

# **Effects of Simulation Teaching Technique on Co-Educational Secondary Schools Students' Attitude Towards Learning Physics in Buuri-East Sub-County, Kenya**

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## **Abstract**

Learner's performance on secondary school physics in the Kenya National Examination Council is below average. This poor performance may be attributed to conventional teaching techniques that are applied in teaching physics that leads to students having a negative attitude towards the subject. Hence, this study sought to investigate the effect of Simulation teaching technique on students' attitude towards learning physics specifically on the topic Magnetism. Solomon-four, non-equivalent research design was used. Four schools were randomly sampled from 16 co-education day secondary schools in Buuri East Sub-County of Meru County, Kenya. The sampled schools were randomly assigned to experimental and control groups. A total of 123 students from the sampled schools were involved in the study. Students Attitude Questionnaire (SAQ) was used to collect data on students' attitude towards learning physics. The instrument was validated and pilot tested for use in data collection. Cronbach alpha was used to estimate the reliability of SAQ, and a reliability coefficient was found to be 0.73. Both descriptive and inferential statistics were employed in data analysis, these included mean-score, t-test and Analysis of Variance (ANOVA). All statistical tests were tested at a 0.05 alpha level of significance. The results from post-test mean scores for control groups were as shown (Control 1 MS=2.77, Control 2 MS=2.275) those of experimental groups (Exp 1 MS=2.88, Exp 2 MS=2.85). These results revealed that the students exposed to the treatment improved their attitude towards learning physics. However, the difference was not statistically significant. The results also showed a difference between boys and girls attitude towards learning physics though it was not statistically significant. The study recommends that physics teachers should embrace the use of simulation in teaching to boost students' attitude towards learning physics

**Keywords:** Attitude, Education, Gender, Physics and Simulation.

## **Introduction**

Physics is a branch of science that deals with the relationship between matter and energy. Today people's lives are heavily dependent on machinery, industry and technology. Ngatia et al. (2019) point out that technology that is continually transforming the world can be directly traced back to research in physics. These foundations necessitate people with knowledge and skills in Physics, hence the need to support Physics education in Kenya. Adeyemo (2011) notes that, it is essential for every child to be given an opportunity to acquire knowledge and concepts in Physics.

Despite the importance of Physics, students' achievement in this subject has been below average as attested by Kenya Certificate Secondary Education (KCSE). There are a number of reasons that have been raised to explain the poor students' achievement in Physics. One of the factors that have been raised is conventional teaching techniques. In this study conventional teaching techniques means any techniques that a teacher uses that does not involve models such as simulation or a

practical and limits students participation in the learning process. The poor achievement in this subject has lead learners to developing negative attitude towards learning physics. According to Guido (2013), attitude is a tendency for individuals to organize thoughts, emotions and behavior towards a psychological aspect. In the study attitude refers to the way one thinks and feels towards physics which may be either positive or negative.

Mushinzimana, et al. (2016) found that the performance of physics students is poor at the department of physics in Nyarugenge campus, Rwanda, due to negative attitude towards the subject. It is, therefore important for teachers to instill the right attitude towards a subject in students. Medine (2016) argues that teachers can change views of students towards physics in a positive way. This is possible if they are well equipped with the right teaching techniques and resources. This study seeks to fill this gap by determining the effects of simulation teaching technique on students' attitude towards learning physics.

Some students form a negative attitude towards physics long before enrolling in secondary school due to the opinion they get from their parents, elder siblings, friends and even teachers (Kahare, 2011). Ezeliiori (2004) observes that in most countries, from birth girls are made to believe that science is a male student's subject by societal stereotypes. This denies them an opportunity to experience the environment to explore, which is a pre-requisite to learning of science. This has contributed to most girls shying away from science subjects especially physics and developing an attitude that science subjects are meant for boys. The few that select the subject do not perform well as compared to the boys. This study also sought to determine the effects of simulation teaching technique on students' attitude towards learning physics by gender.

