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Enhancing the Teaching of Basic Concepts in Circle Geometry Using E-Learning Approach; A Quasi- Experimental Study

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ABSTRACT

The study analyses the effect of e-learning approach on students' academic achievement in mathematics circle geometry in senior secondary schools in Calabar Education Zone of Cross River State, Nigeria. The study adopted the quasi-experimental design. The study also adopted a stratified random sampling technique in selecting 456 SS3 students (212 males 244 females) from nine public secondary schools in Calabar Education Zone for data analyses. The instrument used for data collection in this study was Circle Geometry Mathematics Achievement Test (CGMAT). The instruments were duly validated, and its reliability estimate established. The data were collected and collated, and the two null hypotheses tested at .05 alpha level using an independent t-test analysis statistical tool. The result showed that there is significant influence of using the e-learning approach in teaching Mathematics circle geometry on the Academic performance in Mathematics among SS3 students in Calabar Education Zone. Also, Male SS3 students in Calabar Education Zone significantly differ from their female counterparts in their academic performance in Mathematics circle geometry when taught using the e-learning approach. Based on this result It was recommended among others, that e-learning approach should be deliberately adopted by teachers when teaching and learning basic concepts in circle geometry, as it enhances effective understanding, aid interpretation and visualization of this basic circle geometry concept, male and female students should be advised to put more effort in understanding circle geometry, most especially the females.

Keywords: E-learning, Circle Geometry, Approach, Academic Performance, Mathematics,

INTRODUCTION

The 21st century age is characterized by rapid developments and changes resulting from the scientific and technological progress witnessed by the world, most notably the development of the use of computers and information and communication technology, which has reflected in various fields of progress, especially education.

Information Communication Technologies (ICTs) directly influences the development of teaching and learning processes, since they promote innovative pedagogical actions, as well as generate new learning spaces. These pedagogical events enhance the transformation of the classroom as we know it, since they allow for the elimination of spatial-temporal barriers, as well as access to a large amount of information, with different formats. It has also promoted the improvement of students' motivation, autonomy, involvement, and attitude towards educational content. (Antonio-José et al., 2021).

Among the pedagogical actions based on ICTs is digital e-learning, which according to (Cole,2020) is the pedagogical act that takes place online, thanks to the use of the Internet and technological devices, whether mobile or not, with synchronous or asynchronous connection, and from anywhere.

The term E-learning comprises a lot more than online learning, as the letter "e" in E-learning stands for the word "electronic", E-learning would incorporate all educational activities that are carried out by individuals or groups working online or offline (Som Naidu, 2006) and Li (2009) sees the "e" in e-learning to mean evolving, enhanced, everywhere, every time and everybody, because of the merits of e-learning to both the teacher and the student. This makes digital E-learning practices the paradigm of modern education.

In geometry, a circle is a two-dimensional (2D) shape consisting of all the points that are at a given distance from a fixed point, called the centre of the circle. (Haylock, 2018). It is a flat figure of special importance (Mollakuqe et al.,2021) and the importance of studying circles is shown in the variety of its application in our daily lives. (Arnigo et al.,2018). Learning of circles starts from its basic units, which are the radius, diameter, areas and properties, up to its applications. This implies that students should have more experience and knowledge in lower-level skills, in this case definitions and relationships, before they are able to progress on reasoning at a high level of difficulty such as its application. (Arnigo et al.,2018).

A better understanding of how students learn mathematics coupled with effective application of mathematical e-learning can enhance meaningful learning of mathematics and make the subject more exciting. (Jeong and Akugizibwe, 2018) This is because how mathematics is taught is a contributory factor in students' learning opportunities (Ntow, 2021) and this applies to circles in Geometry. However, the concept of circles the paper seeks to address has to

do with parts of the circle (which shall be listed later in the paper), excluding the construction of circles, equations of a circle, finding angles of circles and theorems surrounding the circles.

