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Influence of ILA and RTM on the Achievement of Students on the Topic: Cells and Simple Circuits Based on the Type of School

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Abstract:
Physics concepts and skills are very useful in manipulating a wide range of tools in life in the home, Industry, Medicine, Aviation and Agriculture. Physics is a science subject that is part of the secondary school curriculum in many countries. In Kenya, Physics is studied by all Form one and two students. At forms three and four, Physics is studied as an optional subject. The performance of students in Physics at the Kenya Certificate of Secondary Examination is generally poor. The methods that encourage direct and student concentrated involvement have been in vogue. Integrated Learning Approach (ILA) promises better engagement than the Regular Teaching Method (RTM) through: provision of hands- on activities, short assignments, opportunity to acquire skills, development of attitudes towards Physics and ensuring that concepts are applied in life. The study was quantitative, utilizing quasi experimental design of pre- test, post- test, and non-equivalent groups. This study was done in Nandi County in the Rift valley province. This study compared ILA and RTM teaching methods. The objectives of the study were: to find out the achievement of students in Physics, determine the skill acquisition and investigate attitude development after instruction using ILA and RTM on the topic of cells and simple circuits. The target population was form two students who study Physics in sub county and county schools. A sample of 395 respondents from ten schools was selected using multi stage and simple random sampling techniques. A questionnaire was used to determine students' attitude development towards Physics. A checklist was used to gauge the acquisition of skills. Two Physics Assessment Tests (PAT) gauged students' achievement in Physics. PAT 1 was administered at the beginning of the study to determine the students entry behavior while PAT 2 established the students' achievement after instruction using ILA and RTM. The instruments were piloted for validity and reliability in two secondary schools in Nandi County. The validity determined by three Physics- subject experts was classified as good. Reliability coefficients of 0.803, 0.791, 0.910 and 0.715 for PAT1, PAT2, SOC, and AOC respectively were obtained using Cronbach's Alpha coefficient. Data from PAT1 and questionnaire was collected by the researcher during the second visit to the schools. The second questionnaire, skill acquisition checklist and PAT 2 were collected during the final visit to the schools. Data analysis utilized t- test, ANOVA and chi square. The results of the study showed that students in county schools obtained better grades than those in sub county schools when ILA and RTM were used during instruction.

Keywords: *Physics, achievement, students, county and Sub County schools ILÀ, RTM*

1. Statement of the Problem

There are rapid changes taking place in the manufacturing Industry, Communication, Agriculture and Medicine. The Education sector is a major player in the envisaged industrialization in Kenya by 2030. The curriculum offered at secondary school is expected to address industrialization as a central and cross-cutting theme. Science is instrumental in bringing about changes through the advancement of technology and industrialization.

The number of students who enroll to study physics at forms three and four in secondary schools in Kenya is low. For those who enroll, the performance at the end of secondary school leaving Examination is dismal. Poor performance in sciences affects economic, social and political pillars of development. The students generally show little interest and motivation to study Physics. This is despite many efforts by stakeholders aimed at restructuring the curriculum and attempts at prolonged in-service programmes for teachers that are supported by interested stakeholders. The challenge has been to find and apply methodologies that excite the learners. This should lead to motivation to enroll and continue studying Physics throughout the secondary school cycle. Meaningful methodologies should engage learners in cognitive development. In addition, skills that concern psychomotor development should be addressed. This study proposed to investigate the Integrated Learning Approach which concentrated on cognitive skills and attitudinal development. The study targeted secondary school students' learning of cells and simple circuits. The study compared learning developments due to ILA and RTM in county and sub county secondary schools.

1.1. Objectives

Find out the influence of ILA and RTM on the achievement of students on the topic: cells and simple circuits based on the type of schools

1.2. Scope

Only Form two secondary school students participated in this study. The study investigated the achievement of students in two Physics Assessment Tests (PAT 1 and PAT 2). The PAT 1 was based on the content at standard eight and Form one in the Kenyan Education System. The second test, PAT 2, was based on the content taught on the topic: Cells and simple circuits during the research study period. The students wrote their responses in the spaces on the question papers.

2. Theoretical Framework

This study was guided by Gagne's Conditions of Learning Theory. Gagne's theory deals with three aspects of learning namely: conditions of learning, processes of learning, and outcomes of learning. The conditions of learning are further concerned with external and internal factors of learning. External conditions of learning are caused by other people through motivating or arousing the learner by asking questions in tests, assignments and any other challenging situations in order to determine the level of understanding of that which was taught.

