EFFECTS OF INTERACTIVE BASIC PROGRAMME ON STUDENTS' PERFORMANCE IN LINEAR AND QUADRATIC INEQUALITIES IN SAKI, OYO STATE

By

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Abstract

In spite of the importance attached to mathematics as a core subject in Nigerian schools and its application to everyday life, there have been consistent poor performances of students at all levels starting from the primary school level of education. The poor achievement of students has been blamed mostly on the poor instructional approaches to the subject. Therefore, the study examined the effects of interactive basic programme on students' performance in linear and quadratic inequalities in Saki, Oyo State, Nigeria. This study was a quasi experimental research. A total of 98 SS II students were sampled for the study. The researchers employed the use of purposive sampling technique to select a school with well equipped computer as the experimental school and a school with no computer as control group. A researcher-designed Mathematics Performance Test (MPT) was used for data collection. The instrument was duly validated and the reliability index was found to be 0.68. The three formulated hypothesis were tested using t-test and ANCOVA at 0.05 level of significance. Findings revealed that: the use of interactive basic programme for the teaching of linear and quadratic inequalities in senior secondary schools have effects on students' performance in the subject, students' gender has no influence on the performance of students in mathematics linear and quadratic inequalities using interactive basic programme and students' scoring level has effects on performance of students' taught linear and quadratic inequalities using interactive basic programme. Therefore, it was recommended among others Mathematics teachers should employ the use of interactive basic programme in the teaching of linear and quadratic inequalities in senior secondary schools to enhance students' better performance in Mathematics.

Keywords: Interactive, Basic Programme, Performance, Linear Inequalities, Quadratic Inequalities, Gender,

Introduction

Mathematics as a subject is the study of quantity, structure, space, relation, change and various topics of pattern, form and entity. It promotes the training of the mind. It is an indispensable subject and the Queen of sciences. Life (2014) viewed mathematics as king of arts, queen of science. It is also a science of number which systematically digs out patterns, rules, principles and theories to explain events (Odugwu, 2014).

However, everyone especially in this present scientific and technological world uses mathematics every day. Emphasis in Nigeria today is on technological development and mathematics is needed for this technological development. Linking mathematics to development and progress through science and technology, Azuka (2007) stated that the arrows connecting mathematics with development and progress of any nation are as shown in the figure 1:

Figure 1						
Mathematics	→	***Science***	→	***Technology***	→	***Development and Progress.***

In line with this relationship between Mathematics, Science and Technology, Hill and Lewis (2011) remarked that mathematics remains the pivot on which the success of any scientist depends and no scientist can succeed without going through mathematical demonstration; that any nation that wants to develop technologically begins by developing her mathematical arts right from the classroom. In other words, mathematics and science are important in our daily lives (Crawley & Fine, 2004).

Baiyelo (2007) observed that mathematics is widely regarded as the language of science and technology. Adebayo (2000) stated that science is the bedrock that provides the springboard for the growth of technology; mathematics is the gate and key to the sciences.
There have been a number of theoretical approaches applied to issues surrounding technology use in the secondary mathematics classroom and the last decade has seen efforts aimed at using these frameworks to provide different, complementary views of the same subject. For example, Drijvers (2013) through a review of 800 articles distinguished seven dimensions related to ICT use in mathematics classrooms: integration, epistemological-semiotic, cognitive, institutional, instrumental, situational and the teacher-dimension. While this appears to have been quite neglected during the years 1990-2000, it has increasingly been taken into account in the last decade, including a recent book devoted to the mathematics teacher in the digital era (Kitchener Post 2016).

In addition, Drijvers (2013) have suggested the need for an integrative framework in which considerations of didactical functionalities play an essential role, combining the three major dimensions of tool features, educational goals and associated potential of the tool and modalities of use in a teaching/learning process. While it is clear that the role of the teacher is a key to the successful use of digital technology in the mathematics classroom, incorporating technology into teaching remains a challenge for many teachers and they need to be well prepared (Aho, 2012).

Hoyles (2010) provides evidence for the critical role of teachers: as a *facilitator* who maintained and supported the interaction, as a *gatherer*, making visible on a common workspace (the screen, for example) students' production and as a mechanism for discussion; validating what did and did not make sense in terms of knowledge building. Some of the intrinsic factors contributing to the challenge facing teachers are their orientations; their instrumental genesis and orchestrations; their perception of the nature of mathematical knowledge and how it should be learned; their mathematical content knowledge; and their mathematical knowledge for teaching (MKT) (Schoenfeld, 2011).

