EFFECT OF GEOGEBRA AND PAPER/PENCIL TO THE TEACHING AND LEARNING OF SIMULTANEOUS LINEAR EQUATION IN SOME SELECTED JUNIOR SECONDARY SCHOOLS AT ZARIA\ KADUNA STATE OF NIGERIA.

by

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Abstract

This study examined the effect of GeoGebra and paper/ pencil on the teaching and learning of mathematics. The population comprised four selected junior secondary schools in Zaria, Kaduna state of Nigeria and constituted a total sampling of 50 students for experimental as well as 50 students for the control. Experimental group were interacted with different kind of GeoGebra tools to solve problems in Simultaneous linear equations. The control group was exposed to the traditional method (by using paper/pencil) and taught the same topic. The experiment lasted for the period of eight weeks. Instrument used for data collection is students test in mathematics (STM). Moreover, data collected were analyzed by the use of SPSS software (version 18.0 However, the result showed that there is considerable variation between before-test and after-test performances. Consequently, the result in the control group performed slightly better in (STM) than the experimental group at the pre-test of both groups before intervention. The result indicate that t- value is -1.63 while p-value is 0.001<0.05 at level of significant and the decision is rejected which indicate that both groups have similar Mathematical abilities before the treatment was administered. Besides, the experimental group performed better in (STM) than the control group at the post-test of both groups after intervention. Statistical evidence from this null hypothesis revealed that the t- value is 6.81 while p-value is 0.001<0.05 at level of significant, indicating that the t-value is less than p-value. This implies that the decision is retained. The study recommends among others that Government and critical stakeholders should encourage and support teacher training so as mathematics teacher can brings the desire changes to the full implementation of ICT into secondary schools.

keywords*: GeoGebra; paper/ pencil; Simultaneous linear equations and students test in mathematics (STM).*

Introduction

Mathematics is a branch of science which deals with quantities, sizes and shapes as determined by numbers and signs; and is a tool whose knowledge and skills are the bedrock of all societal transformation and transfer of ideas into reality. Mathematics has a number of useful benefits to our mind if we go into its study. It develop our reasoning, help us to have analytical thinking, quickens our mind, generates practicality and also its use can be applied in the day to day activities (Odo& Ugwuda, 2014). Mathematics plays a crucial role in nation building through medicine, agriculture, economic sector, entertainment, transportation, communication etc. Mathematics and science are taught as separate subjects at all the secondary school level. Furthermore, science activities in the classroom have mathematical implication as solving mathematics problems have scientific impact and vice versa. Mathematics is not a classroom discipline only but what everybody needs at any time (Holbrook, 2009).

Secondary school mathematics is aimed at developing learners understanding of basic scientific phenomena and the application of scientific ideas of everyday life. The objectives of mathematics curriculum at the secondary school level are to: provide basic literacy of mathematics for functional living in the society; Acquire basic concepts and principles of mathematics as a

preparation for further studies; Acquire essential scientific skills and attitude as a preparation for technological application of mathematics and stimulate and enhance creativity (FRN, 2004).

New technologies are changing the way we work and live so also the introduction of ICT into our schools curriculum.ICT integration into mathematics comes with diverse promise, so also some challenges and interruptions into the classroom teaching and learning. furthermore, a lot of reported examples of real use and apparent teacher enthusiasm to transform their instructional practice, and further details of what students learn using ICT and how teachers could advance their method of teaching (Ofsted (2001, 2002).

GeoGebra is open and available software that connect Geometry and algebra (White, 2002).The self-motivated mathematics software (GeoGebra) could be used for teaching and learning of mathematics from primary schools to Universities (Hohenwarter and Preiner, 2008).Consequently, GeoGebra as stressed by Markus Hohenwarter, as an open, basis and self-motivated mathematics software that could be used in the teaching/learning of geometry, algebra and calculus (Hohenwarter, Jarvis and Lavicza, 2008). However, the software is a combined attribute of big software programs such as; Maple, Derive, Cabri and Geometer's Sketchpad (Sahaa, Ayub and Tarmizi, 2010). In addition, the open dynamic mathematics software may gives a better room for visualization by allowing learners to observe and discover mathematical associations as well some concept that are difficult to show in the past prior to technology or with paper/pencil environment. Furthermore, the software gives room for constructions of conic sections, points and lines. Besides, it provides classic features to be used in a computer algebra system such as; in the discovery of vital points of functions, roots, direct input of equations and co-ordinates, finding derivatives and Integrals of the entered functions. The objective is to make use of GeoGebra to offer an atmosphere for dynamic discovery of mathematical structures through the numerous representations (Waxman, Connell, and Cray, 2002).