Outcomes of learning are concerned with motor skills and cognitive strategies such as: verbal formation which is useful in writing, discussion and dramatizing; intellectual skills in the ability to discriminate and classify things; cognitive strategies that entail remembering; attitudes exemplified by values, dislikes, fears and needs; motor skills like printing, writing, using rulers typing and driving. The theory outlines the factors essential for learning as: circumstances in which learning occurs, the acquisition of motor skills, cognitive abilities, organization of information, insightfulness, thinking, acquisition of attitudes, learner arousal by use of asking questions through assignments, and tests. Learning outcomes also include verbal formation which is useful in writing, discussing and dramatizing. The motor skills include printing, using rulers, typing and driving lead to the development of attitudes such as responsibility, curiosity and cooperation.

Gagne's theory identified various key types of learning: problem solving, rule learning, concept learning, discrimination and verbal association, simple chaining, S-R learning and signal learning. It is important that students' attention is drawn to the important aspects of a lesson. The teacher was to provide learners with examples or models of behavior expected of them during learning situations. It is suggested that to enhance retention and transfer, students should be given more than one example during a lesson. The content was reviewed in small amounts and related the current information to the previous concepts learnt. Educational implication of Gagne's theory was that it presented insights which required that learners master concepts presented to them. Constant revision, discussion and assignments based on the topic covered were used to help strengthen learning.

Gagne's theory finds support in a study done by Wambui (2005) which suggests that research cards could be used during the process of learning. This would place the responsibility of learning in the hands of students. The said cards could have the effect of making the teacher a mentor and facilitator during the teaching learning process. In this study the ILA intervention was expected to contribute towards empowering students with cognitive abilities and motor skills which improved their academic performance and provide positive attitude towards Physics. Physics knowledge and skills enabled students to answer questions in physics tests and examinations and also react appropriately in situations that required Physics skills.

3. Conceptual Framework

Arising from the theory on Conditions of Learning, this study was formulated to find out the effect of Integrated learning Approach (ILA) and Regular Teaching Methods (RTM) on performance, skill acquisition and attitude development in Physics. ILA activities included application of concepts, hands- on activities, short assignments, research cards, taking responsibility, cooperation, classification, drawing conclusions and curiosity. These activities were to lead students towards ownership of the learning experiences hence bring about behavior change. The schematic diagram below shows the conceptual framework envisaged for this study.

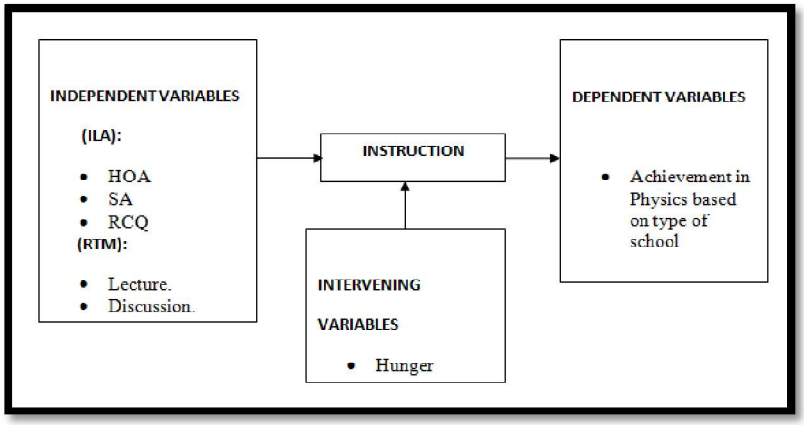

Figure 1: Conceptual Framework

The Integrated Learning Approach (ILA) had the activities that included hands on activities, short answer questions, research card questions and skills. The hands on activities (HOA) included drawing diagrams, recording data, manipulating apparatus and instruments. These HOA entailed the use of hands in doing experiments demonstrations and other activities that make use of hands. The short answer questions (SA) are meant to remind the respondents to the content they handled during the teaching-learning process. The respondents therefore go over the day's content in answering SA. Research card questions (RCQ) require the respondents to search for information from various sources. RCQ have the effect of encouraging respondents to do independent reading and enhancing better understanding of concepts.

The Regular Teaching Methods (RTM) was envisaged to include popular activities like lecture, discussion and demonstration. Lecture activities that entailed the teacher presenting content with very little respondent involvement. Discussion was an activity where the respondents give their points of view concerning a given topic. Demonstration was the activity where the teacher performed most of the activities while the respondents remained passive.

