EFFECT OF CONSTRUCTIVIST-BASED INSTRUCTIONAL APPROACH ON PUPILS' RETENTION: A CASE STUDY OF PRIMARY MATHEMATICS IN ENUGU STATE

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Abstract
This study examined the effectiveness of constructivist-based instructional approach on pupils' retention in primary school Mathematics. The study adopted quasi-experimental research design, precisely, the pretest posttest non-equivalent control group design. The sample size for the study was 134 pupils from two primary schools in Nsukka Education Zone of Enugu State. Two intact classes in each of the sampled schools comprising all the primary four pupils were randomly assigned in to experimental and control groups. The Experimental group was taught Mathematics using the constructivist approach (5Es Model), while the control group was taught using the conventional lecture method. Two research questions were formulated to guide the study and three hypotheses were tested at p ≤ 0. 05. A Fraction Achievement Test (FAT) of ten items was used to obtain data on pupils' retention. Research questions were answered using mean and standard deviation while hypotheses were tested using analysis of covariance (ANCOVA). The result revealed that constructivist approach was more effective in enhancing pupils' retention in mathematics than the conventional method. Based on the findings, it was recommended among others, that the 5Es instructional approach should be adopted in the teaching of mathematics in primary schools in Nigeria as to enhance effective learning of Mathematics.

Keywords: Mathematics, primary education, retention and constructivist approach

Introduction

Mathematics has been proved to be an indispensable discipline in education. It serves as a powerful tool and backbone of science and technology, and therefore plays immeasurable role in national development. Mathematics is a pivot upon which other sciences and all activities of human development such as in sports, medicine, transportation, commerce to mention but a few, revolve (Odili, 2006). The study of mathematics is a basic preparation for informed citizenry and gateway into numerous career choices in life (Kurumeh & Imokoh, 2008). Mathematics is the only language and culture common to all studies. In respect of the above mentioned importance, the study of mathematics has been made compulsory for all students regardless of their age and class from primary, through the junior secondary to the senior secondary school level of the educational system.

The importance of mathematics in our day to day activities such as in looking, washing, trading, medical preparation, tailoring and the likes cannot be over emphasized (Odili, 2006). Any statement having to do with "how much or how many" is expressing mathematical ideas. The knowledge of mathematics serves as a very useful tool in the management of life affairs; hence it is obvious that the science of mathematics was developed as a means of solving quantitative problems that arises in our rapidly changing and expanding society.

Nonetheless, mathematics is generally regarded as a very difficult subject and there has been feeling of anxiety among students with regard to mathematics. Yet other educational system rest upon the pivot of this subject, hence there is a need to involve a more comprehensive approach to handling the subject matter especially at the primary level which is a function of other educational system. The first stage of compulsory and basic education given to pupils between the ages of five and fourteen years is primary education (MDG, 2008). The major goals of primary education are achieving basic literacy and numeracy amongst all pupils as well as establishing foundation for future education (FME, 2007). The primary level is the key to the success or failure of the whole system as it is the bedrock for future education and functional life in the society.

Research evidence on pupils' academic retention and achievement in mathematics suggests that the state of mathematics in Nigerian schools is largely unsatisfactory, as majority of students not only lack interest in mathematics but perceive it so abstract and not related to their daily living (Kurumeh, Agogo & Usman, 2010). In many studies, it has been argued that many Nigerian pupils do not possess the depth of knowledge or skills needed to assure either personal life success or national economic competitiveness. This problem is compounded as the pupils do not see the relevance of this subject being taught in relation to the success of other subjects. Hence, the need for a more effective instructional approach that will improve pupils' retention in mathematics for social, political and economic engineering.

Effective learning is expected to last in one's memory for a long time. Once learning is not organized, or there is intervention of some factors during learning, there is high tendency for distortion, which automatically hinders retention. Retention is simply having an information stored in a long term memory that can be retrieved easily in response (Bennet & Rebello, 2012). Retention is the ability to remember after learning takes place more effectively when experiences are passed across the learner through an appropriate instructional method. The implication is that retention plays an important role for us to correctly and effectively apply whatever we have learnt. Gagne, (1970), opined that the type of materials included in the learning programme, structure in a carefully formed sequence is quite resistant to forgetting. That is, any instructional approach, which is effective in students' conceptual change, can as well help students retain some concepts effectively. Therefore, retention is a crucial construct that teacher should maximize among pupils which this study focused on.