THE CONCEPT OF E-LEARNING

The introduction of network technologies, cloud-based services, big data, as well as virtual and augmented reality into pedagogical practice has dramatically increased learning opportunities. It became possible to teach not only faster and deeper, but also to implement the concept of lifelong learning, as well as complete immersion in the learning process and the availability of training not only in classes, but at any student's whereabouts (Zi-Yu et al., 2020), this is supported by Jeong and Akugizibwe ,(2018) when they opined that the expansion and dominance of technology is increasing globally, one of which is the influence of e-learning in educational systems. This means that as technology advances so is e-learning significant as an educational tool.

Electronic-Learning otherwise called e-learning is not a recent or newly developed mode of teaching and learning. According to Al-fahd, (2009), the actual use of e-learning in the educational system began in the early sixties, specifically in 1959, where each of leonid, Anderson and Rwat proposed the application of the use of computers in the implementation of educational tasks of which they had already programmed a number of educational materials.

Different authors have as well attempted to give their scholarly definitions of e-learning and for the purpose of the study, we shall state a few of them in addition to the one already stated in the introduction.

According to Ghuloom (2003), e-learning is an educational system that uses information technologies and computer networks to strengthen and

expand the educational process through a range of means, including computers, the Internet, and electronic programs prepared either by specialists in the ministry or companies. Kassahun (2014) sees E-learning as any electronic supported learning either with or without infusing the ICT facilities in the current conventional learning methods be it traditional or active learning. Lee et al., (2014), Ho and Dzeng, (2010) in Baji, et al., (2022) opines that e-learning refers to the use of recent computer network technologies in education processes that include web-based asynchronous and synchronous communications and interactions, information achievement and knowledge distribution, which may occur using simultaneous online interactions (synchronous) or offline nonparallel ones (asynchronous).

Hamad (2022), however observed that some group of scholars sees e-learning as a teaching method to transfer content to the learner based on multimedia via electronic media while the other group believes that e-learning is an integrated system with its inputs, processes, and outputs. However, the researcher concluded that E-learning can best be defined as the science of learning without using paper printed instructional material. E-learning is the use of telecommunication technology to deliver information for education and training. Siu & Garcia, (2016) in Baji, et al., (2022) added that E-learning is often considered synonymous with other terms in the educational technology field, such as distance learning; however, distance learning does not necessarily apply to computer technologies. Examples of e-learning tools includes but not limited to the following Zoom, blackboard learn, slack, Dropbox, GeoGebra, Geometry pad, Geometer's sketchpad, Shapes3D etc.

According to Pei-Chen Sun et al., (2008), the great advantages of E-learning include liberating interactions between learners and instructors, from limitations of time and space through the asynchronous and synchronous learning network model.

Although E-learning can address some of the unmet needs of learners and educational communities; however, not all learners and educators accept e-learning as a delivery modality. The critical link of success in the implementation of e-learning in various educational settings is its acceptance by the students. Thus, in assessing e-learning application, various dimensions of student's acceptance including attitudes, intentions, and perceptions, should be taken into consideration. (Baji et al.,2022). Nevertheless, e-learning practices are yet to attain full potential in developing countries, partly due to high initial costs of designing and setting up the platforms as well as low internet connectivity in developing countries. (Jeong and Akugizibwe ,2018)

STEPS IN TEACHING BASIC CONCEPTS IN CIRCLES:

Since circle is a topic in geometry, it is expedient for a teacher to apply the Van Heile's levels of geometric understanding in teaching as the theory points to the fact that effective learning takes place when students are thought sequentially, and they are actively involved in the lesson. (Mason, 2004).