An equation is a statement that shows two mathematical expressions are the same. A linear equation is an equation that is in the form $ax + b = 0$ where a and b are constants. When two linear equations hold at the same time or apply together, we have what is called simultaneous linear equation. In other words, simultaneous linear equation, involves two linear equations with two unknowns (TESSA, 2010).

TEACHING AND LEARNING OF MATHEMATICS WITH ICT AT JUNIOR SECONDARY SCHOOLS.

The introduction of ICT into mathematics education may come with different issues of investigation for the researchers and to me one important question to be considered in this context is whether mathematics education teachers can brings about these long desire needs into classrooms teaching. An interpretation on processes with and without the aid of technology is supreme at the instant or could arise by opportunity and the quantify problem is how can we cut off processes to view in those environments?(paper \hand and new technology environment), one reasonably and noticeable technique is just to connect in doing a lot of mathematics actions in both environment and note down what way are in use (Monaghan, 1997).

There is a sign that technology may bring changes in the approach of teachers in their classrooms teaching. The option of computer technology is not ultimate remedy to education problems (Jered, 2007 cited in Jaafaru 2015) or a total solution for educational change (Jered, 2007 cited in Jaafaru 2015) but as a instrument, that could be used to sustain learning.

Moreso, ICT may be another option to be used in enhancing teaching/ learning of mathematics in the 21st century. (NCTM 2008) argues that secondary schools should make sure that all their students have access technology.

Drijvers, Boon and Van Reeuwijk (2010) make out three mathematical functionalities that could aid ICT use in the teaching/ learning of mathematics in our secondary schools:
(1) The mediational task for solving mathematics, which indicates the capability of working out problems with paper/pencil and ICT.
(2) The role of learning atmosphere for active skills.
(3) The purpose of learning mood for development and growth of theoretical perceptive.

STATEMENT OF THE PROBLEM:

Students with poor background in their training accussing skills may not be able to use the algebraic instruction correctly, and also in situation when the fundamental instructions or tasks are not easy to understand, learners may be confused on what way forward and be at lost. Several strategies that comprise the use of mathematical tools and free software's may not be suitable for the learners to handle as a new task. Paper\pencil seems not to be automatic to some extent and therefore involve different processes. Feature extension of the software's icons that take care of the mathematical analyses, different application and the use of 3D seems to be difficult to the students. It seems there are limited research on the effect of GeoGebra and paper/pencil on the teaching and learning of simultaneous linear equations at junior secondary schools and need to be improved for easy technology integration (Sahaa, Ayub and Tarmizi, 2010).

Objectives of the study

The major objective of the study was to investigate the effect of computer assisted instruction and the convectional instruction (paper/pencil) on the student's performance in Mathematics in simultaneous linear equation among junior secondary schools. Therefore, the specific objectives of the study were to:

i. Investigate if there was any significant difference in the mean performance of the experimental and control group before intervention.
ii. Determine if there was any significant difference in the mean performance of the students in the experimental and control group after intervention.

Research Questions

The following research question guided the study

i. To what extent does the performance of the experimental group differ with that of the control group before intervention?
ii. To what extent does performance of the experimental group differ with that of the control group after intervention?

Hypotheses

The following null hypotheses were formulated and tested at $P \leq 0.05$ to find the relationship between the variables in the study:

iii. There is no significant difference in the mean performance of the experimental and control group before intervention.
iv. There is no significant difference in the mean performance of the students in the experimental and control group after intervention.

SIGNIFICANT OF THE STUDY

This research study will serve to inform teachers, researchers, students and other societies on the teaching/learning process particularly those related to the use of ICT (GeoGebra) and paper\pencil in relation to mathematics knowledge. This research will focus on the processes, difficulties and approaches that affect teachers, researchers, students etc that will need to encounter when using the combined methods. The investigation may find out the

role of teachers, peers towards the use of various technological instruments that may affect learning outcomes with respect to the Vygostkian approach (Vygostkian 1978). However, the findings may provides tentative information on the learners abilities towards interaction as well their performances to the task; such information is crucial in designing and preparationn of huge classroom lesson as well as learner different capabilities. Besides, the learning reveals how the joint methods may improve the teaching and learning of simultaneous linear equation in junior secondary schools.

METHODOLOGY

The research design that was adopted for this study is a quasi- experimental design. A Pretest and Posttest for the two groups was used in this format; one group of students (experimental) was taught some linear simultaneous equation using computer GeoGebra Software while the other group (control) was taught the same concepts using conventional instruction.

