems in algebra, emphasis and use of quantitative techniques and not quantitative understanding of underlying concepts and the frequent appeal to definition and conventions (Tsuma, 1998). This is in contrast to girls' preference in learning physics in a conventional style involving collaborative activities and working with concrete objects.

The high school learners are adolescents who try to cope with their physical and emotional changes, and girls particularly, are left with a less intact self-esteem as they try to cope with these changes. This leads to loss in their academic confidence and hinders participation and interest especially in learning physics (Trowbridge, Bybeer & Powell, 2004). It is therefore important for teachers to be sensitive to these changes since in physics classroom girls' relationships with their teacher are very significant for learning. Thus, the teacher should show leadership and adopt friendly teaching styles (Sharp, 2004). This is traditionally different from what a physics class is, that is, highly structured and teacher controlled with clear instructions. Girls prefer friendly teaching styles, however this does not develop aggression, competitiveness and activity which are typical of a physics class. In reaction, the girls' participation in class is withdrawn and hence they do not volunteer to participate (Barry & Herber, 1995). Therefore, choice of learning activity should be selected carefully to ensure that girls do not withdraw from physics learning.

There is a continued male domination in text books, classroom posters, teachers and historical contributions. Despite ignoring women contributions, no explanation is made of their lack of involvement. This denies girls identity into the subject (Trowbridge, Bybeer & Powell, 2004). In this study the school practices which include the teaching and learning activities in a classroom were investigated to find out their influence on attrition of girls from physics after form 2.

### **Purpose of the Study**

The purpose of the study was to investigate the influence of classroom practices on girls' attrition from physics learning in secondary schools.

## Hypotheses

The following hypotheses were tested:

H<sub>01</sub>: There is no statistically significant relationship between teacher led teaching and learning activities and attrition of girls from physics learning in secondary schools.

H<sub>02</sub>: There is no statistically significant influence of physics theory on girls' attrition from physics.

H<sub>03</sub>: There is no statistically significant influence of physics practical on girls' attrition from physics.

## Methodology

This study employed a cross-sectional descriptive survey. There were 1299 girls in form two in secondary schools in Embu district at the time the study was conducted. Multi-stage sampling technique was used. First, six schools were randomly selected from the 35 secondary schools in Embu district. Then one form two stream was selected from each of the participating schools. It is at the end of form two when students select two of the three science subjects offered in form three, namely, physics, chemistry and biology. A total of 297 form two girls from the 6 schools participated in the investigation. A questionnaire was used to collect data. It was administered to the girls who intended to pursue physics after form two as well as to those who did not intend to pursue physics after form two. The questionnaire was based on the Likert scale with scores ranging from 1 to 5. Scores of 1 and 2 were awarded to those who agreed, and scores of 4 and 5 were awarded to those who disagreed. Those who were not sure were given a score of 3. The relationship between classroom practices and attrition of girls from physics learning in secondary schools was tested by chi square statistic.

## Results

*Influence of Teacher led Teaching/Learning Activities on Girls' attrition from Physics.*

The teaching/learning activities were assessed on their ability to make physics less difficult and consequently relevant to girls'. Data were analyzed by descriptive statistics and chi-square statistic. The following classroom activities were investigated on their influence to making physics easy to understand and motivate the learner to pursue it to form 4.

- A. Teacher led class discussion.
- B. Group work discussion.
- C. Individual exercises.
- D. Class practical in groups or as an individual.
- E. Teacher demonstration.

Girls were grouped according to those who intended to pursue physics and those who did not intend to pursue it. Then, the girls in each group were asked to indicate whether or not each of the teaching/learning activities stated above makes physics easy to understand. Those who strongly disagreed and agreed were labeled AGREE; and those who disagreed and strongly disagreed were labeled DISAGREE. Results are given in Table 1.