Van Heile's levels of geometric understanding as pointed out in Arnigo et al., (2018) are as follows:

1. Visualization: Here the students learn by recognizing the physical features i.e. Circumference, Radius, Diameter, etc and can identify them
2. Analysis: Here the students recognizes properties of the figure but still has no ideas on the relationships of such properties.
3. Abstraction: Here the students can already make sense and relationships between the properties. The students can now also make informal arguments or reasoning.
4. Deduction: The students have already seen the importance of definitions, theorems, and conditions, and learned the deductive way of proving or reasoning.
5. Rigor: At this level students can establish and contrast mathematical systems.

However, for the purpose of this study the essentials of a circle are given below:

What is a Circle?

A geometrical closed round figure formed by joining a set of all points that are at a fixed distance from a fixed point is called a circle. Examples of circles includes a tyre, rings, coins etc.

Parts of a Circle:

Circumference: This is simply the perimeter of a circle. It forms the shape of a circle. Mathematically, Circumference, C, is given $C= 2\pi r$.

Radius: This is a line segment from the centre of a circle to any part of the perimeter of = the circle. $r = d/2$

Chord: This is a line segment joining two points on a circle.

Diameter: This is the longest line segment that passes through the centre of a circle touching the perimeter of the circle at both ends. It is a special kind of chord. Mathematically, it is given as $d=2r$

Centre: This is the midpoint of a diameter and the starting point of radii. Without the centre, there is no circle.

Arc: An arc of a circle is any portion of the perimeter of the circle formed from two endpoints.

Sector: This is a region enclosed by the arc of a circle and it's two radii.

Segment: This is a region of a circle enclosed by the chord of a circle and it's associated arc.

Tangent: A line segment that touches the perimeter of the circle at one point and it is perpendicular to the radius of the circle.

Area of Circle:

The area of a circle denoted by A, is the measure of the space in square metres enclosed inside the circle. The following are the areas of circle.

$A = \pi r^2$ (when radius is given)

$A= \pi(D/2)^2$ (when diameter is given)

$A=C^2/4\pi$ (when circumference is given).

THE NEXUS BETWEEN CIRCLE LEARNING AND E-LEARNING

Electronic devices like computers, smartphones and tablets can help learners access a large variety of e-learning options. To motivate and improve students' mathematics confidence, teachers need to be creative by using innovative explorations to create dynamic instructional pedagogies that may involve technology integration and learner-centred approaches. (Erebakyere, 2022).

It is highlighted that technology adds new dimensions to the teaching process and provides new learning opportunities that help learners visualize and engage with different mathematical objects and concepts (Saha et al., 2010) in (Erebakyere, 2022).

In this contemporary age, appropriate technology integration into mathematics education is noted as an effective approach that can facilitate effective teaching and learning processes (Agyei, 2013). Hence, for effective learning of the concepts of circles via e-learning tools, the need for a well-known learning principles and theories that can create mathematics content that fit the learners' needs and the teachers' overall intentions and an appropriate software is vital.

The circle is an important concept that is taught from basic to university level. But in reality there are still difficulties in learning the circle, so that required learning media such as with Geogebra.(Sudihartinih & Purniati, 2019) as it provides several digital tools that enable users to develop mathematical relationships of practical situations, synthesize and personally manipulate diagrams using several representations and modelling tools.(Adelabu et al.,2022). Other e-learning tools with almost the same feature of GeoGebra according to Hussin (2018) are (1) Geometry Pad which allows the learner create fundamental geometric shapes, explore and change their properties and calculate metrics and (2) Geometer's sketch pad which gives students at all levels—from third grade through college—a tangible, visual way to learn mathematics that increases their engagement, understanding and achievement.

STATEMENT OF PROBLEM

The quality of lesson delivery can be seen in the learning outcome of the students and the teaching methods employed by the teacher can either make or mar the interest of the students in learning a particular concept. Borji et al., (2019) in Ntow (2021), opines that in traditional or conventional instruction, the primary focus of teachers is on helping students to follow a set of rules and procedures required to solve questions correctly with very little explanation and justification of how and why the formula works. This conventional teaching approach has resulted in most students having difficulties in grasping Mathematical concepts including geometric concepts.

