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PROGRAMMED INSTRUCTIONAL METHOD OF TEACHING ON STUDENTS INTEREST IN MATHEMATICS

Udeh, Ikemefuna James
Department of Electrical and Electronic Engineering, Faculty of Engineering,
Enugu State University of Science and Technology (ESUT), Enugu-Nigeria

Edeoga, Benjamin Odo
Department of Science Education, Faculty of Education,
Ebonyi State University, Abaki1iki

Okpube, Nnaemekea Michael
Depariment of Science Education, Faculty of Education,
Ebonyi State University, Aabki1iki

ABSTRACT

The study investigated the effects of programmed instructional package on secondary school student's interest in mathematics. The study employed a quasi experimental procedure. The specific design is non-equivalent control group design. The sample for the study comprised of 300 SSII students drawn from four co-educational secondary schools in Awgu Education Zone of Enugu State. Mathematics Interest Inventory test was administered to the schools chosen, two research questions and two hypotheses guided the study. It was discovered that programmed instructional package has a great higher effect in enhancing students' interest in mathematics. The results of the study also revealed that there was no significant interaction between gender and instructional approach on students' interest in mathematics. Based on findings the researcher made recommendations and conclusion for the study.

Keywords: Programmed Instruction, Interest in Mathematics, Mathematics Interest Method,

1. Introduction

Background to the Study

Mathematics occupies a peculiar position in the life of every individual and the society. It plays an indispensable role in the development of arts, humanities, science and technology. Mathematical thinking began right from the ancient times. Certainly, it made considerable progress among the Sumerian, and Babylonians (Hussen, 2009). With the development of mathematical thinking and their application in stone monuments in Egypt, mathematical ideas began to spread to all parts of Africa (Sertima, 2009). Today, mathematics has been applied in all spheres of human endeavors – in day-to-day business, leisure activities, agriculture and formal academic disciplines. In fact, mathematical principles have also been intensively utilized in religious, cultural practices and virtually all life activities (Suleiman, 2010).

A survey of students' interest in mathematics depicts a very sad situation. Imoko and Agwagah (2006) reported a very low interest in mathematics among secondary school students. Adeniyi and Salman (2015) stressed that interest controls the motivation to learn and as such should possess a direct positive relationship with achievement in a given field of study.

With the realization of the indispensability of mathematics in the survival of our society and the educational system, mathematics educators have been concerned with the ways in which students learn mathematics. This includes methods of teaching and instructional materials that aid the learning processes, means of identifying and overcoming difficulties encountered in the learning of mathematics, ways of providing for individual differences and the implementation of effective mathematics instruction (Eze, 2008; Suileman, 2010, Shri & Badri, 2013). Particular emphasis, however, has been placed on theories of learning related to mathematics, motivation, concept formation, sensory learning, transfer of training, drill, individual differences and the implication of learning theories for the improvement of instruction and improvisation (Ihendinihu, 2013; Etukudo, 2012).

One aspect of learning, which has been neglected in mathematics instruction but has relevance in experimental learning theory, is the programmed instruction (Staine, 2010). According to Staine (2010), although programmed instructional approach is one of the most basic and recent development in Information and Communication Technology (ICT), it has not formed a part of normal instructional practice in Nigerian schools. While it has also become explicit that a lot of advanced mathematical principles are embedded in programmes of various forms, current

emphasis on mathematics instruction has continually ignored programmed instructional approach.

One of the greatest contributions of technology to the world today is the development of computers and its application in all aspect of life including education. Erickson and Curl (2008) described computer as an enormously complex teaching machine which functions like the central nervous system. Solaki (2010) indicated that computer is one of the inventions that have placed man in a higher level of capacity. Interactive multimedia technology presents itself as a powerful tool for instruction, since it combines the potential of many new information-related technologies. When such technologies as text, audio, graphics, skill images and full-motion video are mixed into a single, computer-controlled multimedia program, the possibilities for the classroom are virtually unlimited. In particular, the prospects for preparing elementary and secondary school teachers appear especially promising in light of such technology (Sofolaha, 2009).

