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Utilization of 7E learning Model Based Computer-Assisted Teaching Materials on Pupil's Academic Achievement in Geometry

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Abstract
The study investigated whether 7E instructional model will improve pupils' achievement in geometry. Based on the purpose of the study, two research questions and two hypotheses guide the study. Quasi- experimental design involving pre-test post- test design was used for the study. The instrument used for data collection was researchers made Geometric Concept Achievement test (GCAT). The validity of the instrument was done by two experts, from mathematics education and measurement evaluation. The reliability of the instrument was determined using K-20 and it found to be 0.73. Mean and standard deviation was used to answer the research questions while ANCOVA was used to test the hypotheses at 0.05 level of significance. The results of the study reveal that 7E instructional model was effective for enhancing pupils' achievement in geometry. Gender was not a barrier to achievement. Based on the result, it was recommended that mathematics teachers should adopt 7E instructional model in teaching geometry at the primary school level.

Keywords: 7E Instructional Model, Achievement and Geometry

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Introduction

Technology have become key tools and had a revolutionary impact on how we see the world and how we live. Today, the place of technologies in education and the world in general cannot be undermined. Technology is always connected with obtaining certain result, resolving certain problems, completing certain tasks using particular skills, employing knowledge and exploiting assets (Lan and Young, 1996). The concept of technology does not only relate to the technology that embodies in the product but it is also associated with the knowledge or information of it use, application and the process in developing the product (Lovell, 1998; Bozeman, 2000). Modern day businesses are conducted and facilitated through the use of telephones, fax machines and computer communication networks through the internet. The phenomenon has given birth to the contemporary e-commerce, e-government, e-machine, e-banking and e-education among others. According to Bamidele (2006), technology is a revolution that involves the use of computers, internet and other telecommunication technology in every aspect of human endeavour. The term technology has been given various definitions by previous literatures. According to Kumar et. al (1999) technology consists of two primary components: 1) a physical component which comprises of items such as products, tooling, equipments, blueprints, techniques, and processes; and 2) the informational component which consists of know-how in management, marketing, production, quality control, reliability, skilled labor and functional areas. Sahal (1981) views technology as 'configuration', observing that the transfer object (the technology) relies on a subjectively determined but specifiable set of processes and products.

Similarly, Ofodu (2007) also define technology as electronic or computerized devices, assisted by human and interactive materials that can be used for a wide range of teaching and learning as well as for personal use. From these definitions, ICT could be defined as processing and sharing of information using all kinds of technologies for the manipulation and communication of information. Aribasala (2006) posited that technology are increasingly playing an important role in organizations and in society's ability to produce, access, adopt and apply information. They are however being heralded as the tools for the post-industrial age and the foundations for a knowledge economy due to their ability to facilitate the transfer and acquisition of knowledge. Stressing the importance of the use of technology in schools, Olorunsola (2007), posited that through technology, some educational needs have been met; it changes the needs of education as well as the potential processes. Looking at the role of education in the national building and the population explosion in technical colleges these days, the use technology in the teaching and learning process becomes imperative. This is because its adoption by teachers will enhance effective teaching. Issues like good course organization, effective classroom management, self-study collaborative learning, tax-oriented activities, and effective communication between the actors of teaching-learning process and research activities will be enhanced by the use of technology. Teaching and learning have gone beyond the teacher standing in front of a group of pupils and disseminating information to them without the learners' adequate participation (Ajayi, 2008). Afriyie (1988) defines technology as encompassing: 1) the basic knowledge sub-system; 2) the technical support system (software); and 3) the capital-embodied technology (hardware). This perspective views that technology recognizes the need to identify the different elements of a particular country's technology that are complementary and mutually reinforcing. The previous studies done by the researchers have offered various definitions and concepts of technology from different disciplines, contexts and perspectives. The use of modern instructional tools has become significant in education to improve the quality of education. One of such tools is technology which has the advantage of simulating more senses simultaneously, leading to increase in learning and in making the learning long lasting. Therefore, animations,

simulations, pictures and voice make learning environment more effective and improve the learning levels in mathematics (Clark & Craik, 1992).

Mathematics has long been recognised worldwide and seen by society as the foundation of scientific- technological knowledge that is vital to the social economic development of a nation. It is in realisation of the vast application of mathematics that made Eraikhuemen (2003) to suggest that a disciplined and ordered pattern of life can only be achieved through the culture of mathematics. According to Ezeweani (2016) the competence gain in the study of mathematic is widely used in all spheres of human life. Mathematics plays a key role in shaping how individuals deal with the various spheres of private, social and civic life. The primary school mathematics is divided into five sections namely number and numeration, Basic operation, Algebra, everyday statistics and geometry.

