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## Teachers' Attitude on ICT based Teaching in Physics and Impact of ICT use on Students' Academic Performance in Mombasa County, Kenya

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### **Abstract:**

*Information and Communication Technology (ICT) gives a chance for Educational Institutions and other organisations to develop and use technology to complement the teaching and learning process. Despite the heavy investment and donation of ICT resources to schools, it has been difficult to provide students with the ICT skills for them to function effectively in this dynamic and information-rich environment. Unless ICT is effectively integrated in teaching and learning, the investment for the development of ICT in schools could go to waste. The school curriculum may also not be able to realise its mission to produce learners who are ready for the job market, which is increasingly becoming reliant on ICT to generate and disseminate knowledge. One aim of this study was to find out the teachers' attitude towards using ICT in teaching Physics. The information needed was obtained through administering questionnaires to 148 Physics teachers both in public and private secondary schools. Further, the study sought to find the effect of using ICT on academic achievement of Secondary School Physics students in Mombasa County. To achieve this, an experiment was conducted involving 143 Form Two Physics students and one Physics teacher in a purposively selected secondary school. The quantitative data based on Likert Scale was analysed with the aid of the SPSS computer software (version 20) while the experimental data was analysed using a two-way analysis of variance (ANOVA). The results show that students performed better in Physics when ICT was applied in the teaching of Physics which agrees with others researchers in literature. On the basis of these findings, it was concluded that it was necessary to avail better quality ICT resources with maintenance support to secondary schools for improved learner's academic performance in Kenya.*

**Keywords:** ICT integration, attitude, academic performance

### **1. Introduction**

There has been a lot of research and publication related to ICT use for educational purposes during the past four decades in the industrialised nations. Most people in these nations have access to ICT. The purchase of computers for school use in nations such as the United States has been increasing at such a pace that it was difficult to keep track of how many computer machines there were in American schools (Harper, 1987).

In Britain, the scenario was similar, since the wider availability of computers in schools was made possible through government funding, largely by the Local Education Authorities (LEA). Following the Education Reform Act in Britain 1988, the Central Government of Britain availed millions of pounds, over time, to promote the use of computers in school administration and management. Like in the United States and Britain, other developed nations also embraced ICT hence budgeting huge sums of money for the same (Visscher, Wild, Smith & Newton (2003).

Although ICT was at the centre of education reforms globally, not all countries were able to benefit from the development and advances that technology could offer. These countries were thus faced with challenges related to access, pedagogy or assessment when using ICT to improve and reform education (Kozma & Anderson, 2002).

Due to the fact that much research in the area of technology integration in education has been conducted in technologically advanced countries but little in developing countries, few statistics were available from the developing countries (Jhurree, 2005). This could imply that the developed countries had a wealth of knowledge, skills, expertise and competitive edge that a number of the developing countries did not have. He further suggested that the developing countries could gain a lot from their advanced counterparts.

Many governments in Africa, have made concerted efforts to initiate Internet Connectivity and Technology Training Programmes. Such programmes help to link schools around the world so as to improve education, enhance cultural understanding and develop skills that the youth need for securing jobs in the 21<sup>st</sup> Century (Carlson & Firpo, 2001).

In Kenya, the government recognised the positive effect of ICT in steering the country towards being a middle level economy as is envisaged in the Kenya Vision 2030. The effort to implement ICT integration in schools was first initiated through the Sessional Paper No.1 of 2005, where ICT was given prominence. This was meant to equip public secondary schools with ICT resources and integrate it into the existing school curriculum so as to meet the challenges of Information Technology in society. The paper encouraged school teachers, students and communities around the schools to participate in acquiring ICT skills that were desirable to the knowledge-based economy.