The instrument named student test in mathematics (STM) was an achievement test designed to find our student's performance in simultaneous linear equation after an instruction was given to them by the researcher through computer instruction and convectional instruction. The achievement test consisted of 10 past questions of the essay type.

Population and sample

The population of the study consisted of some selected junior secondary school students in Zaria. Four schools in Zaria were sampled for the study.

The schools were government junior secondary school Tudun Jukun, Baba Ahmad Foundation, government junior secondary school Tudun Wada and Suntal secondary school. One hundred students from the four schools (100) were randomly selected from one thousand (1000) students in junior secondary schools in Zaria.

Instrumentation

Ten restricted past questions items test was design for the selected junior secondary schools and taken to the four schools for the students test in mathematics (STM) and lasted within eight weeks for the students to attempt and solve. The questions were to measure the student's performance in JSS level. The STM was used for both pre-test and post-test.

Validity and Reliability of Instrument

The STM was examined by four mathematics/computer science specialist and it was modified accordingly. They were requested to determine the appropriateness of the questions in the instrument for the purpose of the research.

A test is said to be reliable if repeated measurements using the test gives more or less the same results (Omwirhirem and Khalil, 2016). The data obtained from the pilot study after marking and recorded were used to determine the reliability coefficient. The reliability coefficient of the instrument was computed to be 0.85 using Kuder-Richardson 21 formula. This indicates that the test item was usable and reliable.

Administration of Instrument

Before the commencement of the treatment, a pre-test was administered to both the experimental and control groups. The scores of the pre-test was analyzed using t-test to ascertain if there is any significant effect in the performance of the students in the experimental and control groups. The study lasted for a period of eight weeks, during which the topic were treated with students in collaboration with the Mathematics teachers in each of the schools.

A pre-test and post-test were administered to all the students and last for eight weeks. In the first group (experimental group) which consists of fifty students were exposed to computer assisted instruction and same to control group (convectional) way of teaching.

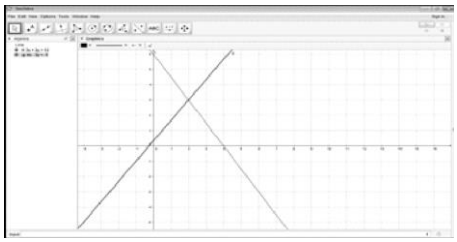
Instructional manual used for the Experimental group (GeoGebra software) and control group (paper/pencil).

The experimental group was treated in the lab with one desktop to each student. The GeoGebra window was projected o n the screen with use of computer. The researcher explained and demonstrates to the students the processes involve in using GeoGebra tools (Command and other necessary feature of the software). Furthermore, the researcher demonstrates how to solve problems involving simultaneous liner equation by step by step method. The students were given chance to carry out exercises using the software with some guidance from the researcher.

However, the control groups were equally treated by the use of paper/pencil and graph to demonstrate to the students the processes involve in solving simultaneous liner equation. Finally, a task was given to the students and they were encouraged to use the two different methods to obtain the solution of the simultaneous liner equation as illustrated below:

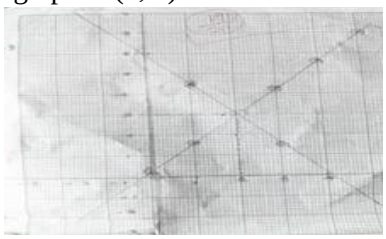
By GeoGebra

Step 1. Open GeoGebra file.
Step 2. Using the input bar, type 3x+2y=12 and press enter to obtained the first straight line.
Step 3. Using the input bar, type 4x-3y=-1 and press enter to obtained the second straight line.
Step 4. Point of intersections of the curve is automatic at (2,3) and the result is shown below:



By Paper/Pencil

Step 1. Construction of table of values f of the two equations **(**3x+2y=12 & 4x-3y=-1) from -5 to +5.
Step 2. Plotting of the graph
Step 3. The plotted graph is used to determine the point of intersection of the curves.
Step 4. The solution from the graph is (2, 3) as illustrated below:



Method OF Data Analysis

The scores from the experimental and control groups form the data for the study. The research questions were answered using the mean scores and standard deviation while the hypotheses tested using the t-test statistic at 0.05 level of significance.