The technology also makes possible simulations of complex systems that can be useful for problem solving purposes or when field studies on a particular topic are not feasible. Technology can help reduce the time spent on routine mathematical tasks, allowing students to devote more of their efforts to thinking and concept development instead of the computational aspect of the problem (The Ontario Math Curriculum, 2005). Hoyles (2013) expressed that it is important to incorporate all tools available, including technology, to help students have a deeper understanding of the mathematics concepts. Technology integration in mathematics lessons involves interaction and dialogue among students and between students and teachers. It calls for organisation and strong communication skills in order to display and present coherent mathematical ideas (Leder, 2010).

Serious attempts to use programming in teaching mathematics in primary and lower secondary school started with Seymour Papert (1964). Papert's idea was simple to create an interactive universe (microworld) that children access through mathematics, which prompts them to think mathematically by embedding nuggets of mathematical knowledge into the microworld that the pupils playfully stumble upon while developing projects (Jaworski, 2012).

As a means to obtain this goal, Seymour Papert (1964) developed the programming language (LOGO) where the child steers a small turtle around the screen with commands such as “forward 10” and “right 90”. The turtle can leave a trace allowing the child to create various geometrical figures (Trouche, 2011). During the 1980s there was great enthusiasm and confidence that LOGO and similar programming languages would radically reform mathematics teaching in primary schools (Churchhouse & International Commission on Mathematical Instruction, 2006). However, the results in mainstream implementation did not entirely live up to the expectations. There are a number of reasons for the disappointing results; for instance, students easily overlook the nuggets of mathematical knowledge (Stocker & Hoyles, 2013) making their work in the microworld non-mathematical.

The idea that programming could be helpful in mathematics education in the late 1980s also developed in the context of teaching mathematics in high school and college. The geometric and artistically framed LOGO program was less popular. On the contrary, teachers often utilized common programming languages such as BASIC, COMAL and PASCAL to support learning. One of the outspoken hopes was to create a process-oriented approach to abstract mathematics, basing abstract constructions in concrete numerical computations. The arguments for this approach were often based in constructivism and radical constructivism, which claims that all abstract learning has a concrete starting point, as well as in the end in the discussions of process-object duality (Sfard, 2011).

From the National Curriculum for senior secondary schools, mathematics is divided into six sections, which include: Number and Numeration; Algebraic processes e.g. inequalities; mensuration; plane geometry; trigonometry, statistics and probability. The focus of this study is on algebraic processes. This is because reports have shown that algebra especially inequalities occupies a major content in school mathematics and students perform poorly in algebra (WAEC Chief Examiner Report, 2017). Inequalities is a branch of mathematics of Arabian origin. It is a generalization and extension of arithmetic in which symbols are employed to denote operations and letters to represent number and quantity (Wikipedia, 2007).

Inequalities are an aspect of mathematics that opens students mind to critical thinking. According to Knuth (2012), inequalities is an aspect of mathematics which every individual must know, as it is a gate way to other areas of mathematics, yet many students struggle with inequalities and are left behind because they find it difficult to understand. The importance of Inequalities makes it to be in almost all the classes in the National Mathematics Curriculum. Inequalities involve solving equations, graphing linear, simultaneous linear and quadratic inequalities equations (Federal Ministry of Education, 2013). These areas have the potential to open students’ mind towards different styles of thinking and understanding. It is good for students to know the fundamentals in Inequalities to meet up with the challenges of other areas of mathematics (Chamot & Omalley, 2008).

Wikipedia (2007) stated forms of Inequalities equations as follows: linear equation, simple and simultaneous equations, quadratic equations. Inequalities is a major topic in SS II mathematics curriculum and also appears in West African School Certificate Examinations (WASCE) syllabus (WAEC, 2017).

In spite of the importance attached to mathematics as a core subject in our schools today and its application in everyday life there have been consistent poor performances at all levels starting from the primary school level to the tertiary level (Vahay & Meloy 2013). This poor performance could be as a result of method use in teaching the subject. The poor achievement of students has been blamed mostly on the poor instructional approaches to the subject. Researchers such as Begley (2016) and Effandi (2015) have pointed at teaching approaches and strategies used in the classroom by the teachers as one of the causes of the undesirable and poor achievement in mathematics especially in Linear and Quadratics inequalities equation.

Researchers have equally used computer both as a tutor and as a tool, but view has used it as an interactive programme in teaching and learning of mathematics linear and quadratic inequalities. Researchers such as Igweh (2012), Fakuade (2011) and Borasi (2010) used computer as a tutor and tools while Etukodo (2009) used it as an interactive programme in teaching and learning of mathematics in colleges of education in Nigeria.