### 1.1. Statement of the Problem

The link between ICT use and students' performance has been the focus of extensive literature review during past decades. Literature shows that many countries have invested in ICT infrastructure, equipment and professional development producing mixed results with regard to students' academic performance. Many researchers have argued that adoption of ICT in teaching enhances the quality of learning and improves the quality of education (Solar *et al.*, 2013 and Wastiau *et al.*, 2013). According to research, in many countries, the investments in ICT infrastructure, equipment and professional development to improve teaching have produced little evidence on improvement of students' academic performance (Babaheidari and Svensson, 2014). In Kenya, very little research has been carried out on the impact of investments in ICT infrastructure, equipment and professional development on students' academic achievement. It was therefore necessary to find the missing link between this investment and the students' academic performance. There was also need to establish experimentally whether integrating ICT in teaching had any positive effect on students' academic performance. Literature review shows that Physics is classified as a difficult and unpopular subject, which is avoided by most students because of poor performances in Kenya schools (Wambugu and Changeiywo, 2008). Based on the identified research gaps and the problem statement, this research investigated the attitude of the Physics teachers towards using ICT in the teaching of Physics in Mombasa County and the impact of using ICT on student academic achievement.

### 1.2. Objectives

The goal of this study is to investigate Physics teachers' attitude towards using ICT in teaching Physics and the impact of teaching using ICT on students' achievement in Physics. However, specific objectives of this research were to:

- Investigate the attitude of the Physics teachers towards using ICT in the teaching of Physics in Mombasa County
- Determine the effect of using ICT in the teaching of Physics on students' academic performance in secondary school Physics.

### 1.3. Research Questions

The research aimed at answering the following questions: -

- What is the attitude of the Physics teachers towards using ICT in the teaching of Physics?
- What is the effect of using ICT in the teaching of Physics on students' academic performance in secondary school Physics?

### 1.4. Research Hypothesis

- $H_0$ . Students taught using ICT have a higher academic performance in secondary school Physics than those taught using traditional method.
- $H_1$  Teaching using ICT has no effect on students' academic performance in secondary school Physics education.

## 2. Literature Review

Literature review shows that ICT has great potential in enhancing academic achievements if fully integrated into Physics teaching and learning. However, there may be challenges confronting its integration including lack of adequate ICT infrastructure and negative teacher's attitude towards use of ICT in teaching secondary schools in Kenya. Positive attitudes towards ICT use might have an impact in teaching and learning (Liaw *et al.*, 2007; Marwan and Sweeney, 2010 and Efe, 2011). This section gives literature review focusing mainly on teacher's attitude on ICT use in teaching and the impact of using ICT on students' academic achievement.

### 2.1. Teachers Attitude and the Use of ICT

According to Ajzen and Fishbein (1977), attitudes refer to the ability to predict a person's behaviour toward certain targets. Ajzen (1988) regarded attitude as a predisposition to respond favorably or unfavorably to a person, object or an event.

The strong relationship between computer-related attitudes and computer use in education has been emphasized in many studies (van Braak, 2001). Teachers' acceptance of the usefulness of technology, and their decision to integrate ICT into their classroom were influenced by their attitudes towards computers (Akbaba & Kurubacak, 1999). According to Myers and Halpin (2002), the major reason for studying teachers' attitudes was that it was a major predictor of future classroom computer use. Among the factors that affect the successful use of computers in the classroom, teachers' attitudes towards computers played a key role. (Huang and Lia, 2005). Research by van Braak, Tondeur, and Valcke (2004) also supported the view that class use of computers was strongly affected by attitudes toward computers in education. In his study involving 184 pre-service teachers, Khine (2001) found a significant relationship between teachers' attitudes towards computers and their use in institutions.

## 2.2. Effect of ICT on Learning Outcomes

According to Tedla (2012), ICT created a room to explore new things, provided a conducive climate for teaching-learning process to take place. This in turn, provided students with the opportunity to develop their cognitive skills. He noted that the integration of ICT into classroom instructions, however, remained far behind because of several inhibiting factors such as the inadequacy of infrastructures, lack of realistic policy on ICT use, lack of teacher's pre-service and in-service training, poor teachers' welfare and morale and lack of parent and community participation. Furthermore, it was realised that the importance of empirical research on the use of ICT was imperative so as to expose further inhibiting factors and at the same time to promote the opportunities for training which are crucial in the learning process, teacher satisfaction and student achievement.