Data Analysis and Results

The instrument used for the study was student test in Mathematics with the use of GeoGebra and paper/pencil. The instruments were analyzed and executed using the statistical package for social sciences version18.0 (SPSS 18.0). However, the study aimed at finding out if any difference existed in the performance of students exposed to computer assisted instruction and that of paper/pencil in the test administered, the mean scores were calculated. Besides, t- test scores of the two groups were tested before and after the study for statistical significant difference. The tables and discussions that follow may illustrate the effect of computer assisted instruction and the convectional instruction (paper/pencil) on the student's performance in simultaneous linear equation in the sample of the schools.

Presentation of results

The result of this were obtained from research questions and hypothesis answered through data collected and analyzed.

1. To what extent does the performance of the experimental group differ with that of the control group before intervention?

Table 1: Result of the independent t-test on the Pre-test of both groups

Group	N	X	SD	Df	t-value	p-value
Experimental	**50**	**15.22**	**4.29**			
				98	**-1.63**	**0.001**
Control	**50**	**18.16**	**2.40**			

$P \leq 0.05$

From table 1, the mean score for the experimental group is 15.22 with SD=4.29 while for the control group is 18.16 with SD=2.46,t=-1.63, df=98 and p-value of 0.001.this shows that the control group performed slightly better in students test in Mathematics than the experimental group at the pre-test of both groups before intervention. However, this difference is significant at 0.05 levels and the decision is rejected. This result showed that both groups have similar Mathematical abilities before the treatment was administered.

1. To what extent does the performance of the experimental group differ with that of the control group after intervention?

Table 2: Result of the independent t-test on the Post-test of both groups

Group	N	X	SD	Df	t-value	p-value
Experimental	**50**	**16.69**	**3.76**			
				98	**6.81**	**0.001**
Control	**50**	**12.68**	**4.43**			

$P \leq 0.05$

From table 2,the mean score for the experimental group is 16.69 with SD=3.76 while for the control group is 12.68 with SD=4.43,t=6.81, df=98 and p-value of 0.001.This shows that the experimental group performed better in students test in Mathematics than the control group at the post-test of both groups after intervention. Statistical evidence from this null hypothesis revealed that the t- value is 6.81 while p-value is $0.001<0.05$ at level of significant, indicating

that the t-value is less than p-value. This implies that the decision is retained. Because the mean score of the experimental group is significantly higher than the control group and it is justifiable to say that the experimental group that is taught with GeoGebra software performed better than the control group that is the group taught with traditional method of instruction after treatment.

Discussion

The findings of this study revealed that the students taught using computer assisted (GeoGebra) achieved significantly better than those taught using conventional (paper/pencil) method after intervention and vice-verse before intervention. Thus, the teaching of mathematics using software appears to be more effective when compared with the traditional method of instruction. However this finding is line with the findings of Mamman and Isa (2018). They investigated the effectiveness of student's performance in quadratic graphs using GeoGebra. The findings show that the student in experimental group taught with the computer assisted (GeoGebra software) performed significantly better than the control group that is taught with traditional method teaching.

CONCLUSION

Mathematics outside the classroom cannot be toyed with. Seeing that all the wonderful for which our age is known, which characterize and dominate our age are rooted in mathematics and mathematical sciences, one wonders what our age could have been without mathematics (Moore, 2006).

The use of computer assisted instruction principally, GeoGebra software package, is a very important facility for teaching and learning mathematics most especially where diagrams and sketches are involved. Furthermore, it is obvious that interpretation of graphs and sketches are easily learned with the use of computer, hence students who were taught with computer learned graph of simultaneous linear equations better than those using conventional methods. This indicate that the use of GeoGebra software package gives good result in learning of simultaneous linear equations than the conventional (paper/pencil) classroom method. In a nutshell, junior secondary schools students taught graph of simultaneous linear equations using computer assisted instruction (CAI)- GeoGebra software package- performed significantly better than those taught using the conventional (paper/pencil) classroom method.

Recommendations

Based on the learning outcomes of the students involved in this study, their responses and the experience gathered in the course of carrying out this research, the following recommendations are put forward in conformity with the findings of this study.

(i) Government should provide relevant facilities to mathematical laboratories for fully integration of ICT into secondary schools.

(ii) Government and critical stakeholders should encourage and support teacher training on how mathematics teacher can brings the desire changes to the introduction of ICT into secondary schools.

(iii) Government, proprietors and school authorities, among others, should try as much as possible to contribute their own quota in providing enough teaching staffs that can handle the facilities for student's use

(iv) Government should make computer education a core subject at all levels of education.

(v) Teachers should be encourage to use the two methods in their teaching (ICT GeoGebra)/ (Traditionally).

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