4. Instructional Techniques used in Physics

Knowledge that is acquired without sufficient structures to tie it to is knowledge that is likely to be forgotten. Physics Education is not a constant but a variable. It changes in direction in relation to the developments in society (Lijnse, 1983).

In a study on grade ten students, it was established that the teaching styles were major determinants of students' attitude towards science. The students did not appreciate the contemporary practice of copying a teacher's notes. The students preferred taking an active role in the learning activities (Ebenezer and Zoller, 2006).

Allison and Yang (1998) showed that 52% of the students interviewed sometimes ignored text reading assignments because they had difficulty making sense of what they read in Physics textbooks. 40% of the students agreed that they had difficulty in identifying the main points of a text. However the students agreed that note-taking from textbooks could assist learning.

The baseline survey conducted by SMASSE on students' performance in science subjects and Mathematics found out that teachers used inappropriate methodology in teaching at the secondary school level. Most of the lessons presented to students are teacher-centred (SMASSE, 1998). The performance of students in Examinations reveals that the standard of teaching students is low. Lecture method is the most popular mode of teaching Physics at the secondary school level. However this method makes students passive learners (Munavu et al, 2008).

A study done in three districts of Lagos State on 78 teachers and 500 junior secondary school students, established that teacher-centred activities dominated the lessons at the expense of student involved in science lessons. Another startling statistic was that about 50% of the 80 minute lessons were used by the teacher in demonstrations, explanations and taking notes; only 16% of the lessons were devoted to group-based lessons (Ogunmade, 2005). In Tanzania teachers still use the traditional lecture method in teaching Physics at the secondary school. The results also show that the teachers rarely provoke students to ask questions and there is very little interaction between the teacher and the students.

In another study it was found that 62% of the secondary school teachers use lecture method in teaching Physics. Students taught by the lecture method consistently demonstrate poor student motivation and achievement in the Physics programme. This is because the lecture method does not provide students with opportunity to comprehend, apply and analyze Physics problems. The data obtained from the study show that students taught by lecture method performed poorly in higher cognitive hierarchies. On the converse it was found that students taught by laboratory method performed better than those taught by the lecture method (Ali, 1980).

A workshop held at University of Cape Coast in Ghana was informed that Physics teachers need to come up with interventions and methods addressing the difficulties that dodge the teaching of Physics. Participants discussed the need to improve the teaching and learning of Physics in order to stem fears about the study of the subject. Policy makers need to consider mandating science education to move towards a real world and context- based approach in the teaching/learning process of school science at all levels (UNESCO, 2003).

Field trips, problem solving, inquiry method, cooperative learning, Project method and guided discussion are recommended for use in teaching Physics at secondary school level in Nigeria. This method was recommended because it results in high student- scores. Project work is rarely used because it is thought to be expensive on resources and also takes a lot of time (Omowunmi and Ojo, 2007). ILA intervention suggested could help the dilemma of instructional strategies by using a battery of strategies that could be used to cover the whole spectrum of teaching/learning process in Physics.

5. Research Design

The investigation was quantitative in nature. Quasi-experimental research design was employed in this study. The pre-test, post-test nonequivalent groups design was used. This was done because the classes were used as intact groups in the study.

Group	Pretest	Treatment	Posttest
A	O_1	X	O_2
B	O_3	C	O_4

Table 1: Pretest Posttest Nonequivalent Research Design
Key:O- Observation, $O_1$and O_3 Pretest, X-Treatment/Manipulation, Posttests (O_2andO_4), C- Control

According to Best (1981) the Pre-test, post-test nonequivalent groups design is suitable for classroom experiments when experimental and control groups are naturally assembled as intact groups.