Geometry is a special branch of mathematics that involves the study of special relationships (position, shape and size). Its study can be carried out through observations, construction and other descriptions of shapes and location of points in one, two or three - dimensional space (Fajemidagba 1992). The benefits derived from the study of geometry are substantial. It has helped to establish to a great extent the relationship between lines or shapes in the environment. It has helped man to think and find out the value of image produced and how to combine two or three- dimensional shapes to create new ones in the environment (Harsan 2001).The curricula have aimed at developing students' understanding of intended geometric concepts at primary, junior and senior secondary levels. Moreover, the school curriculum has emphasised child- centred methods of teaching to promote the understanding of geometry learning. Similarly, according to the National Council of Teachers of Mathematics, geometry is one of the "content standards" of school mathematics, which aims at developing spatial reasoning problem- solving skills, and communication (Sellke, 1999). Geometry is regarded as core content area of school mathematics. Irrespective of the relevance of this aspect of mathematics, the teaching and learning have not produced a favourable achievement. Chief examiners report (2009) pointed that, "apart from not giving answers to the required degree of accuracy, majority of the candidates could not apply the basic concepts and theorems correctly in some aspects of the syllabus, such areas of the syllabus as reported included: mensuration, 3D shapes, circles theorems, trigonometry and geometrical construction. This gives evidence that pupils' background in geometry is bad and needs improvement. According to Nwosu and Nzewi (1998), current studies on how pupils learn science and mathematics have revealed new ideas and innovative instructional approaches that have proved effective. These include problem solving, inquiry cooperative learning and constructivism. Constructivism is a kind of learning strategy that lays emphasis on active role of learners in the process of constructing their own knowledge (Nwagbo and Obiekwe 2010).

The seven (7E) instructional models are one of many resources that have been developed through constructivism to support teaching and learning. 7E model is based on the ideas that children learn best when they are able to work out concepts for themselves over a period of time, through various learning activities structured by the teacher. This idea is informed by a constructivist view of learning, in which learners build connections between existing and new knowledge (Haswker Brownlow Education 2010). 7E Model enables learning a new concept or trying to understand a concept that has been known in-depth. It includes skills and activities that increase curiosity for research, satisfies learners' expectations, and make the learners focus on an active research for information and understanding. Pupils use their previous knowledge in discovering new concepts to gain a meaning. 7E Model is the Model which is based on research Oriented Constructivism

learning theory and experimental activities. 7E Model, while including learners in activity at every phase, encourages children to construct their own concepts (Martin 2000).

The 7E learning cycle has seven phases which are called the elicit, engage, explore explain, elaborate, extend and evaluate. Eisenkraft (2003) describes these phases as follows:

Elicitation Phase: this phase involves taking into account students' poor knowledge and conceptions teachers are to ask student so as to motivate them to express their own knowledge.

Engagement Phase: The engage phase includes triggering learners' attention, getting student to think about the subject matter, reasoning questions in students' mind. The teacher must motivate the student to be curious to learn such as using interesting stories to introduce the subject matter.

Exploration Phase: The explore phase of the learning cycle engage students in observing, recording data, isolating variable, designing and planning experiments, creating graphs, interpreting results, developing hypotheses, and organising their finding. In this phase teachers may formulate questions recommend approaches, give feedback, and evaluate understandings.

Explanation Phase: In the explain phase, students are presented with models, laws, and theories. It is expected that students have got enough information, then bring it to analyse, summarise and present in various formats.

Elaborate Phase: In the elaborate phase of the learning cycle, students apply their knowledge to new situations, which may involve reasoning new questions and hypotheses to explore.

Extension Phase: The inclusion of the extent phase to the elaborate phase is aimed to clearly remind teachers to the importance of practising the transfer of learning for students. Student need to apply their knowledge to a new contract and is not limited to simple elaboration.

Evaluation Phase: The evaluate phase of the learning cycle involves both formative and summative evaluations of students understanding.

Researchers like Shaheen&Kayami (2015) compared the effectiveness of the instruction based on 7E instructional model and traditional instructional model for the teaching of Biology on 9^{th} - grade students' achievement. The results of the study showed that 7E instructional model was more effective than the traditional in terms of students' achievement.

Harun, Ganze & Kartal (2013) investigated the effect of the computer- aided 7E teaching model on students' science process skills. The results showed a significant increase was observed in the science process skills of the students included in the experimental group.