**Table 1:**

Results by Groups Showing the Influence of Teacher led Teaching/Learning Activities on Girls' Attrition from Physics

Concern	Those Intending to Pursue Physics N =131 df =4			Those Not Intending to Pursue Physics N =166 df =4			$\chi^2$	P
	AGREE	NOT SURE	DISAGRE E	AGREE	NOT SURE	DISAGRE E		
A	105(80.1%)	12(9.2%)	14(10.7)	110(72.3%)	23(13.9%)	23(13.8%)	8.825	.066
B	112(85.5%)	7(5.3%)	12(9.2%)	127(76.5%)	17(10.2%)	22(13.2%)	7.302	.121
C	98(74.8%)	18(13.7%)	15(11.5%)	100(60.4%)	31(18.7%)	35(21.1%)	13.179	.010
D	99(75.6%)	19(14.5%)	13(9.9%)	108(65.4%)	25(15.1%)	33(19.9%)	10.147	.038
E	104(79.4%)	11(8.4%)	16(12.2%)	121(72.9%)	21(12.7%)	24(14.4%)	14.985	.005

Table 1 shows that the frequencies (percentage) of respondents in both groups are similar in magnitude and distribution. Large percentages from each group agree that classroom activities make physics easy to understand. Among those intending to pursue physics 80.1% agreed, 9.25% not sure and 10.7% disagreed that the teacher led discussion makes physics easy to understand while among those not intending to pursue physics 72.3% agreed, 13.9% not sure and 13.8% disagreed. For group work discussion, those intending to pursue physics 85.5% agreed, 5.3% not sure and 9.2% disagreed to its importance in making physics easy to understand while among those not intending to pursue physics 76.5% agreed, 10.2% not sure and 13.2% disagreed.

Individual exercises received some disparity, whereas those intending to pursue physics to form 4, 74.8% agreed, 13.7% not sure and 11.5% disagreed to its importance in making physics easy to understand, those not intending to pursue physics 60.4% agreed, 18.7% not sure and 21.1% disagreed. The class practical individually and in groups showed that among those intending to pursue physics, 75.6% agreed, 14.5% not sure and 9.9% disagreed that it makes physics easy to understand, while among those not intending to pursue physics 65.4% agreed, 15.1% not sure and 19.9% disagreed to the importance of the practicals in making physics easy to understand.

The teacher demonstration had among those intending to pursue physics 79.4% agreeing, 8.4% not sure and 12.2% disagreeing to its influence on making physics easy to understand. However among those not intending to pursue physics 72.9% agreed, 12.7% not sure and 14.4% disagreed to the importance of teacher demonstration in making physics easy to understand.

The chi square ( $\chi^2$ ) statistic was used to determine the significance of the influence each aspect of classroom practices on pursuing physics to form four. Among the five classroom practices individual exercise, class practicals in groups or individuals and teacher demonstration a p value  $< 0.05$ . These therefore influence attrition of girls from physics in secondary school.

Among the five aspects of classroom practices dealing with practical there is a statistically significant influence on girls' attrition from physics. This concurs with Sharp (2004) that girls are generally skill deficient on practical work due to their out of school activities. Statistical significance noted in individual exercises relationship to pursuing physics to form 4 concurs with Trowbridge, Bybeer and Powell, (2004) that, the classroom is highly structured and teacher

controlled with clear instructions. This suits the girls preferred learning style, however a physics class requires aggression, competitiveness and activity as required in doing individual exercises.

### *Influence of Physics Theory on Girls' Attrition from Physics*

The following aspects of physics theory were investigated about their influence on girls to understand physics and thus choose to pursue it to form 4:

- F. Stating definitions, laws and principles.
- G. Explaining application of physics in daily life.
- H. Choosing correct formulae to use in a descriptive question.
- I. Making calculations.

Girls were grouped according to those who intended to pursue physics and those who did not intend to pursue it. Then, the girls in each group were asked to indicate whether or not each aspect of physics theory stated above makes physics easy to understand.

**Table 2:**  
Results by Groups Showing the Influence of Physics Theory on Attrition

Concern	Those Intending to Pursue Physics N =131 df =4			Those Not Intending to Pursue Physics N =166 df =4			$\chi^2$	P
	AGREE	NOT SURE	DISAGRE E	AGREE	NOT SURE	DISAGRE E		
F	99(73.3%)	21(16.0%)	14(10.7%)	99(65.0%)	33(19.9%)	25(15.1%)	9.334	.053
G	97(74.0%)	18(13.7%)	16(12.2%)	100(60.2%)	44(25.5%)	22(13.2%)	12.37	.015
H	89(68.0%)	28(21.4%)	14(10.7%)	80(48.2%)	51(30.7%)	35(21.1%)	12.98	.011
I	86(65.6%)	28(21.4%)	17(12.9%)	80(48.2%)	50(30.1%)	36(21.7%)	15.66	.003

Table 2 shows frequency and percentage of the respondents in the way they view aspects of physics theory. The percentages generally show a disparity with those intending to pursue physics to form 4 having higher percentages in agreeing that various aspects of theory make

understanding of physics easier, and this influences their decision to pursue it to form 4. For example, Stating definitions', laws and principles; those intending to pursue physics, 73.3% agreed, 16.0% not sure and 10.7% disagreed to its influence in making physics easy to understand while 65.0% agreed, 19.9% not sure and 15.1% disagreed among those not intending to pursue physics to form four.