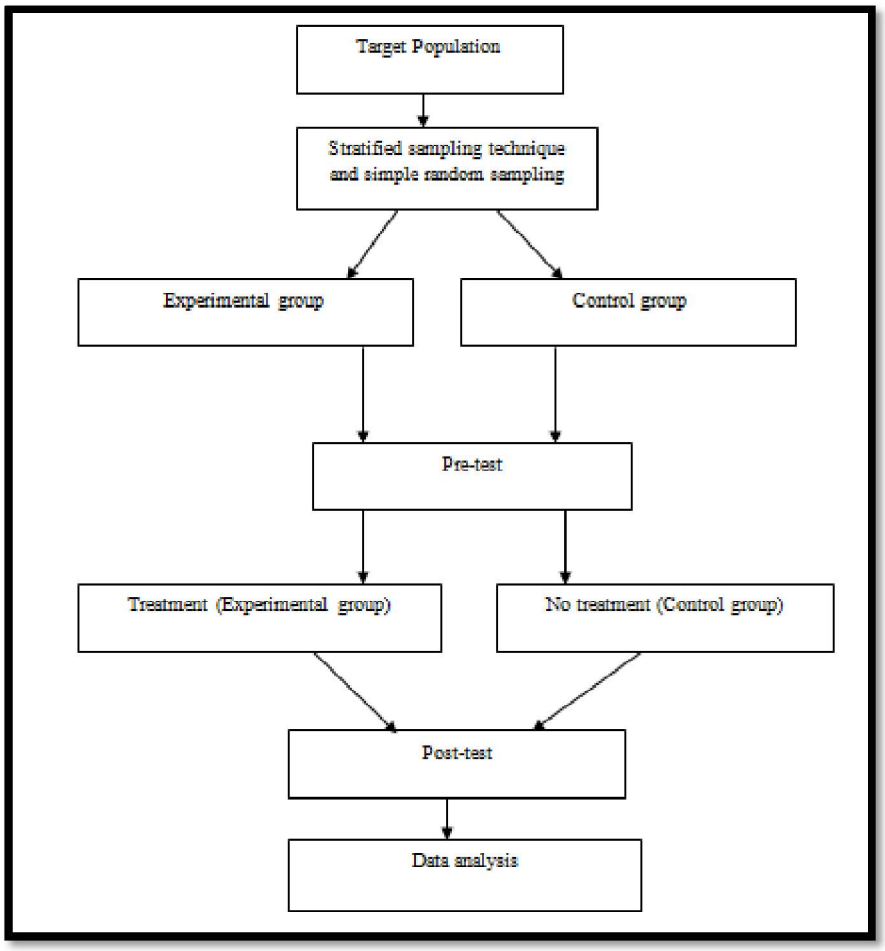

Figure 2: Operationalizing of the Research Design

5.1. Sampling Procedures and Sample Size

Multi stage sampling technique was applied to the target population to obtain the sample from the schools. The study used stratified sampling technique to select ten secondary schools. The strata were boys and girls; county and sub county schools. Simple random sampling technique was then applied on the strata to obtain experimental and control groups of students. The experimental and control groups were drawn from different schools. This was to reduce the chance of interaction among the groups of respondents.

Type of School	ILA (%)	RTM (%)	Total (%)
S/ County	90(22.8)	46(11.6)	136(34.4)
County	157(39.8)	102(25.8)	259(65.6)
Total	247(62.5)	148(37.5)	395(100.0)

Table 2: Sample Size of Respondents in County and Sub County Schools

The total number of respondents in the Sub County and County was 395. The number of respondents drawn from the Sub County schools constituted 136 (34.4%) of the total subjects. Another 259 (65.6%) of the respondents were drawn from the county schools. The experimental group (ILA) made up 247 (62.5%) of the respondents while the control group (RTM) had 148 (37.5%) of the respondents as shown in table 3.4 above.

5.2. Research Instruments

The instruments used in this study were: Physics Assessment Test (PAT 1) for pretest, Physics Assessment Test (PAT 2) for posttest, Skill Observation Checklist (SOC) and Attitude Observation Checklist (AOC).

5.2.1. Physics Assessment Test 1(PAT 1)

The PAT 1 was based on the topic: cells and simple circuits. This content was that learnt by students during the study of Science in standard eight and Physics in form one. The PAT 1 was used in establishing the entry behaviour of the students. This test consisted of seven structured items on cells and simple circuits. The PAT 1 was marked out of twenty five marks then converted to percentage.

The items included listing fundamental quantities measured in Physics and stating the SI units of quantities. Respondents stated examples of conductors and insulators and also gave the names of instruments used in measuring quantities. Other items required the respondents to state the type of connections in simple circuit diagrams. The instrument had an item on drawing a simple cell in an electric circuit. (KIE, 1999; Singh, 1992).

5.2.2. Physics Assessment Test 2 (PAT 2)

The PAT 2 was a test on the topic: cells and simple circuits covered during the treatment period. The researcher used PAT 2 as a post test for both experimental and control groups. This instrument consisted of six items that tested various abilities. The respondents attempted an item where they were to draw a complete circuit showing a cell, an ammeter, a voltmeter, a variable resistor and a bulb. They attempted an item where they were to draw a labeled diagram of a simple cell.