Erebakyere,(2022) opines that many studies have reported that learners appear to experience challenges in applying or relating the required knowledge of geometric properties and relationships to a given task even after teachers have taught the concept and this confirms the opinion of Jeong and Akugizibwe (2018), that the quest to teach mathematical knowledge in a viable and effective way so as to induce creativity and applicability among learners is an ongoing challenge, especially in the developing countries.

However with the vast dominance of technology in the educational system and the introduction of digital e-learning tools, Mollakuqe et al.,(2021) suggest that the classic method of teaching is outdated and for the younger generations it is as vague as it is unattractive.

On the other hand, while efforts towards improving e-learning usage in developing countries are gathering pace, most of the works has been general in perspective and only few have emphasized mathematical e-learning specifically (Juan et al., 2012; Namukasa et al., 2010; Elijah, 2012) in Jeong and Akugizibwe ,2018)

Base on this premise the study contended that Since learning is all about having interest, perhaps, integrating a digital technology will enhance the learning of the concepts of circles.

PURPOSE OF THE STUDY

The study was designed to determine:

1. The influence of using e-learning in teaching and learning of basic concepts in circle geometry.
2. The gender differences that exist when e-learning tool is used in the teaching and learning of the basic concepts in circles

RESEARCH QUESTIONS

1. Does e-learning affect the academic achievement of students in the teaching and learning of basic concept of circle geometry in Mathematics.
2. Do there exist any gender differences in academic achievement of students when e-learning is used in the teaching and learning of the basic concepts in circles geometry.

RESEARCH HYPOTHESES

Hypothesis 1:

HO_1: E-learning approach has no significant effect on the academic achievement of students when taught basic concept of circle geometry.

HA_1: E-learning approach has significant effect on the academic achievement of students when taught basic concept of circle geometry.

Hypothesis 2:

HO1: There is no significant gender differences in academic achievement of students when e-learning is used in the teaching and learning of the basic concepts in circles geometry.

HA: There is significant gender differences in academic achievement of students when e-learning is used in the teaching and learning of the basic concepts in circles geometry.

METHODOLOGY

The research design that will be adopted for this study is the quasi-experimental design. A quasi-experimental design is convenient when intact groups of participants are used in an experiment rather than assigning participants at random to experiments treatments. The design was found to be appropriate because the administrators in educational institutions do not allow dismantling of the intact classes to allow for random assignment. The study used the intact classes as they were without random assignment and compared the scores of students that receives treatment and that which does not receive the treatment. The study covered the Calabar Education Zone of Cross River State. Calabar Education Zone comprises seven local government areas, namely: Akamkpa, Akpabuyo, Bakassi, Biase Calabar South, Calabar Municipality and Odukpani with a total of 85 public secondary schools. The zone is in Cross River State, and the state is in the rain forest zone of West Africa. It lies between latitudes $20^0 18^1$and $30^0 25^1$ North of the Equator and Longitudes $40^0 30^1$ and $50^0 16^1$ East of the Greenwich Meridian, covers a land mass of 13,074km^2 (National Population Commission 2006).

The population of the study comprised all senior secondary three (SS3) students in public secondary schools in the Calabar Education Zone of Cross River State, numbered 8,549 in 2016/2017 academic session, according to the State Secondary Education Board, Calabar (2017). The study adopted a stratified random sampling technique in selecting 456 SS3 students (212 males 244 females) from nine public secondary schools in Calabar Education Zone for data analyses.

The instrument used for data collection in this study was Circle Geometry Achievement Test (CGAT). The Circle Geometry Achievement Test (CGAT) comprised a 30-item multiple choice objective test with four options. The reliability method to determine the internal consistency which gave a coefficient

of 0.76. All the copies of the instrument distributed were retrieved immediately from the students after distributed the exercise. The data collected and collated were analysed using an independent t-test and tested at .05 alpha level.