Simulation is the use of computer to predict outcome of a real-life situation using computer model. Computer simulation technique transforms physics concepts from theoretical to practical form. According to Pfefferova (2015), simulation is a technique that helps students comprehend better in basic features of oscillatory motion and improved their attitude towards physics. Students who were taught using computer simulation technique in Physics had higher mean acquisitions of practical skills and a positive attitude towards learning Physics (Jayantha, 2018). In this study, the concept of Magnetism was used due to the abstract nature of its concepts. This topic is also tested in paper 2 physics which is the worst performed paper among the three physics papers as per K.N.E.C reports. It is also a crucial topic since it forms a foundation for other topics taught in forms three and four physics.

## **Purpose of the Study**

The purpose of this study was to determine the effects of simulation teaching technique on students' attitude towards learning physics. It also intended to ascertain if simulation teaching technique has any effect on students' attitude towards learning Physics by gender.

### **Objectives of the Study**

This study was guided by the following objectives

- (i) To compare students' attitude towards learning physics between students taught through simulation technique and those taught through conventional technique in Buuri East sub-county.
- (ii) To investigate if there was gender difference in students' attitude towards learning physics when taught physics through simulation technique.

## **Hypotheses of the Study**

The following hypotheses were tested during the study

H0<sub>1</sub>: There is no statistically significant difference in students' attitude towards learning physics for those students taught through simulation technique and those taught through conventional techniques in Buuri East sub-county.

H0<sub>2</sub>: There is no statistically significant gender difference in students' attitude towards learning physics when taught through simulation technique.

### **Theoretical framework**

The research was guided by dual coding theory proposed by Allan Paivio (1986). He developed this theory from the ideal that formation of mental images aids in learning. According to this theory there are two ways a person could learn this through verbal associations and visual imagery. Visual and verbal information are processed differently and along distinct channel in the human mind. They create separate representations for information processed in each channel (Sternberg, 2006). However, Human mind can code information as visual, verbal or both. The codes are used to organize incoming information that can be acted upon, stored and retrieved for use. Coding information in two different ways increases the chance of remembering that information as compared to coding in just one way. Individuals who dually code information presented are more likely to recall the information when tested at a later date. Simulation teaching technique is a technique that uses both verbal and visual information in teaching. This gives a chance to code the information received as either verbal or visual or both. Some Physics concepts are so abstract and presenting them using visual images supports the verbal presentation, this may make the abstract concepts more concrete. This helps the learner to conceptualize concepts easily, which leads to better performance and in turn the learners develop a positive attitude towards learning physics.

### **Research Methodology**

The study employed Solomon four non-equivalent control group research design. Four schools were randomly sampled from the 16 co-educational public secondary schools in Buuri Sub-County of Meru County, Kenya. Stratified sampling was used to group the qualifying schools into four strata, this assisted in controlling diffusion effect. The sub-county has four wards which represented our four strata for this study. One school was selected randomly from each strata, this yield four sample schools that were used in the study. Simple random sampling was used to allocate the four schools into either experimental and control group. Two of the schools were randomly assigned to experimental groups while the other two were assigned to control groups. 123 form two students from the sampled schools took part in the study. This is because the form the topic under study is in form two. A Student Attitude Questionnaire (SAQ) was developed, validated and pilot tested for use in data collection. The reliability coefficient of SAQ was 0.7. A pretest was administered to students in one control and one experimental school. Simulation teaching technique was then applied on the experimental groups as treatment for three weeks. Thereafter, a posttest SAQ was administered to students in all the four groups. SAQ results were then scored and analyzed using ANOVA, and t-test at  $\alpha$  level of 0.05. Figure 1 shows the representation of the Solomon Four Non-Equivalent Control group design.

Group	Pre-test	Treatment	Post-test
E1	O1	X	O2
E2	-	X	O3
C1	O4	-	O5
C2	-	-	O6

Figure 1: Solomon’s Four Non-Equivalent Control Group research design

Source; Fraenkel and Wallen (2011)

E1- Experimental group one

E2- Experimental group two

C1- Control group one

C2- Control group two

O- Indicates observations or outcomes at pre-test and post-test phases

X - Indicates treatment

-----Non-Equivalent Control Group Design

### Results and Discussion

The SAQ scores were recorded and constituted data used in the study. Data was analyzed using ANOVA and t-tests at  $\alpha$  level of 0.05. A statistical package for social sciences (SPSS version 22) was used in data analysis.