Professional development programs can profit from interactive multimedia instruction by providing structured observations of students and expert teachers in their classrooms. Being able to observe teaching skills and concepts in action can greatly enhance the acquisition of basic instructional skills by novice teachers as well as perfect the teaching practice of experienced teachers. Analyzing important instructional events helps to develop cognitive frameworks for thinking about the teaching and learning of mathematics.

Technology is a highly significant in the society. The mathematics curriculum is rapidly incorporating the increased use of technology change and innovation in teaching of mathematics. The use of concrete materials in teaching mathematics emphasizes meaning in learning content. There are four basic gains for appropriate usage of computers in classroom application. They include:

- Providing interactive learning experiences at appropriate levels of difficulty (individualization of instruction);
- Dispensing information in a novel manner (tutorial assistance);
- Developing program writing skills which can be used to enhance the learning of other materials (programming skills development) and to enable evaluation of learning;

- Enabling evaluation of learning with immediate feedback and reinforcement capacities (Radlow, 2008).

The frequent evaluation and remediation are required in all mathematics classrooms. The use of the microcomputer to assist the classroom teacher in reaching specified objectives has both time-efficiency and professional creativity implications. Computer can be applied in many forms. It could be used in Computer-Assisted Instruction (CAI), Computer-Scheduled Education (CSE), Computer-Based Learning (CBL) and Computer-Managed Learning (CML).

All these are based on learning from computer and learning with computer. Learning from computers involves CAI (Computer-Assisted Instruction). This involves drill and practice, and tutorial programs. In drill and practice, it is assumed that the students have already been taught the appropriate materials and the computer simply provides a large number of practice problems on this material for the students. The computer takes the role of the dispenser of information and may include practice questions on the materials as the tutorial lesson proceeds. This is usually helpful in factual knowledge that may be effectively practical by the use of drill and practice programs (Ubana, 2009).

From culture to culture and within any culture, mathematical instructional programmes appear in various contexts which are either clear-cut or mutually exclusive. With the variations in programmed instructional approaches and obvious differentials in drill patterns, it has been speculated that the impact of such mathematical instructional programmes on male and females may vary.

According to Okenyi (2010), the extent to which programmed instruction influences the learning process of males and females still remain a source of concern to the proponents of Computer based learning approach in mathematics. In fact, the extent to which the programmed instructional approach influences the achievement and interest of secondary school students in mathematics may have some far-reaching implications which are worth exploring hence this study.

2. Literature Review

Teaching and Learning of Mathematics

The classroom is occupied by two principal actors; the teacher and the learner. The concept of teaching and learning therefore, hinge on the activities of these actors in the

classroom, which leads to the learner changing his behaviour positively. The concept of teaching can be approached at that angle. Teaching represents two variables; profession and activity. As an activity, teaching involves exploring all available opportunities to bring about positive change in behaviour in the learner. This is the aspect that is of interest here. Teaching, according to Onwuka, Iweka and Monseri (2010), is the creation or provision of experience and guidance of activities designed to promote learning on the part of those engaging in the activities. In support of the above, Iji (2010) commented that teaching is a conscious and deliberate effort by the teacher to provide directions, guidance, activities and materials in order to promote learning.

In the process of teaching, the learner acquires new attitudes, new skills, new knowledge, new values or appreciations. This is to say that in the process of teaching, learning occurs. In the view of Sertima (2009), teaching is a process whereby one person mediates between another and the substance of this is to facilitate learning. Adaramola (2014) views teaching as a deliberate effort by a mature or experience person to impart information, knowledge, skills etc to an immature or less experienced person through a process that is morally and pedagogically acceptable. Abakpka and Iji (2011) asserted that teaching is a systematic activity, which involves the continuous assessment of learner's progress. Teaching is useless without learning. There are various methods of teaching and materials, which form part of educational technology, also facilitate teaching.

On the other hand, learning according to Abubakar (2015), is independent of teaching and can be facilitated through setting up of activities to that effect. Eze (2008) views learning as a process whereby an organism changes its behaviour as a result of experience. She emphasized that learning is a process. That is, it takes time and that it involves change in behaviour. Azuka (2013) contended that learning occurs through the learner's experiences and reactions to conditions in the environment. For Etukudo (2009) learning should be distinguished from the effects of native response tendencies manifesting as instincts or maturation. He insists that learning is what the learner does, not what the teacher does before the learner. In other words, it is what the learner does that he learns. Suleiman (2010) contended that the learner had to be set and ready for learning to be possible.