Most primary school teachers in Nigeria adopt the conventional approach for teaching which rely heavily on textbooks and workbooks. In this setting, students are viewed as "blank slate" unto which information is poured by the teacher. The teacher seeks the correct answer to validate students' learning outcome. The assessment of students' learning is viewed as separate from teaching and it occurs almost entirely through testing (Ogbonna, 2003). In this case, success in school has very little to do with true understanding and much to do with coverage of the curriculum; that is, curriculum coverage is absolute in the mind of the teacher to the detriment of the pupils' retention and achievement in mathematics.

To this effect, many instructional strategies have been proposed such as learning by doing, delayed formalization, guided discovery, problem solving and so on (Obi, 2006). In Nigeria, emphasis is placed on the use of guided discovery instructional strategy (FME, 2004). Yet, over the years, the result of this instructional strategy planned towards improving the quality of instruction in primary school mathematics has been disappointing and seems ineffective (Obi, 2006).

One of the innovative instructional approaches is the constructivist-based instructional approach. The 5Es as the components of this theory developed by Bybee, et al (2006), simply denotes engagement, exploration, explanation, elaboration and evaluation. Central to this approach is the premise that a learner constructs meaning from new information and events as a result of an interaction between the individual's alternative conception and his or her current observation. Constructivist teachers gauge a students' prior knowledge, then carefully orchestrate cues, classroom activities, and penetrating questions to push students to higher levels of understanding. This means that pupils' ideas should form a basis for discussion and investigation in the class room. The constructivist teachers generally behave in an interactive manner, mediating the environment for pupils and also seek the pupils' point of view in order to understand pupils' present conceptions for use in subsequent lessons. Furthermore, constructivism is a model of instruction and learning, an interactive process in social settings. It is problem-solving oriented approach that allows students explore all works in groups, making meaning of tasks and setting out to solving problems that are perplexing to them (Ogbonna, 2003). Constructivist based teaching is guided by five principles as prescribed by Boyd (2018) which are: (i) teachers seek value of students (ii) classroom activities challenge student's assumption, (iii) teachers pose problems of relevance, (iv) teachers build lessons on big ideas, and lastly, (v) teachers assess learning in the context of daily teaching. Human beings are remarkable at learning from and adjusting to the physical environment. We are constantly acquiring new skills without the use of didactic memorization teaching techniques. Everyday children actively come together and socially construct their own knowledge and understanding using a natural constructivist style. In constructivist environment, the teacher observes and directs the discussions, while learners participate not in a competitive way, rather cooperatively and share in the responsibility and the goal.

A number of researches have been done in this subject matter. Narli, (2011) conducted a researched on constructivist learning environment really effective on learning and long-term knowledge retention in mathematics. The purpose of the study is to investigate the efficiency of constructivist learning environments on students' retention of knowledge of infinity concept. The sample of the study is sixty (60) freshmen University mathematics teachers of a State University in Turkey who are randomly grouped into experimental and control group. The result of this study indicate that even 14 months after instruction, the active group students remember subjects more clearly than those of the control group. Therefore, the researcher concluded that constructivist learning environment is really effective on retention of student knowledge in this study. Furthermore, Agomuoh (2010) investigated the effect of PEDDA and TLC constructivist instruction models on SS 2 students' conceptual change and Retention in physics in Umuahia Educational Zone of Abia State. The results revealed that the models led to greater retention in students and there was no significant difference in the mean post mathematics achievement scores of male and female students in the experimental group. In another study, Madu, (2004) also investigated the extent to which PEDDA constructivist instructional approach affects students' conceptual change and retention in current electricity. The result of the finding revealed that the mean retention score for the constructivist base instructional model (PEDDA) is superior to the conventional methods in enhancing students' retention of physics concepts. The findings also revealed that male physics students slightly perform better than their female counterparts in their conceptual shift from alternative to scientific conception.
However, the fact that some models of instructional approach have significant retentive effect in science subjects at secondary and tertiary level does not suggest anything on the possible retentive effect of constructivist –based instructional model in fraction, as it is not well confirmed. Therefore, it becomes imperative to explore the retentive effects of

constructivist approach in the context of Mathematics (fraction) at the primary level of education as a foundation.