The aspect of explaining applications of physics in daily life had frequencies: 74.0% agreed, 13.7% not sure and 12.2% disagreed to its influence in making physics easy to understand among those intending to pursue physics; while 60.2% agreed, 26.5% not sure and 13.2% disagreed among those not intending to pursue physics. For the aspect of choosing correct formulae to use in descriptive questions, among those who intended to pursue physics, 68.0% agreed, 21.4% not sure and 10.7% disagreed that it makes the understanding of physics easier while those not intending to pursue physics had 48.2% agreeing, 30.7% not sure and 21.1% disagreed on this influence. Making calculations had the following frequencies: Among those intending to pursue physics 65.6% agreed, 21.4% not sure and 12.9% disagreed of this influence ,however, among those not intending to pursue physics 48.25 agreed, 30.1 % not sure and 21.7% disagreed with the influence.

Chi square ( $\chi^2$ ) statistic was used to determine the statistical significance of the influence of each aspect of physics theory on attrition of girls from physics in secondary schools. The results show that explaining application of physics in daily life, choosing correct formulae to use in a descriptive question and making calculations have a p value  $< 0.05$  and hence influence attrition of girls from physics in secondary schools.

#### *Influence of Physics Practical on Girls' Attrition*

. The following aspects of physics practical were investigated to find out their influence on girls' understanding and pursuing physics to form 4.

- J. Setting up apparatus
- K. Explaining/ analyzing experiments
- L. Recording or stating observations
- M. Describing experimental procedures
- N. Collecting data
- O. Writing down conclusions



Girls were grouped according to those who intended to pursue physics and those who did not intend to pursue it. Then, the girls in each group were asked to indicate whether or not each aspect of physic practical stated above makes physics easy to understand. Results are given in Table 3.

**Table 3:**  
Results by Groups Showing the Influence of Physics Practical on Attrition of Girls from Physics

Concern	Those Intending to Pursue			Those Not Intending to Pursue			$\chi^2$	P
	Physics N =131	df =4		Physics N =166	df =4			
	AGREE	NOT SURE	DISAGRE E	AGREE	NOT SURE	DISAGRE E		
J	84(64.1%)	32(24.2%)	15(11.5%)	80(48.2%)	53(31.9%)	33(19.9%)	10.53	.032
K	83(63.4%)	29(22.1%)	19(14.5%)	89(53.6%)	43(25.9%)	34(20.5%)	4.334	.336
L	91(69.5%)	21(16.0%)	19(14.5%)	99(59.6%)	50(30.1%)	17(10.2%)	14..6	.007
M	87(66.4%)	27(20.6%)	17(13.0%)	79(47.6%)	51(30.7%)	36(21.7%)	12.37	.015
N	74(56.4%)	32(24.4%)	25(19.0%)	89(53.6%)	44(26.5%)	33(19.9%)	1.134	.889
O	101(77.1%)	10(7.6%)	20(15.3%)	100(60.2%)	36(21.7%)	30(18.0%)	12.85	.012

Table 3 shows the frequency (percentage) of respondents in the way they view aspects of physics practicals in enabling the understanding of physics and consequently providing a motivation to pursue it to form 4. Among those intending to pursue physics 64.1% agreed that setting up practicals enables them to understand physics and motivate them to pursue it. This compares to only 48.2% who agreed on the same among those not intending to pursue physics. 24.4% and 11.5% of those intending to pursue physics were not sure and disagreed respectively. However among those not intending to pursue physics 31.9% were not sure and 19.9% disagreed on the same.