The psychology of human learning has done a lot in the improvement of learning. Generally, mathematics is made up of a set of concepts, facts, and principles and operations (with numbers, etc.) that are fundamental to the existence of every individual. Some of these are being used daily, sometimes without people knowing them. It is therefore obvious to learn mathematics. According to Azuka (2013), mathematics is concerned with searching for patterns and relationship among entitles with developing and expressing generalizations in mathematical symbols. This gives a way of looking and analyzing things in the environment around us. Abubakar (2015) considered mathematics as a science, and a way of thinking that has rules, goals and players just like a game. Its learning calls for imagination, participation (practice) and skills. Mathematics as a game is played for intellectual satisfaction, acquisition and practice of skills.

The abstract nature of mathematics is such that, it demands perseverance, constant practice and a lot of thinking both critically and analytically from its learner. Unfortunately, most students lack the patience and the required time to think properly in solving mathematical problems. In addition Adeniyi and Salman (2015) noted that mathematics is a symbolic language of size and others, which many students cannot comprehend easily. Hence, there is the general impression that the subject is difficult, and something to be feared. It has also been observed that Nigerian secondary school students' interest towards mathematics is generally negative (Ale, 1981). Iji, Emiakwu and Utubaku (2015) posit that comparatively, secondary schools student in Nigeria perform very poorly in mathematics. These poor performances in mathematics are not unconnected with the ineffective teaching methods, techniques and procedures (Ajai & Imoko, 2015).

In teaching of mathematics using computer, there is the need to develop the ability of the students to see mathematics in a situation, and to use the knowledge to solve problems that arise from it using computer. Ihendinihu (2013) stressed that the situation in which the problem occurs should involve real objects or simulation of real objects. This will enable the students to see the relationship between a situation or event and its mathematical model. Azuka (2013) also emphasized the point that students of mathematics should be led to understand concepts and processes so that computer can find applications in various subjects such as mathematics.

Interest in School Mathematics

Interest according to Imoko and Agwagah (2006) is a sense of concern with, and curiosity about someone or something. It is a reason for wanting something done or wanting to learn something. It is a state of curiosity or concern about something. Interest is an important variable in learning. One can only achieve an objective for any activity when one is interested in it. Lack of interest on the other hand inhibits learning. Oladele (2005) defined interest as a persistent tendency to pay attention and enjoy some activity or event. He further explained that interest is a powerful motive and should be sustained for a meaningful learning to take place. Also, it is understandable that the influence of programmed instructional package in the society is more encompassing than those emerging from other fields of knowledge. And for this fact student tend to develop interest in science subjects.

Onwuka, Iweka and Monseri (2010) affirmed that the level of students' achievement in science education depends on the level of the students' interest which is a factor of the instructional strategy of the teacher. It is the instructional strategy employed by the science education teacher at the course of teaching and learning that determines the students' interest and achievement. On the strategies to be applied to increase interest in science Olor (2010) said that innovative teaching methods like programmed instructional method in the class and outside classroom could improve interest in mathematics.

The above prompted the Teachers Training Institute to affirm said that teachers should not limit themselves to the traditional method of teaching the students alone; but that they should accompany the teaching methods with innovative approaches such as programmed instructional method which is capable of enhancing interest of the learners. . It further explained that programmed instructional method is a powerful innovative teaching technique that a science teacher can utilize to blend the traditional teaching methods.

Okenyi (2010) view programmed instructional package as a teaching tool which has greater chances of integrating the unit of study into the cognitive structure of the students and thus being retained. It is absolutely essential that teachers should adopt this method of teaching and learning so as to enhance the interest of the students. It adds that, the complex and counter initiative nature of scientific concepts such as mathematics and physics process require an opportunity for interactive learning, reasoning, interpretation and reflection. Introducing technical tools and resources which students can use interactively for expressing, evaluating and revising their

developing ideas as they visualize the consequences of their own reasoning is very essential for mathematics learning.