PAT 2 had an item on the difference between primary and secondary cells while in another item respondents were expected to bring out the difference between the electrolytes used in a simple cell and a dry Leclanche cell. The instrument had an item on the care and maintenance of secondary cells. In other items the test needed the respondents to define the ampere and also state the SI unit of an electric current. The test was marked out of twenty five marks then converted to percentage.

5.3. Piloting the Instruments

The questionnaire was piloted in Nandi County in two schools that were not of the main study. The pilot was used to establish the adequacy of time, space provided for answers to questions, the level of language use and the appropriateness of the items that made up the instruments.

5.4. Validity of the Instruments

The instruments were checked for face and content validity by experts in questionnaire, test and the skill checklist construction. The validation of PAT 1, PAT 2 and SOC was recorded in table below.

Experts	Instruments	Face Validity	Content Validity	Average	Comments
Expert(1)	PAT1 (10)	8	8	8.0	
	PAT2 (10)	7	7	7.0	
	SOC (10)	8	7	7.5	Good
	AOC (10)	8	8	8.0	
Expert(2)	PAT1 (10)	7	7	7.0	
	PAT2 (10)	8	8	8.0	
	SOC (10)	7	7	7.0	Good
	AOC (10)	7	6	6.5	
Expert(3)	PAT1 (10)	8	9	8.5	
	PAT2 (10)	8	8	8.0	
	SOC (10)	7	7	7.0	Good
	AOC (10)	8	7	7.5	

Table 3: Validation of the Instruments

The validity for each instrument was scored out of ten (10). From the values in the table above, the three experts rated the instruments as good. Expert 2 awarded PAT 1 the highest score of 8.5 out of 10 while AOC had the lowest score of 6.5 out of 10 awarded by the same expert

5.5. Reliability of the Instruments

The PAT, SOC and AOC were tested for reliability using Cronbach's Alpha coefficient, r_{xy} by applying split-halt method. The value of r_{xy} was calculated for each instrument. The coefficients of reliability for PAT1 and PAT2 were 0.803 and 0.791 respectively. The coefficient of reliability for SOC was 0.910. The 25 items in AOC scored an overall coefficient of reliability of 0.715.

6. Data Collection Procedures

The researcher sought permission to conduct this study from the School of Graduate Studies and the Ministry of Education Science and Technology. Schools were then sampled. The researcher pre-tested the instruments in two secondary schools in Nandi County before implementation of the study. Physics teachers participated in the study as research assistants. Half of them taught their regular form two classes using ILA. The other half used RTM.

The researcher distributed PAT1, SOC and AOC to all the sampled schools. The PAT 1 and AOC were administered and their results collected from all the schools at the beginning of the study. The SOC was scored over the period of four

weeks of the study. The post test (PAT 2) and Attitude Observation checklist (AOC) were answered by students at the end of the final week of the study. The results of PAT 2, AOC and SOC were collected during the final visit to the schools.

7. Data Analysis Techniques

The data collected from instruments was coded to make it suitable for analysis. The data was analyzed using the statistical package for social sciences version 21 (SPSS-X). Descriptive and inferential statistics were used to analyze the data obtained. The t-test statistics was used to establish differences in the means of PAT 1 and PAT 2, Experimental and Control groups, initial AOC and final AOC, boys and girls, county and sub county schools. The ANOVA test was also used to find out the difference in the means of types of schools and gender in relation to Experimental and Control groups. The means of PAT 1 and PAT 2 were compared for Experimental and Control groups. The difference between the means of the scores of Pretest and Posttest were tested for statistical significance at the 95 % confidence level (Kothari, 2009). The skill level of students in ILA and RTM groups was compared using Chi square. Chi square was also used to compare ILA and RTM on students' attitude development based on gender and the type of schools.

Objective	Type of Data	Variables		Statistical Analysis Tools
		Independent Variable	Dependent Variable	
1	Interval/ ratio	ILA & RTM	Achievement in Physics	t- test, ANOVA
2	Ordinal	ILA & RTM	Skill acquisition in Physics	Chi square (x^2)
3	Ordinal	ILA & RTM	Attitude towards Physics	Chi square (x^2)

Table 4: Data Analysis and Statistical Tools

The details of the objectives in the table above are indicated below:

- Objective 1: t-test and ANOVA were used to find out the influence of ILA and RTM on students' achievement in Physics based on gender and type of school.
- Objective 2: Chi square (x^2) was used to determine the effect of ILA and RTM on students' skill acquisition based on gender and type of schools.
- Objective 3: Chi square (x^2) was used to establish the effect of ILA and RTM on students' attitude development in terms of gender and type of schools.