Purpose of the Study

The study aimed at finding out the effect of Constructivist teaching approach on primary school pupils retention in Mathematics in Nsukka Educational Zone, Enugu State.

Specifically, it sought to achieve the following objectives:

(i) Finding out the effect of constructivist teaching approach on pupils' retention in Mathematics in Nsukka educational zone

(ii) Examining gender influence in the use of constructivist- based teaching approach in Mathematics

Research Questions

(i) Is there any difference in the retention level of pupils taught mathematics using the constructivist-based instructional approach and those taught using the conventional method?

(ii) Is there any difference in the retention level of male and female students taught mathematics using the constructivist-based instructional approach?

(iii) Is there any interactive effect of constructivist-based instructional approach and gender on pupils' retention in Mathematics?

Hypotheses

The following null hypotheses were formulated for the study and tested at $P \leq 0.05$ level of significance:

Ho_1: There is no significant difference in the mean retention scores of pupils taught mathematics using the constructivist-based instructional approach and those taught using the convention method.

Ho_2: There is no significant difference in the mean retention scores of male and female students taught mathematics using the constructivist-based instructional approach.

Ho_3: There is no significant interaction effect of constructivist-based instructional approach and gender on students' retention scores.

Methodology

The research design for this study was quasi-experimental design, specifically pretest, post-test, non- equivalent control group design. The population for this study comprises all the primary four pupils in Nsukka Local Government Area of Enugu State. Using simple random sampling technique; two schools were drawn from the 115 primary school in Nsukka LGA (Enugu State Universal Basic Education Board, ESUBEB). The two intact classes in the chosen schools were randomly assigned into experimental and control groups. The sample size for both the treatment and comparison group was 134 primary four pupils. The treatment group was 72 while the comparison group was 62. The instrument used for pre-test, post-test and delayed post-test (retention test) data gathering was the Fraction Achievement Test (FAT) developed by the researcher. The test observed all the necessary test development processes. The instrument was validated by three experts from the Faculty of Education, University of Nigeria, Nsukka, and their comments and modification were duly effected in order to ensure the face and content validity of the instrument. For the reliability of the instrument, test-retest method with an interval of two weeks was used to test the instrument using twenty pupils that were not part of the sampled schools. The two scores were correlated using Pearson product Moment Correlation Coefficient formula and a coefficient index of 0.63 was obtained, indicating that it was reliable.

Experimental Procedures

Two instructional approaches were employed for this study. The two approaches were identical in terms of content, specific instructional objectives and the mode of evaluation. Research Assistants (teachers) were recruited on the basis of primary four they are teaching with the same qualification and experience. Several meetings were held with teachers to acquaint them with the demands of the study. After training, the teachers were randomly assigned into treatment or control group. The pupils in both groups were given a pre-test before the commencement of the treatment. After the pre-test the researcher starts the experiment following all the steps involved. Each group met for 35-40minutes, thrice per week for four weeks. The control groups were instructed by conventional teaching method.

The treatment group were taught using 5Es model which have five phase approaches:
The first phase is the engagement phase; here pupils were allowed to interact with selected content materials in fraction as a concept in Mathematics. This is aimed at stimulating their thinking to identify problems while teacher generate questions with which he led the pupils through the problem to gather facts/information.

The second phase is the exploration phase; at this stage, pupils were allowed to think, plan, investigate and organize collected information on fraction in Mathematics while the teacher ease tension with the use of focusing questions. In fact, students took the responsibility of managing their learning in the class.