Ajai and Imoko (2015) in support of the role of programmed instructional package in increasing interest of students in mathematics learning, added that upon investigation, student teachers presented the following reasons for using programmed instructional package: It helps students to visualize a structure process; It helps less able student to remember a concept or an idea; it helps students' to link an idea with familiar event; and it provides a variety of ideas. Also Adeniyi and Salman (2015) said that the utilization of programmed instructional package strategy in classroom teaching and learning, leads to enhancement of interest and permanent learning in the students.

3.0 Design

This study adopted the quasi-experimental design. Specifically this study employed Pre-test Post-test non-equivalent control group design. The design was represented thus:

Area of the Study

The study was conducted in secondary schools in Awgu Education Zone of Enugu State, Nigeria. Awgu Education zone has a total of 46 secondary schools. The reason for choosing the zone was because of poor achievement of students in mathematics in the area which could be attributed to low interest in the subject and also for the uniform structure of the public schools in the area.

Population of Study

The population of the study comprised all senior secondary two (SSII) students in the 46 secondary schools located within the area. The choice of SS II students was because their scheme of work contains the topics for which the instructional programmes were developed and it is not an examination class.

Sample and Sampling Techniques

The study sample comprised 300 SSII students from intact classes of the sampled schools from the study. Two co-educational secondary schools were drawn for this study. The choice of co-educational schools was because coeducational schools are adequate in providing data on variables of gender. The researcher employed simple random sampling technique in selecting the

two schools. Out of the two secondary schools that were used for the study, one was assigned to the treatment group while the other was assigned to the control group through a simple toss of coin. All the intact classes of SS II in the selected schools were used for the study.

Instrument for Data Collection

Mathematics Interest Inventory (MII) was used for data collection. The instrument was designed on a 4-point rating scale to measure students' interest in Mathematics. The instrument has twenty items which are spread across the four constructs noted in interest. They are academic interest, vocational interest, leisure interest and general (unclassified) interest.

Validity of the Instrument

The MII was subjected to construct validation. The 25 item draft MII was assessed using Factor Analysis. Five factors were extracted. Items 1, 8, 13, 17, 19 and 24 were loaded in factor 1 while items 2, 5, 9, 10 and 14 were loaded in factor 3. In the same vein also items 6, 11, 15, and 21 were loaded in factor 4 while items 4, 12, 16, 20 and 22 were loaded in factor 5. On the other hand no item was loaded in factor 2. Item 3 loaded on two factors and was discarded as factorial impure. Items 7, 18, 23, and 25 were not loaded on any factor and were also discarded.

Reliability of the Instrument

After validation, the instrument was subjected to test of reliability using Cronbach Alpha estimate to ascertain its internal consistency in measuring what is was designed to measure. The instrument yielded reliability co-efficient of 0.83.

Method of Data Collection

At the onset of the experiment, the researcher administered the pre-test to the students. Scores of the students on the pre-test were recorded and kept behind for use after the experiment. At the end of the experiment, the post-test for was administered to the entire members of the class. For each of the groups, data for the pre-test and post-test were recorded separately.

Method of Data Analysis

Research questions were answered using mean and standard deviation while the hypotheses were tested at an alpha level of 0.05 using the Analysis of Co-Variance (ANCOVA).

Research Question 1

What is the interaction effect of programmed instructional package and gender on students' mean interest in mathematics?

Table 3.1: Mean and standard deviation interest scores of students taught mathematics using programmed instructional package (PIP) and those taught using the convention teaching method (CTM)

Group	Mean	Std Deviation	No
PIP	55.085	10.48	162
CTM	32.23	4.56	138

Source: Researchers field work, 2017.

Results on Table 3.1 showed that the mean interest score of 55.085 and standard deviation of 10.48 for the experiment group and mean interest scores of 32.23 and standard deviation of 4.56 for the control group. From the table, the treatment group showed higher interest in mathematics than the control group.

Research Question 2

What is the effect of programmed instructional package on the mean interest scores of male and female students' in mathematics?

Table 3.2: The mean interest scores of male and female students for the treatment group only were used to answer this research question.

Gender	PIP	CTM
Male	55.93	40.89
Female	53.97	39.96

***Source*:** Researchers field work, 2017.

The result on Table 3.2 showed that the mean interest scores of male students is 55.93 and the standard deviation is 10.89 while the mean score for female is 53.97 with a standard deviation of 9.96. Thus, PIP favored the male students than the female ones.