### Results of the Pre-tests

Pre-testing was carried out with, two groups sitting for the pre-tests one control group and one experimental group .The aim of the pre-test was to ascertain whether or not the students selected to participate in the study had comparable characteristics before presenting the treatment. Table 1 shows the results of the comparison for pre-test SAQ scores between Experimental and Control groups.

**Table 1:** SAQ Pre-test Results Between Experimental and Control Groups

Variable	Group	Mean	SD	t-value	p-value
SAQ	C1	2.7419	0.239	-.190	0.417
	E1	2.7502	0.221		

The results from Table 1 shows that the SAQ pre-test mean score was not statistically significant different since at the level of at 0.05 significance  $p=0.417$ . This means that the groups used in the study were comparable. They had similar entry behavior and this made them appropriate for the study. Similar analysis was done based on gender. The differences in Attitude towards learning physics pre-test by gender were also examined during the pre-test analysis. Boys and girls pre-test scores in SAQ from Control group1 and Experiment group 1 were compared. Table 2 shows summary of the pre-test scores on SAQ based on students gender.

**Table 2:** Independent Sample t-test Scores on SAQ Based on Students Gender

Scale	Group	N	Mean	SD	t-value	df	p-value
SAQ	Boys	28	2.69	0.18	1.002	58	0.32
	Girls	32	2.55	0.17			

The results for SAQ showed a difference in boys and girls means score in favor of boys. This difference was however not statistically significant since the p value was 0.32 which is greater than .05 at a level of  $\alpha=0.05$  significance. Only one control group and one experimental group were subjected to the pre-test. This helped the researcher to establish similarities of the groups before introducing the intervention and generalize the findings to the groups which were not given the pre-test.

### Students' attitude towards learning Physics.

To determine the effect of simulation teaching technique on students' attitude towards learning physics an analysis of students' post-test SAQ scores was carried out. Table 3 shows SAQ post-test mean score which were obtained by students in the four groups

**Table 3:** Students SAQ, Post-test Mean Scores

Group	Mean Score	N	SD
C1	2.7798	32	.19975
C2	2.7542	31	.23813
E1	2.8869	32	.24424
E2	2.8554	28	.23703
<b>TOTAL</b>	<b>2.8184</b>	<b>123</b>	<b>.23379</b>

The results of Table 3 shows that the post-test mean scores for control groups (C1 MS=2.7798,C2 MS=2.7542)were lower, than those of experimental groups ( E1 MS=2.8869,E2 MS=2.8554). The results indicate that the experimental groups had a better attitude towards learning physics than the control groups. To establish whether the difference was statistically significant, a one-way ANOVA was performed. Table 3 shows the results obtained from the analysis of one-way ANOVA.

Table 4: ANOVA Results of the SAQ Post-Test Scores

Sources of Variation	Sum of Squares (SS)	D.f	Mean Squares	F-ratio	p-value
Between groups	.364	3	.121	2.291	.082
Within groups	6.304	119	.053		
<b>Total</b>	<b>6.668</b>	<b>122</b>			

The result from Table 4 shows that the p-value is .082 which is above 0.05.This indicates that there is no statistically significant difference among the four groups. The analysis from this study implies that the null hypothesis  $H_0$  which states "There is no statistically significant difference in students' attitude towards learning physics between those taught through simulation technique and those taught using conventional techniques" is accepted. The findings of the study showed there was a difference in attitude towards learning physics for those exposed to the treatment, in favor

of those who were exposed to the treatment. However after further analysis the difference was found not to be statistically significant.