According to Makanda (2015), teaching using computer as a tool raised students' enthusiasm, interest and creativity. ICT use in teaching had effect on several teaching approaches such as collaborative learning and activity learning which have been associated with positive impact on learning outcome. According to Kamau (2014), the use of ICT in education improved teaching and learning at all levels of education.

## 3. Research Methodology

This study was conducted in Mombasa County in Kenya. The study adopted the mixed method approach which considers both quantitative and qualitative treatment of data as methodological solutions. The study employed both descriptive survey design and quasi-experimental research design.

### 3.1. Descriptive Survey Study Design

Descriptive survey deals with describing a phenomenon or the state of something (Walliman, 2011). It included gathering data related to products, people, individuals, events and situations and analysing it (Traverse, 1978). The Descriptive Survey Study Design was employed in this study to define opinion, attitude or behaviour held by Physics teachers on ICT integration in Physics Education.

### 3.2. Quasi-Experimental Design

The Solomon's Four Group Design Model was used in this case. This was the preferred model because it took care of the effect of pre-test on the performance of the experimental group in the post-test (Campbell & Stanley, 1963). The model may be represented as shown in Table 1.

Group	Pre-test	Treatment	Post-test
E <sub>1</sub>	O	X	O
C <sub>1</sub>	O		O
E <sub>2</sub>		X	O
C <sub>2</sub>			O

Table 1: Solomon's Four Group Design Model

Note: C: Control groups, O: Observation, E: Experimental groups, X: Treatment,

This design was used to investigate the effect of using ICT in teaching, on the academic performance of Physics students. The design involved two control groups and two experimental groups. As treatment, the experimental groups were taught some concepts in the topic *Electrostatics*, using ICT. On the other hand, the control groups were taught using the usual traditional instructional method without involving the use of ICT tools. This topic was preferred due to its abstract nature since the experiments involved in this topic do not work well in humid areas like Mombasa which is close to the ocean. Such experiments could therefore be substituted with teaching the topic using ICT tools like video clips and animation.

All the groups involved in the Quasi-experiment were drawn from Form Two Physics students from a purposively selected four-streamed school secondary school. These students were organised into four groups, according to their streams, two of which were Experimental groups E<sub>1</sub> and E<sub>2</sub>, while the other two were Control groups C<sub>1</sub> and C<sub>2</sub>. A pre-test and a post-test were administered before and after the treatment respectively to Experimental group E<sub>1</sub> and Control group C<sub>1</sub>. The Experimental group E<sub>2</sub>, was given only a post-test after receiving treatment. The Control group C<sub>2</sub> was neither given the post-test nor the treatment.

### 3.3. Sampling and Population

In this study we engaged 151 Physics teachers, three of whom took part in the pilot study. We also engaged and 143 student respondents from 64 secondary schools. There were three (3) ICT Champions in Mombasa County who were interviewed out of the four who were recruited. Both purposive and random sampling technique assisted in getting a personal bias-free data because the respondents were interested to participate in the study (Alvi, 2016).

### 3.4. Data Collection Tools and Instruments

This study has made use of structured questionnaire in order to collect data from selected school teachers. The questionnaire focused mainly use of ICT in teaching their lessons, the challenges faced in using ICT facilities in teaching and the possible solutions to those challenges. It also had items on teachers' attitude towards the use of ICT in teaching Physics.

### 3.4.1. Physics Teachers' Questionnaire, (PTQ)

The instrument had a section which had ten 5-point Likert-type items arranged along the preferences SA (Strongly Agree), A (Agree), N (Neutral) D (Disagree) and SA (Strongly Disagree). These items were designed to measure the teachers' attitude towards the use ICT in teaching Physics.