Hypotheses

Ho_1: There is no significant difference in the mean interest scores of students taught mathematics using programmes instructional package (PIP) and those taught using the conventional teaching method (CTM).

Ho_2: The interaction effect of method and gender on the mean interest scores of students in mathematics will not be significant.

Table 3.3: ANCOVA results for Ho_1 and Ho_2

Sources of Variation	Sum of Squares	df	Mean square	F-ratio	Sig.
Covariates	7342.791	1	7342.791	84.230	
Pretest	7342.791	1	7342.791	84.230	
Main effects	32816.809	2	16448.904	188.687	
Methods	**32816.165**	**1**	**32816.165**	**376.438**	**3.91**
Gender	35.331	1	35.331	.405	
2-way interaction	65.138	1	65.138	.747	
Method and Gender	**65.138**	**1**	**65.138**	**.747**	**3.91**
Explained	40305.738	4	10076.435	115.588	
Residual	12553.255	296	87.175		
Total	**52858.913**	**300**	**357.155**		

Significance at p<0.05

***Source*:** Researchers field work, 2017.

As shown in table 3.3, the F-calculated value for hypothesis 1 is 376.438 while the critical value at 95% confidence level is 3.91. Since the calculated value is higher than the critical value the researchers reject the null hypothesis and concludes that there is a significant difference in the mean interest scores of students taught mathematics using the PIP and those taught using the CTM.

For hypothesis 2, on the test of interaction between method and gender the calculated value is 0.747 while the critical value at 95% confidence level is 3.91. Base on the decision rule the researcher upheld the null hypothesis and conclude that there is no significant interaction between method and gender on students mean interest in mathematics.

Discussions

Summary of results indicated that programmed instructional package is superior to the conventional teaching approach in enhancing students' interest in Mathematics. Summary of

results also revealed that there is no interaction between gender and teaching approach on students' interest in mathematics. Treatment interaction generally implies that different learners with different characteristics may profit more from one type of instructional approach in other to maximize learning outcomes or whichever dependent variable that is involved.

Although the goal of research in treatment interaction is to find significant disordinal interaction between alternative treatments and personal variable, it must be emphasized here that any approach which yields a superior no interaction is cost effective and better in all ramification. With this in mind, one may begin to appreciate the worth of the programmed instructional package both in its superiority over the conventional teaching approach and its ability to accommodate both males and female students in fostering interest in Mathematics.

Conclusions

1. The programmed instructional package as a teaching method is significantly better than the conventional teaching method in enhancing students' interest in mathematics.
2. Although with the programmed instructional approach, male students show higher mean interest score than the female students, the difference in the mean interest score of male and female students taught mathematics using the programmed instructional package is not statistically significant.

Educational Implications of the Findings

The result of this study has provided empirical evidence on the efficacy of the programmed instructional package in teaching mathematics. This suggests the need for mathematics teachers to employ programmed instructional package in teaching some concept in other branches of mathematics in senior secondary classes. In other words, concepts from other branches of mathematics being taught using the programmed instructional approach would cease to be mere recall of facts, theories and laws. Students would be able to use their own mental process to solve some algebraic problems and other problems in mathematics.

By involving students in programmed instructional package, the teacher would be providing an environment in which equilibration can occur in the minds of the students. The findings of this study have implication for the government in the provision of in-service training and work hops for mathematics teachers. This will equip them with the knowledge of integrating instructional

practices with assessment procedure that ate likely to have positive impact on students' interest and achievement in Mathematics.

The fact that this approach leads to high level of understanding algebraic concepts points unmistakably to curricular implications. It implies that the mathematics curriculum developers should begin to integrate the programmed instructional approach in the curriculum especially at the senior secondary school classes. The absence of interaction between teaching method and gender with respect to interest indicates that the approach in not gender biased and therefore should be employed to enhance interest and develop creative thinking in boys and girls.

Recommendations

Based on the findings, primary and secondary school mathematics teacher should be encouraged to adopt programmed instructional package as part of their teaching method. State and federal government should encourage and sponsor in-service training for mathematics teachers to learn the tenets of programmed instructional package. The government in collaboration with curriculum developers and mathematics teachers should review the existing curriculum and integrate the basic tenets of the programmed instructional package in the curriculum.

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