Therefore, this study focused on investigating the effect of interactive basic programme on students' performance in linear and quadratic inequalities in Saki, Nigeria.

Purpose of the Study

The purpose of this study was to determine effects of interactive basic programme on students' performance in mathematics linear and quadratic inequalities equation. Specifically, this study determined:

i. if difference exist in the performance of students' when taught linear and quadratic inequalities equation using interactive basic programme and those not expose to interactive basic programme;
ii. the influence of gender on students' performance when taught linear and quadratic inequalities equation using interactive basic programme; and
iii. the influence of scoring levels on students' performance when taught linear and quadratic inequalities equation using interactive basic programme.

Research Questions

To achieve the objectives of this study, the following research questions were raised and answered in the study:

1. will there be any difference in students' performance when taught linear and quadratic inequalities equation using interactive basic programme and those not expose to interactive basic programme?
2. will there be any difference in students' performance based on gender when taught linear and quadratic inequalities equation using interactive basic programme?
3. what is the difference in students' performance based on scoring levels when taught linear and quadratic inequalities equation using interactive basic programme?

Research Hypotheses

The following research hypotheses were formulated and tested in the study:

HO_1: There is no significant difference in performance of students taught linear and quadratic inequalities using interactive basic programme and those not expose to interactive basic programme.

HO_2: There is no significant difference in the students' performance when taught linear and quadratic inequalities using interactive basic programme on the basis of gender.

HO_3: There is no significant difference in students' performance on the basis of scoring levels when taught linear and quadratic inequalities using interactive basic programme.

Methodology

The study utilized quasi experimental design involving pretest and posttest. This is made of two groups; experimental and control. The experimental groups (EG) were exposed to interactive basic programme and the control groups (CG) were exposed to conventional lecture method. A pre-test (O_1) was administered to the two groups to determine the equivalence of performance of students prior to the treatment. This was followed by a post-test (O_2) which was administered after the treatment for a period of two weeks to determine the relative effectiveness of interactive basic programme on students' academic performance in Mathematics linear and quadratic inequalities. Purposive sampling technique was used to select two senior secondary schools which one of the two schools was well equipped with computer facilities and having programming as a school subject in the study area before they were randomly grouped as experimental group and intact classes were used for both the experimental and control classes. A total of 98 SS II students (53 male and 45 female) was sampled for the study.

The main instruments used for data collection were Mathematics Performance Test (MPT) question and Interactive Basic Program (IBP) drawn by the researchers on Mathematics linear and quadratic inequalities. The mathematics performance test was an essay type. The instrument contains section A and B. A gives the background information of the respondents, which includes: gender and class, while section B consisted of three (3) essay items on Linear and Quadratic Inequalities in which all are to be attempted. The total obtainable scores are 60 marks while the interactive basic program (IBP) was a program package put together for teaching the experimental group only.

To ensure both the face and content validity of the instruments, the researchers give the instruments to, two computer experts from the Department of Computer Education, two mathematics educators from the Department of Science Education in University of Ilorin, Ilorin, Nigeria and a mathematics teacher in the senior secondary school. The reliability coefficient of 0.68 was obtained using split half methods with Pearson correlation coefficient.

The researcher personally visited the schools to obtain official permission before administering the test with the assistance of the mathematics teachers in the participating schools. The study lasted for two week. The first lesson was used for pre-test, marking and recording of the pre-test. Participants are not prone to any risk because all the lessons took place in the normal class setting and during school hours. The lesson lasted for two weeks with the experimental group using interactive basic programme and control group using the conventional method. The health risks of using the computer such as eyestrain, muscle and joint pains was avoided by not exposing the students for long period of time unnecessarily. Other risks like power surge, sockets explosion and so on, was also avoided through supervision and proper guidance of the students. The last day of the second week was used to conduct the post-test, marking and recording of the post-test.

The data obtained from the study was analyzed using descriptive and inferential statistics to answer research questions and test the null hypothesis raised. Null hypotheses one and two were tested using t-test independent statistics and null hypothesis three was tested using Analysis of variance (ANOVA) at $p = 0.05$ significance level.

Analysis and Results

Hypothesis 1: There is no significant difference in performance of students taught linear and quadratic inequalities using interactive basic programme and those not expose to interactive basic programme.