#### **Attitude towards learning Physics between boys and girls**

The study sought to find out whether there was any statistically significant difference between girls and boys attitude towards learning physics for those taught through simulation teaching technique. The analysis of the experimental groups was conducted to find out if there is a difference in attitude towards learning physics for boys and girls. Table 4 shows the independent sample test of the post-test SAQ scores for boys and girls exposed to simulation teaching technique.

**Table 5:** SAQ Scores for Boys and Girls Exposed to Simulation Teaching Technique.

<b>Gender</b>	<b>N</b>	<b>Mean</b>	<b>SD</b>	<b>t-value</b>	<b>Df</b>	<b>p-value</b>
Boys	28	2.89	0.263	0.588	58	0.25
Girls	32	2.85	0.220			

Table 5 shows the results of post-test SAQ mean score for boys and girls as 2.89 and 2.85 respectively. From the results the boys performed slightly higher than the girls. The results from the independent sample T-test shows that the p-value was 0.25 this implies that the difference between the girls and boys mean score was not statistically significant at  $\alpha=0.05$ . With reference to the results obtained the null hypothesis  $H_02$  which states that there is no statistically significant gender difference in students' attitude towards learning physics when taught through simulation technique is accepted. This means that simulation teaching technique doesn't favor any gender in terms of attitude towards learning physics.

#### **Discussion of results**

The study results indicated that E1 and E2 had a mean score of 2.8869 and 2.8554 respectively. C1 and C2 had a mean score of 2.7798 and 2.7554 respectively. The hypothesis of the study sought to determine whether there is a statistically significant difference in students' attitude towards learning physics between those students who were taught by simulation technique and those who were taught through conventional teaching technique. The results indicated a difference in the means of experimental groups and control groups in favor of the experimental groups. Though the difference was not statistically significant, there is improvement in attitude towards learning physics, by the experimental groups which can be attributed to the use of simulation teaching technique.

There are other studies that have shown significant difference in learners attitude when they were exposed to simulation teaching technique. Abdulmumini (2018) stated that simulation model technique is more effective in teaching of science and technology subjects as well as in producing desirable attitudes in students and teachers respectively in his research on effect of simulation model on attitude, retention and performance in qualitative analysis among secondary school chemistry students. Issa and Jana (2021) in their research on Examining the Use of PhET Simulations on Students' Attitudes and Learning in General Chemistry II found out that interactive simulations have an overall positive impact on students' attitudes and perceptions about learning, simulations promote students' development of conceptual understanding of chemistry

concepts and content, simulations seem to promote and facilitate learning and understanding of abstract concepts, and simulations furnish learning opportunities.

The findings also revealed that there was no statistically significant difference in attitude between boys and girls who were exposed to simulation teaching technique. Although findings from the study reveal that male students had an improved attitude towards learning physics than their female counterparts the difference was not statistically significant. The findings of this study are in agreement with Hussaini et al (2015) study who found out that male and female student do not differ in the attitude towards science. Kabiru (2020) findings on effect of interactive simulation on attitude and academic achievement in mathematics also agrees with this study findings he found that interactive simulation strategy for teaching mathematics did not show any significant difference in attitude and achievement in mathematics amongst male and female students

Some education science researchers have contradicted this study results there have found a significant differences in attitude towards science and technology between boys and girls. Kay (2008) noted that girls respond very positive to online learning environments. He argues that inserting computer simulation learning environments in the science lessons in school is a possible measure to influence girls' attitudes towards science and technology. Chen and Howard (2010) posited that simulation teaching techniques influences the attitude of students towards science after exposure positively. This study shows that computer simulation teaching technique bridges the gap in the attitude of male and female students towards learning physics. This is because there was no statistically significant difference in the attitude of male and female students who were exposed to the treatment. It gives girls an equal opportunity to learn physics and get placed to STEM careers without leaving the boys behind

### **Conclusion and Recommendations**

From the findings, it is evident that simulation teaching approach has a positive effect on the physics attitude though not significant. The technique should be included in the teaching of physics in the secondary schools to improve the student attitude towards learning physics. The physics curriculum developers should also develop the teaching-learning materials in line with the simulation teaching technique to help the learner easily conceptualize abstract physics concepts.

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