8. Students' Achievement in Physics Based on Type of School

This section presents the findings of PAT 2 that indicate the effect of ILA and RTM on the academic achievement of students in Physics based on type of schools (County and sub County schools) in tables below.

Type of school	Experimental Group		Control Group	
	Mean (%)	SD	Mean (%)	SD
Sub County	52.5	14.60	49.0	17.66
County	59.5	14.79	50.4	17.04

Table 5: Students' PAT 2 Scores Based on Type of School

The mean score obtained by students in the County schools (55.9%) was higher than that of students from Sub County (51.9%). The results indicate that the experimental group had higher mean scores than the control group. The values of SD (14.79 and 14.60, 17.66 and 17.04) among county and sub county schools in the experimental and control groups were comparable. The overall difference in the mean scores of students from County and sub County was significant ($p = 0.031$) at 95% confidence level. The null hypothesis was therefore rejected and the alternative upheld.

The mean score of the control group from County schools (50.4%) was higher than that of control group in the sub county schools (49.0%). The sub County schools in the control group posted a lower mean score (49.0%) than the sub County schools in the experimental group (52.5%). County schools that made up the experimental group had a higher mean score (59.5%) than the sub county schools that formed the control group (49.0%). County schools that belong to the control group posted a lower mean score (50.4%) than the county schools in experimental group (59.5%). It was also established that the sub County schools in the experimental group had a higher mean score (52.5%) than the County schools that were in the control group (50.4%). In the experimental group, County schools (59.5%) posted a better mean score than the sub county group (52.5%). Computation of the data obtained from one –way ANOVA for students' achievement is displayed in tables below

	Sum of Squares	df	Mean Square	F	Sig.
Between groups	1633.436	2	816.718	3.211	0.041
Within groups	99714.979	392	254.375		
Total	101348.415	394			

Table 6: Computation of One Way ANOVA for Students Achievement in PAT2 by Type of School

The computation of one way ANOVA gives a value [F (2,392) =3.211, p<0.05]. The ANOVA value obtained above shows that there was statistically significant difference between the experimental and the control groups at 95% confidence level.

9. Discussion of the Achievement of Students in Physics Based on ILA and RTM

The fact that PAT 2 had a higher mean than PAT 1 indicates that ILA was a better approach than RTM. The findings from previous studies are in agreement with the fact that ILA was a more suitable than RTM for teaching Physics at secondary school level. This is because ILA approach puts the learner at the centre of the lesson activities so that the teacher plays the role of facilitator.

Munavu et al (2008) reported that lecture was popular among teachers yet it made students passive due to little participation in the teaching- learning process. According to According to Ali (1980) lecture method did not motivate students to comprehend, apply and analyze Physics problems. The converse is that students taught by the laboratory method perform better than those who utilize the lecture method. Osokoya and Akuche (2012) in their study found out that the location of the school had significant effect on the cognitive achievement in Physics. A survey by SMASSE on students' performance showed that teachers used inappropriate methodology in teaching Mathematics and science subjects at the secondary school level.

Notable causes of gender differences include the view that science is a male domain, perceived gender stereotypes and different teacher expectations. (Burkham et al, 1997). The results obtained in this study indicate that there were glaring differences in the performance of boys and girls in Physics. In Kenya, Physics has been made an optional subject hence the students think that it may not be very important. Girls are more concerned with the human dimension of science than the abstract scientific principles, experiments or instruments that are handled in Physics.

Eryilmaz and Ates (2011) established that students taught by the method of hands- on and minds-on activities performed significantly better than those taught by the traditional methods. From the results of this study there was significant improvement in students' performance in Physics when they learn by hands-on and minds- on activities. Musasia et al (2012) found out that practical work helped to improve the performance of girls in Physics. The study also established that the girls in the experimental group outperformed those in the control group.

SMASSE (1998) reports that some teachers use inappropriate methodology that is mainly teacher centred. The findings above are also in agreement with Munavu et al (2008) who argued that the performance of students depends on the standard of teaching-learning achieved by teachers and students.

Berson (1993) and Colliver (2000) in their studies did not find any significant evidence that activity-based learning was superior to the traditional learning method of teaching. Similarly Gallagher and Stephen (1996) found no significant difference between activity- based learning and the traditional learning method.

10. Conclusion

ILA approach yielded higher achievement than RTM. Thus the ILA group obtained higher scores than the RTM group. County school students performed better than their sub county counterparts.

11. Recommendations

Secondary school curricula should adapt the integrated Learning Approach in teaching and learning Physics at both county and sub county school

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