The third phase is explanation; at this phase, ownership and voice in the learning process was encouraged. The pupils were involved in purposeful discussion where they are expected to defended, proved, justified and communicated their ideas on fraction while the teacher clarifies their views and misconceptions. They were involved in the analysis of their exploration.

The fourth phase elaboration, the pupils applied the learnt ideas to real world situation in order to solidify their understanding of the concepts. Taking parts from the whole using real life objects and situations were done in the class as to reflect true meaning of fraction in Mathematics. The researcher showed appreciation for multiple perspectives stimulated explanation as to how the pupils have arrived at their answers and provided a different presentation to allow the pupils to discover their errors and construct the correct solution within the learned concept of fraction.

The last phase of the model is the evaluation stage; the researcher asked the pupils' accumulated change in knowledge and skills which were observed even from the beginning of the experiment. The researcher then allowed the pupils to ask questions, gave other pupils opportunity to answer the questions while the teacher helped them where necessary to modify their misconceptions in fraction.

At the end of the experiment, the researcher with the aid of the research assistants administered the posttest to the subjects in the two groups. Also the delayed posttest was administered to the two groups two weeks after the experiment to assess the retention of the subjects. Data obtained from this exercise was used to answer the research questions and test the hypotheses stated in this study. The two research questions were answered by computing the means and the standard deviation of the experimental and control groups. The three hypotheses were tested at $P \leq 0.05$ probability level using the analysis of covariance (ANCOVA). The use of ANCOVA was to take care of lack of initial equivalence in the groups since intact classes were used for the study.

Research Question One: Is there any difference in the retention scores of pupils taught mathematics using the constructivist-based instructional approach and those taught using the conventional method?

Table 1: The Mean Retention Scores and Standard Deviation of Pupils in FAT

Group	No	Post-test		Delayed Post-Test	
		Mean	SD	Mean	SD
Experimental Group	72	31.43	9.38	29.32	9.07
Control Group	62	15.16	6.06	9.06	4.64

Table 1 shows the mean retention scores and standard deviations values of pupils in the experimental and control groups as measured by the delayed post-test. From table 1, it can be seen that the pupils in the experimental group had a mean score of 31.43 and a standard deviation of 9.38 in post test, while in the delayed post test the pupils scored a mean mark of 29.32 and a standard deviation of 9.07. For the pupils in the control group, it was observed that they had a mean of 15.16 and a standard deviation of 6.06 in post test while in delayed post test, the pupils scored a mean mark of 9.06 a standard deviation of 4.62. It can be concluded that those students taught using 5Es constructivist-based instructional approach performed better and had higher retention than their counterparts taught with conventional method.

Research Question Two: Is there any difference in the retention scores of male and female students taught mathematics using the constructivist-based instructional approach

Table 2: The Mean Retention Scores and Standard Deviation of Male and Female Students in FAT

Group	No	Post-test		Delayed Post-Test	
		Mean	SD	Mean	SD
Experimental:					
Male	44	32.25	9.33	30.73	8.46
Female	28	30.14	9.50	27.11	9.69

Table 2 shows the mean retention scores and the standard deviations of male and female students in the experimental group. From the table, it could be observed that the males in the experimental group had a mean retention score of 32.25 and a standard deviation of 9.33 in post test; while in the delayed post-test, the male students scored a mean mark of 30.73 and standard deviation of 8.46. On the other hand, the female students in the experimental group had a mean score of 30.14 and a standard deviation of 9.50 in the post test, where as they scored a mean of 27.11 and a standard deviation 9.69 in the delayed post-test. There is indication from this result that male students performed better and had better retention than their female counterparts

Hypothesis One

There is no significant difference in the mean retention scores of pupils taught mathematics using the constructivist – based instructional approach and those taught using the conventional method.