Nazam & Nilgun (2013) investigated the development and application of 7E learning model based on computer- assisted teaching material on participation on titration. The study revealed that post –test scores of experimental group and control group on the achievement test were statistically significant different. The difference indicates that the software has positive effects on students' achievement.

Damer & Ali- Eryilmaiz (2016) investigated the effect of meta-cognitatively stimulated 7E learning cycle on 10th - grade students' epistemological understandings in physics. The results of the study indicated that there was significant difference between two groups' post- epistemological understanding in favour of the experimental group. Therefore, the study investigates pupils' achievement in geometry using 7E instructional model.

Statement of the Problem

The poor achievement of pupils in geometrical concepts in mathematics at primary school certificate examination as noted in chief examiners report (2009) implies that the teaching methods amongst other things used by the mathematics teachers are defective. Therefore, this study was carried out to answer the question whether pupils' achievement will improve in geometry using of 7E instructional model?

Purpose of the Study

The main purpose of the study is to determine whether 7E instructional will improve pupils' achievement in geometry. Specifically, the study will determine whether,

- Pupils taught geometric concepts with 7E instructional model will have better achievement than those taught using traditional method.
- Male and female pupils taught geometric concepts using 7E instructional model will differ in their achievements.

Hypotheses

HO 1: There is no significant difference between the achievements of pupils taught geometric concepts using 7E instructional model and those taught with traditional method.

HO 2: There is no significant difference between the post-test mean achievements of male and female pupils taught geometric concepts using 7E instructional model.

Methodology

In this study, the quasi-experimental research design was used adopting the pre-test, post- test non-equivalent control group design. This was adopted due to the fact that non- equivalent intact classes were used for the study. The population consisted of all the primary six in Alvan Ikoku demonstration Primary school in Owerri Municipal Council in Imo State with a population size of 733 pupils. The sample size consists of one Hundred and Twenty (120) primary six pupils randomly drawn from four (4) intact classes. Two intact classes served as the experimental group while two other classes served as the control group. The experiment group consists of 64 pupils (30 males and 34 females) while the control group consists of 56 pupils (29 males and 27 females). The instrument for data collection was a researcher made Geometric Concept Achievement Test (GCAT). It was a 40- item multiple choice test Questions drawn from the geometric concept's topics contained in the mathematics syllabus which was taught the pupils. The topic includes lines, angles, and triangles. The validity of the instrument was raised by expert judgments of three mathematics teachers. The reliability of the instrument was determined using the kuder-Richardson formulae method (K-20). This gave a reliability coefficient of 0.73 which was acceptable for the study. Two instructional approaches were used for this study; these were 7E instructional model and the lecture method. The same lesson content was applied in the two approaches. The two groups were pre-tested to determine their initial cognitive background. Thereafter, the experiment group was taught using the 7E Model which involved the constructivists' principles and theories

which were activity oriented. The steps of the development process are given as follows: The first step of the 7E learning model is

Excite. In order to having the learners paid attention to the course, scenarios were developed for the topics, Mohr and Volhard methods. Scenarios are based on real life problems and developed by the authors. At the end of each scenario several questions were asked to the participants. Before taking their answers and solving the problems given, they were informed about what they can learn from this activity. In the activity, various questions were asked to the learners. Explore: At the next step, explore, learners were asked to design an experiment to answer the question. In addition, the students were informed about the materials and chemicals through the icons given in the software.

Explain: At the step of explain, the students were asked to draw using the results that they found in the experiments and also to solve the problems given again using the experiment results.

Elaborate: The objective of the step, elaborate, is to reinforce the learners' knowledge they gained in the previous steps and make them able to use it for novice settings. Therefore, the learners asked how the design of this experiment would be. They were instructed to work with their peers to answer these questions.

Extend: The next step is extended. At this step, the participant was given daily examples of the Mohr and Volhard methods and asked to develop ideas based on these examples through discussion with their peers.

Exchange: At the step of exchange, an environment was developed for learners to exchange their ideas about the newly learned subjects with their peers. It followed the premises of social constructivism. Before engaging in the process, they were given time to frame their ideas. They were asked to give examples from daily life and to justify their positions using evidence, proofs and data.

Evaluate: For the last step of the 7E learning model, evaluate, an educational computer game named. The game provides the students with the opportunity to repeat their learning occurred during the previous steps.