RESEARCH FINDINGS

Results

The null hypothesis in this study were restated and tested at .05 level of significance, thus:

Hypothesis one

E-learning approach has no significant effect on the academic achievement of students when taught basic concept of circle geometry among SS3 students in Calabar Education Zone.

The independent variable in this hypothesis is e-learning, while the dependent variable is academic performance in circle geometry among SS3 students in Calabar Education Zone. To test this hypothesis at, 05 alpha level, independent t-test statistical tool used, as shown

Table 1: Independent t-test analysis of students' using e-learning Approach and their academic performance in circle geometry (N = 456)

Groups	N	Mean	SD	t-value	p-level
Experimental group	205	14.25	6.05		
				5.07*	.000
Control group	251	11.09	5.73		

*Significant at .05 level; p< .05

The result in Table 1 revealed that the mean score obtains by the 205 experimental students as regards their academic performance in circle geometry was 14.25 with a standard deviation of 6.05 is greater than the mean score of 11.09 with a standard deviation of 5.73 by the control group students. The mean difference was statistically significant since the t-value of .000 met the criteria for significant at .05 level. This implied that the experimental SS3 students significantly performed better than control SS3 students in their circle geometry performance in Mathematics using e-learning approach.

Hypothesis 2

Male SS3 students in Calabar Education Zone do not significantly differ from their female counterparts in their academic performance in circle geometry when taught using the bar model approach.

Table 2: Independent t-test analysis of students' gender and their academic performance in mathematics (N = 456)

Gender	N	Mean	SD	t-value	p-level
Male	212	15.35	5.63		
				6.85*	.000
Female	244	12.14	4.14		

*Significant at .05 level; p< .05

The result in Table 1 revealed that the mean score obtains by the 212 male students as regards their circle geometry performance in mathematics was 15.35 with a standard deviation of 5.63 is greater than the mean score of 12.14 with a standard deviation of 4.14 by the female students. The mean difference was statistically significant since the t-value of .000 met the criteria for significant at .05 level. This implied that the male SS3 students significantly performed better than female SS3 students in their circle geometry performance in Mathematics when taught using e-learning approach.

DISCUSSION OF FINDINGS

The result of this study revealed that the students taught using e-learning to solve circle geometry significantly performed better than the students that were not taught using that approach in mathematics circle geometry achievement test. This result is not surprising because e-learning has become one of the highly sort after form of educational learning process and has been seen to assist teachers and learners in bringing out the learning concepts in the most appealing format that enhances understanding. However, with the vast dominance of technology in the educational system and the introduction of digital e-learning tools makes teaching of some difficult concepts in mathematics easy. The finding is in consonance with Mollakuqe et al.,(2021) who suggested that the conventional method of teaching is outdated and for the younger generations it is as vague as it is unattractive. students tackle problems faster and correctly with mere visualization. E-learning approach equally helps students to attain an understanding of how a problem needs to be solved and calculated.

The result further revealed that males students perform better than their female counterparts when taught circle geometry using the e-learning approach. This result equally affirms that the male students were better because it has been observed over time that male have more interest in logical reasoning and thinking than females. The females do not always have a positive interest in calculation rather they like reading stories than disturbing themselves in

critical thinking and most of the females thought that mathematics is basically for the males. The finding is in consonance with Orok (2013) which found that generally, boys were readier than girls in the mathematics test and that the mean difference found between boys and girls was statistically significant with the boys performing better than the girls.

RECOMMENDATION

1. E-learning approach should be deliberately adopted by teachers when teaching and learning basic concepts in circle geometry in mathematics, as it enhances effective understanding and aid solving geometric problems.
2. Government at all levels of education should make available adequate ICT infrastructure that will enable teachers and students interact to enhance the learning of basic concepts in circle geometry.
3. Teachers should emphasis mathematics equality among male and female students to enable them put more effort in understanding circle geometry, most especially the females.

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