### 3.4.2. Pre-test for Students-(PRETS)

This was an achievement test designed to suit the level of the form two Physics students. The pre-test had one section that consisted of 11 semi-structured type questions, carrying a total of 30 marks. Its duration was 45 minutes. The test could be administered during after class preps to avoid interfering with other lessons. The questions were adopted from KCSE question papers between 2010 and 2016, whose language and concepts were simplified to suit the level of form two learners.

### 3.4.3. Post-test for Students (POSTS)

The post-test was also an academic achievement test designed by the researcher. It consisted of one section with 10 semi-structured type questions and carried a total of 30 marks. Its duration was also 45 minutes. The questions were also adopted from the KCSE question papers between 2010 and 2016 and modified accordingly.

### 3.5. Data Analysis

The data collected were analysed by using the Statistical Package for Social Sciences (SPSS) programme, version 20. The data obtained were calculated in means and standard deviations to facilitate interpretation of the information.

## 4. Results, Interpretations and Discussions

This section presents results on teachers' attitude on ICT use in teaching and learning in Mombasa County. Also presented is the impact of teachers' use of ICT in teaching on Physics student performance in Mombasa County, Kenya.

### 4.1. Teachers' Attitude towards the Use of ICT in Teaching Physics

One of the tasks in this study was to determine the attitude of Physics teachers towards the use of ICT in teaching Physics. To obtain this data, ten 5-point Likert scale items in the Physics Teachers' Questionnaire were used. The responses ranged from strongly disagree to strongly agree. The teachers' responses to the ten items were as shown in Table 2.

Statement	Response						mean	sd	p-value
	SA	A	NS	D	SD	Missing			
School funds spent on ICT infrastructure are well used	6	77	47	8	4	6	2.49	0.788	0.086
I like preparing ICT lessons	14	96	18	16	0	4	2.25	0.780	0.355
Teaching in ICT lessons is fun	71	69	4	2	0	2	1.58	0.620	0.798
Teaching using ICT motivates students	92	52	2	0	0	2	1.38	0.515	0.106
I prefer using ICT to teach most concepts in Physics to using any other method	26	73	16	20	2	12	2.26	0.983	0.000
ICT facilitates teacher's research in a given topic	72	58	4	4	0	10	1.57	0.694	0.079
ICT lessons improve teacher-student communication	45	75	10	8	0	10	1.86	0.788	0.608
ICT integration in teaching saves	48	64	16	10	0	10	1.91	0.867	0.035
ICT integrated lessons help students to be attentive	52	76	4	6	0	10	1.74	0.718	0.658
I feel competent in using ICT tools in teaching	32	72	18	14	0	10	2.10	0.874	0.784
Total	458	712	139	88	6	76	19.14		

Table 2: Teachers Attitude towards the Use of ICT in Teaching Physics

Note: SA-Strongly Agree, A-Agree, NS-Not Sure, D-Disagree, SA- Strongly Disagree

From Table 2, out of the 1,479 responses to the 10 items, 1,170 responses (79.1%) either agreed or strongly agreed to the items showing a positive attitude, while in 94 responses (6.4%) the teacher disagreed or strongly disagreed showing a negative attitude. In 139 responses (9.4%), teachers were neutral. Further, according to the results in the table, the average of the means, for the 10 responses, was 1.91, which was less than 3 (neutral). This showed that the teachers' attitude toward the use of ICT in teaching Physics was strongly positive. We can therefore conclude that when teachers have a positive attitude towards the use of ICT, they can easily embrace it as a method of teaching. These results agree with Buabeg-Andoh (2012) who observed to ensure the integration of ICT is effectively carried out in the school curriculum and also during teaching and learning, a positive attitude towards computer use by teachers was of great importance.

The results also agree with Olandosu (2012), in his study on Basic Technology, Teachers' Awareness and Attitude towards the use of ICT for Sustainable Development in Lagos Nigeria, who asserted that teachers attitude played an important role in the teaching and learning process that involve computer and internet connections.