Development: The content was given to the software development team in the form of story sheets after developed by the authors. The team was consisted of two undergraduate students attending to the department of computer and instructional technologies teaching. In addition, drawings were developed by an artist. Maya programmer also assisted the software development team. The control group was taught the same concepts using lecture method. The teachers who taught in the experimental groups were trained in the 7E instructional approach while those who taught in the control group were regular mathematics teachers who were not trained on the instructional approach. The teaching lasted for three weeks after which a post-test was administered to both groups using the reshuffled GCAT instrument. The data generated were analysed using mean and standard deviation for the research question while Analysis of Covariance (ANCOVA) were used to test the hypotheses at 0.05 level of significant

Result

Research Question 1: What is the difference in the mean achievement scores of pupils taught geometric concepts using 7E instructional model and those taught using the traditional method.

Table 1: Summary of mean achievement scores of pupils in control and experiment groups

Group	N	Mean	SD	Diff In Ach.	Diff in mean gain
Expt. Post-test	78	49.41	9.73		
Pre-test	78	30.24	8.87	19.17	
control Post-test	85	32.34	8.74	1.84	17.33
Pre-test	85	30.40	8.50		

Table 1 shows that the experimental group had a mean achievement gain of 19.17 after treatment, while the control group had 1.84. Also, a difference in mean gain of 17.33 existed between the experiment and control groups in favour of the experimental group.

Research Question 2: what is the difference in the post-test mean achievement scores of male and female pupils taught geometric concepts using 7E instructional model?

Table 2: male & female achievement in protest

Group	N	Mean	SD	Diff in mean gain
Males	40	50.25	8.29	1.68
Female	38	48.55	11.09	

Table 2 shows that the male pupils in the experimental group had mean achievement score of 50.23 while the female had 48.66 which gave rise to a difference of 1.68 in favour of the male pupils.

Hypotheses Testing

Ho1: There is no significant difference between the mean achievement scores of pupils taught geometric concepts using 7E instructional model and those taught using traditional approach.

Ho2: There is no significant difference between the post-test mean achievement scores of male and female pupils taught geometric concepts using 7E instructional model.

Table 3: ANCOVA results on the students' achievement by treatment & gender

Source	Sum of squares	DF	Mean square	F	Sig	Decision
Corrected Model	14892.613	4	3723.153	44.720	.000	
Intercept	16924.483	1	16924.483	203.287	.000	
Pretest	47.034	1	47.034	.565	.453	S
Method	14233.771	1	14233.771	170.968	.000	NS
Gender	128.106	1	128.106	1.539	.217	NS
Method & Gender	2.576	1	2.576	.031	.861	
Error	13154.136	158	83.254			
Total	282328.000	163				
Corrected Total	28046.748	162				

Computed at alpha (x) 0.05

The result on table 3 shows that the treatment is a significant factor on pupils' achievement in geometry. Also, the probability level of 0.05 is greater than 0.000 (P<005). Thus, the hypothesis (HO1) is rejected and the alternative accepted. This implies that there is a significant difference between the mean achievement scores of pupils taught geometric concepts using 7E instructional approach and those taught using traditional method.

For **H02**, the f-ratio for the gender factor was not significant since 0.05 is less than 0.217 (P>0.05). This implied that there was no significant difference between the mean achievement scores of male and female pupils taught geometric concepts using 7E instructional model.

Discussion

The result of the study revealed that the mean achievement scores of pupils in the experiment group were higher than those in the control group. It was further revealed that method was a significant factor on pupils' achievement in geometry. This implied that pupils taught geometry using 7E Instructional Model, performed better than those taught using the traditional method. Shaheen & Kayami (2015), Damer & Ali- Eryilmaiz (2016) & Harun, Ganze & Kartal (2013) whose works showed that improved methods of teaching geometry such as 7E instructional model enhanced pupils' achievement.

The study also revealed that both male and female students taught mathematics using inquiry- based approach had high achievement gain. The analysis showed no significant difference in the mean achievement scores of male and female pupils taught mathematics using the inquiry- based approach. This result is in tandem with the findings of Ogbonna, (2003), Ogwuche, (2002) which showed no significant difference in achievement of male and female pupils in mathematics as result of instructional approaches.

Conclusion

The study was carried out to improve pupils' achievement in geometry through 7E instructional model. The result of the study revealed that 7E instructional model of teaching mathematics, improved pupils' achievement and this was witnessed across gender.

Recommendations

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

1. Primary school mathematics teachers should employ the 7E instructional model in teaching the pupils as to enhance their performance in the subject.
2. Workshops, seminars and symposium should be organised for mathematics teachers to expose them to effective methods of teaching geometry.
3. Pupils should be exposed to teaching approaches that are learners-centred as to enliven their attitude, interest and commitment on mathematics.

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