Explaining and analysing practicals fairly compares in percentage across the scales in both groups. Among those intending to pursue physics 63.4% agreed, 22.1% not sure and 14.5% disagreed to the influence of explaining and analysing practicals to their understanding of physics and choice to pursue the subject .however, among those not intending to pursue physics 53.6% agreed 25.9% not sure and 20.5% disagreed to the influence. In recording and stating observations , those intending to pursue physics 69.5% agreed 16.0% not sure and 14,5% disagreed that in enables them understand physics and motivates them to pursue it .However among those not intending to pursue physics 59.6% agreed, 30.1% bare not sure and 10.2 % disagreed that recording and stating observations enables them understand physics.

Among those intending to pursue physics 66.6% agreed ,20.6% not sure and 13,0% disagreed that describing experimental procedures makes the understanding of physics easier, however among those not intending to pursue physics 47.6% agreed, 30.7% are not sure and 21.7% disagreed to this influence. Collecting data fairly compares between both groups with 56.4% and 53.6% respectively agreeing among those intending and those not intending to pursue physics that it makes physics easy to understand .24.4% not sure and 19.0 % disagreed among those intending to pursue physics while 26.5% not sure and 19.9% disagreed among those not intending to pursue physics about the influence of collecting data.

Writing down conclusion differs greatly between the two groups with 77.1% and 60.2% agreeing respectively among those intending and those not intending to pursue. Among those not intending to pursue physics 7.6% not sure and 15.3% disagreed while 21.7% not sure and 18.0% disagreed in those not intending to pursue physics.

The chi square ( $\chi^2$ ) statistic shows that setting up apparatus, recording or stating observations, writing down conclusion, describing experimental procedures and writing down conclusions all have a p value  $< 0.05$  which means that they have a statistical significance to attrition of girls from physics in secondary school.

In general, four of the six aspects of practical have a statistical significance to attrition of girls from physics. This concurs with Murphy and Elwood (1998) that, in learning situation, learners

avoid activities they consider outside their domain. This leads to missed opportunities to learn and this causes a difference in actual achievement

## **Discussion**

Among the five aspects of classroom practices dealing with practical there is a statistically significant influence on girls' attrition from physics. This concurs with Sharp (2004) that girls are generally skill deficient on practical work due to their out of school activities. Statistical significance noted in individual exercises relationship with pursuing physics to form 4 concurs with Trowbridge, Bybeer and Powell,(2004) that, the classroom is highly structured and teacher controlled with clear instructions. This suits the girls preferred learning style, however a physics class requires aggression, competitiveness and activity as required in doing individual exercises. Choosing correct formulae to use in a descriptive question and making calculations both deal with mathematics. The findings agree with those by Murphy and Whitelegg (2006) that, achievements in calculations are very significant in students take up of physics. Explaining application of physics in daily life also shows a statistical significance which implies that this aspect influences attrition of girls from physics in secondary schools. This agrees with Johnson (1986) that female patterns of out of school activities are more observation and biology related. These are in contrast to learning activities which involve use of equipments. According to Murphy and Whitelegg (2006), physics content includes illustrations, examples and applications which are more familiar to experiences and interests of males as opposed to females. This content typically omits reference to women and does not involve human and social aspects of physics which would be of interest to girls

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## **Conclusions**

- i. There is a statistically significant relationship between physics practical and attrition of girls from physics in secondary school

- ii. There is a statistically significant relationship between physics theory and attrition of girls from physics in secondary school
- iii. There is a statistically significant relationship between teaching and learning activities and attrition of girls from physics in secondary school

### **Implications**

- i. From the study the role of the teacher comes out strongly in influencing the attrition of girls from physics .It is the teacher who chooses and conducts the teaching and learning activities, chooses pedagogies and organizes group work. All these activities strongly influence how well the girl learner is engaged in the learning and consequently understanding physics. Thus, the teacher needs to be gender sensitive and choose teaching and learning activities that are favourable for learning, use pedagogies that make learning of physics accessible and organize class group work to promote engagement of the girl learner.
- ii. If applications of physics in daily life are emphasized in teaching, then girls are likely to be motivated towards the subject.

### **Recommendations**

In order to assist the policy makers and teachers attain equity in access for girls in physics, this study has brought up the knowledge of how physics practical, theory and teaching and learning activities influence attrition of girls from physics after form 2 and, these are the recommendations:

- i. Girls should be given the opportunity to participate in physics practical as this motivates them towards physics.
- ii. Teachers should make the application of physics in daily life clear to the girls, this will make them appreciate the importance of physics.
- iii.

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