To find out whether the school category, i.e. whether private or public had any effect on the teacher's attitude towards the use of ICT in teaching Physics, a one-way ANOVA was applied with the school category as the independent variable and the 10 items on the use of ICT being dependent variables. The p-value of the level of significance for each item is shown in the last column in Table 2. The table shows that except for two items the p -values are greater than 0.05 (i.e.p>0.05). This showed that on average, the school category had no significant effect on the teachers' attitude towards the use of ICT in teaching Physics.

#### 4. 2. The effect of using ICT on students' Performance

The statistical treatment used in this case was the two-way ANOVA where the first factor is whether the pre-test has been administered or not and the second factor is whether the treatment has been administered or not. The dependent variable is the students' score.

Table 3 shows the two-way ANOVA output of Tests of between subjects' effects'

Dependent Variable: Students' scores						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	239.263 <sup>a</sup>	3	79.754	20.453	.000	.306
Intercept	16808.303	1	16808.303	4310.537	.000	.969
Pretest	150.726	1	150.726	38.654	.000	.218
Treatment	86.272	1	86.272	22.125	.000	.137
Pretest * Treatment	1.276	1	1.276	.327	.568	.002
Error	542.010	139	3.899			
Total	17517.000	143				
Corrected Total	781.273	142				

Table 3: Tests of Between-Subjects Effects

Table 3 shows the actual results of the two-way ANOVA- namely, whether either of the two independent variables or their interaction was statistically significant. From the table, the level of significance p for the interaction between pretest and treatment was 0.568.

When it came to Physics teachers' attitude towards the use of ICT in the teaching of Physics, the average of the means for the 10 responses on the teachers' attitude, was less than 3 (neutral). This shows that the teachers' attitude toward the use of ICT in teaching Physics was strongly positive.

To find out whether the school category (i.e. whether public or private), had any effect on the teacher's attitude towards the use of ICT in teaching Physics, a one-way ANOVA was applied with the school category as the independent variable and the 10 items on the use of ICT being dependent variables. The results show that on average, the school category had no significant effect on the teachers' attitude towards the use of ICT in teaching Physics.

On the effect of teaching using ICT on students' performance in Physics, the two-way ANOVA results show that both the pre-test and the treatment had a significant effect on the students score. The null hypothesis ( $H_0$ ) that students taught using ICT have a higher academic achievement than those taught using traditional method was therefore not rejected.

## 5. Conclusions and Recommendations

The use of ICT as a pedagogical tool in improving the quality of teaching and learning is important in order for Kenya to catch up with education systems in developed countries. Integration of ICT in teaching and learning in Kenya can be of great benefit if fully integrated into Physics class since it has a great potential in improving students' academic performance in Physics in Kenya.

### 5.1. Conclusions

- Our study revealed that the attitude of Physics teachers towards the use of ICT in teaching was generally positive. This implies that with adequate resources, adequate skills on handling ICI resources and adequate time for preparation, there will be greater use of ICT in the teaching of Physics in Kenya.
- On the effect of teaching using ICT on students' academic performance in Physics, the study revealed that using ICT in teaching enhances students' academic achievement. The use of ICT in teaching should therefore be facilitated and encouraged.

### 5.2. Recommendations

For effective use of ICT in teaching Physics, the following recommendations were made

- For proper maintenance and repairs of the ICT equipment, schools should employ ICT technicians, who will also help to induct the new teachers on the use of ICT tools.

- The Ministry of Education should supply adequate and relevant e-content for all topics for use in ICT integrated lessons since the schools may not be able to develop appropriate ones.
- There should be better maintenance of mains electricity power grid to minimise the frequent power failures experienced in our schools. Power generators should also be installed as a contingency measure in case of such power failures.
- The government should ensure the availability of stronger internet connections in schools to allow for easy access to online material.
- Private schools should not be left out when it comes to implementation of National ICT in education. This may be done by subsidising the ICT equipment for the schools, allowing them access to ICT centers, involving them in the training on the use of ICT among other measures.

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