Table 3: Analysis of Covariance of pupils' Retention Scores by Treatment and by Gender

Dependent Variable: Retention					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	19404.570[a]	4	4851.143	446.340	.000
Intercept	.655	1	.655	.060	.807
Post test	5512.527	1	5512.527	507.192	.000
Group*	772.576	1	772.576	71.083	.000
Gender	58.587	1	58.587	5.390	.022
Group Gender	10.496	1	10.496	.966	.328
Error	1402.064	129	10.869		
Total	74127.000	134			
Corrected Total	20806.634	133			

Table 3 showed that pupils in the experimental group retained highly well even after a long time of treatment administration than those taught using the conventional method with $F(1,129) = 71.083$, $P > 0.05$, which leads to the rejection of the null hypothesis. Thus, there is a significant difference between the mean retention score of pupils taught with 5Es model and those taught with conventional method.

Hypothesis Two

There is no significant difference in the mean retention scores of male and female students taught mathematics using the constructivist – based instructional approach.

Table 3 revealed that $F(1,129) = 5.390$, $P > 0.05$. This implies that the null hypothesis was rejected which implies that there was significant difference between male and female pupils' retention scores in mathematics.

Hypothesis Three

There is no significant interaction effect of constructivist – based instructional approach and gender on pupils' retention scores in Mathematics.

Table 3, also reveals that there is no significant interaction effect between treatment (5Es model) and gender as measured by the pupils' retention scores. From table 3, it was observed that P-value of .328 is greater than Alpha- value of 0.05, hence we fail to reject the null hypothesis. That is, we accept the null hypothesis of no significance interaction effect of 5Es model and gender on pupils' retention. This implies that gender does not appear to combine with instructional approach to affect pupils' retention of mathematical concepts and principles in fraction. Hence the observed difference between the mean retention score of pupils in the experimental group (29.32) and the students in the control group (9.06) is due to the treatment.

Discussion of Findings

The finding of the study showed that the use of 5Es model in teaching of fraction to primary four pupils enhances their retention in mathematics positively, than those taught with conventional approach. This was further confirmed by result in table 3 which revealed that method is a significant factor on pupils' retention in mathematics. This implies that the type of instructional approaches used in pupil's instruction could result to significant change in retention of knowledge. This finding agrees with the finding of previous researchers like

(Madu, 2004; Narli; 2011) who suggested that the reasons for the higher mean retention score of the experimental group is due to pupils' active participation couple with the exploration of their previous knowledge during the instruction. Hence this study is conclusive.

More so, the result of this study indicated that the male students in the experimental group performed slightly better than the female students in the same group; This was further confirmed by the result in table 3 which revealed that there is significant difference in the mean retention scores of male and female students taught mathematics using the 5Es model. Even though there is difference, the difference is not statistical significant, as the little difference in their retention score could be as a result of chance and not due to method.

Evidence from table 3 has also shown that a significant interaction effect did not exist between instruction approach and gender on pupils' achievement and retention in mathematics. In other words, gender does not combine with instructional approaches to affect pupils' retention. The finding is in consonance with Ogbonna, (2003) whose result revealed that there was no significant interaction effect between instructional approaches and gender on pupils' achievement and retention in mathematics. Similarly, the findings agreed with that of Madu, (2004); Agomuoh (2010); who found no interaction effects between instructional methods and gender on pupils' achievement and retention in physics concepts/principles. On the other hand, the study of Obi (2006) revealed that interaction effect of treatment and gender was significant on students' achievement in mathematics. Therefore, the study on gender and pupils' retention using 5Es model is not conclusive. But to an extent, this study added evidence on the positive effect of the constructivist approach and its gender friendliness as identified the aforementioned researchers in tis context.

Conclusion

This study investigated the efficacy of the 5Es constructivist-based instructional approach on pupils' retention in primary mathematics. From the findings of this study it can be concluded that that the constructivist-based instructional approach (5Es model) plays an important role in facilitating knowledge acquisition and retention and that the use of the 5Es approach is independent of gender.

Recommendations

The following recommendations are given based on the results of the study:

(i) It is recommended that 5Es constructivist-based teaching approach should be used by mathematics teachers in teaching Mathematics at primary school level as it proved to be effective.

(ii) Mathematics teachers should get acquainted with the constructivist 5Es learning approach for proper implementation in teaching and learning of Mathematics in primary schools through workshops, seminars and symposia.

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