Table 1							
t-test analysis of Posttest Mean Scores of Experimental and Control Groups.							
Groups	**N**	**Mean**	**S.D**	**df**	**t-value**	***P*-value**	**Decision**
Experimental	50	58.94	18.78				
				96	4.79	0.001	*
Control	48	39.71	20.92				
*Significant at *P* = 0.05							

t-test analysis result showed in table 1 indicates that there was no significant difference in academic performance of students taught linear and quadratic inequalities using interactive basic programme and those not expose to interactive basic programme ($t_{(96)}$ = 0.001: p = 0.05). Since the p-value is less than 0.05 alpha level of significance, therefore, hypothesis HO_1 was rejected. Therefore, there was a statistical significant difference in the performance of students taught linear and quadratic inequalities using interactive basic programme and those not expose to interactive basic programme.

Hypothesis 2: There is no significant difference in the performance of male and female students when taught linear and quadratic inequalities using interactive basic programme on the basis of gender.

Table 2							
t-test Analysis of post-test mean scores of males and female students in the experimental Group							
Groups	**N**	**Mean**	**S.D**	**df**	**t-value**	***P*-value**	**Decision**
Male	28	60.89	20.58				
				48	1.13	0.26	**
Female	22	66.82	15.28				
**Not Significant at P=0.05							

There was no significant difference in the performance of male and female students taught linear and quadratic inequalities using interactive basic programme as revealed in the table 2 subjected to t-test statistics ($t_{(48)}$=-1.13: p=0.26). Since the p-value 0.26 is greater than 0.05 level of significance. Thus, the hypothesis 2 was not rejected. This implies that gender has no influence on students' performance when taught linear and quadratic inequalities using interactive basic programme.

Hypothesis 3: There is no significant difference in students' academic performance on the basis of scoring levels when taught linear and quadratic inequalities using interactive basic programme.

Table 3					
Analysis of Variance (ANOVA)of Performance of Students in the Experimental Group base on score level					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	707.26	21	33.68	1.83	0.05
Within Groups	1399.76	76	18.42		
Total	2107.02	97			
P=0.05					

Analysis of variance (ANOVA) was used to determine if there exists difference in students' academic performance on the basis of scoring levels when taught linear and quadratic inequalities using interactive basic programme. The result on table 3 revealed that a significant difference exist ($F_{(76,21)}$=1.83, p= 0.05). This is because the p-value is lower than the 0.05 level of significance. Hence, the null hypothesis was rejected. This implies that there is a statistical significant different in the performance of high, medium and low scoring students taught linear and quadratic inequalities using interactive basic programme. That is score levels of students had influenced on their performance in mathematics when use interactive basic programme.

Discussion of the findings

The findings of the study revealed that students taught linear and quadratic inequalities equation using of interactive basic programme (IBP) had a higher mean performance compared to those taught by the Conventional lecture Method. These results implied that the interactive basic programme (IBP) was more effective at improving students' performance in linear and quadratic inequalities equation. The study agreed with the findings of by Iji (2013) and Johari (2008) who reported that computer based instruction especially interactive basic programme (IBP) affect students' academic performance in mathematics.

A very slight difference was observed in the mean performance score of students with respect to gender in favor of the female students. This difference was not significant when further analysis was conducted. Hence interactive basic programme (IBP) is a gender friendly strategy. This is in agreement with the findings of Nworgun (2010) and Wilson (2012) who revealed that there was no significance difference in students' performance in mathematics using interactive basic programme based on gender.

Also a significant difference was found in the students' academic performance on the basis of scoring levels when taught linear and quadratic inequalities using interactive basic programme. This agreed with the respective study of Abdulwahab (2014), Ayinla, (2011), Olumorin (2012), Saddiq, Salman and Adeniji (2017) who revealed that there were significant differences among students of different score levels when taught mathematics linear and quadratic inequalities equation using interactive basic programme (IBP) with the low scorers group benefiting from the treatment more than any group followed by the medium and high scorers group.

Conclusions

The study concluded that the use of interactive basic programme for the teaching of linear and quadratic inequalities in senior secondary schools have effects on students' academic performance in the subject. The study also concluded that students' gender has no influence on the performance students' in mathematics linear and quadratic inequalities using interactive basic programme.

Finally, students' scoring level has effects on performance of students' taught linear and quadratic inequalities using interactive basic programme in Saki, Oyo State, Nigeria.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. Teachers should employ the use of interactive basic programme in the teaching of linear and quadratic inequalities in senior secondary schools to enhance students' better performance in Mathematics.

2. Schools should include programming as one of the school subject to give the students' opportunity of having required knowledge of programming language.
3. The National Educational Research and Development Centre (NERDC) should encourage the use of interactive basic programme as a method for teaching linear and quadratic inequalities and mathematics. This would make interactive basic programme acceptable among teachers and students.

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