



Efficacy of 5E Learning Strategy in enhancing Academic Achievement in Physics among Students in Rano Education Zone, Kano State, Nigeria

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ABSTRACT

The study investigated the efficacy of 5E learning strategy on the academic achievement of Physics students in Rano Education zone, Kano State-Nigeria. A pretest posttest quasi-experimental research design was adopted for the study. simple random sampling technique was used to draw 2 intact classes of 61 males and 46 females. The stated hypothesis was tested using independent z-test at 0.05 level of significance. The results revealed that students taught Physics using 5E learning strategy perform better than those taught using traditional method, there is no significant difference of achievement scores between male and female students when taught physics using 5E learning strategy. Based on the findings, it was recommended that physics teachers should be encouraged to use 5E learning strategy in teaching the subject and other science subjects in general in senior secondary schools because it improves students' academic achievement for both male and female students.

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INTRODUCTION

Science education is the foundation for sustainable national development by protecting human societies from ignorance, illiteracy, disease and poverty. For any nation to experience economic development there must be strong, stimulating growth in the teaching and learning of science (Nwagbo & Ovute, 2011). Science has been defined as a systemic enterprise of gathering knowledge about the world, organizing and condensing that knowledge into testable laws and theories (Hornby, 2010). According to Rao (2007), science is the system of knowing the universe through data collected by observation and controlled experimentation. Pearson Education (2003) also defined science as knowledge about the world, especially based on examining, testing and proving facts as well as particular parts of science such as Physics, Chemistry and Biology. This researcher views science as a systematic study of nature through experimentation.

For early scientists and philosophers, science was defined as knowledge and on epistemic grounds. Others scholars sees science as the systematic study of the structure and behavior of the physical and natural world through experiment and observation. Science is the investigation of matter with a view to understanding and harnessing to serve human needs (Okoro, 2013). The methods of producing true knowledge were those which distinguished science from other kinds of knowledge; observation,

accuracy, induction, proofs, deduction, etc. are the key terms of the debate.

Physics is a branch of pure science that deals with the study of matter in relation to energy. Physics is highly needed for our nation's technological breakthrough, (Agommouh & Nzewi, 2003). In addition, Danjuma (2008) stated that physics is the soul of science which plays a vital role in all human endeavour and serves as a pre-requisite for courses such as medicine, geology, agricultural science, pharmacy, forestry among others. It is one of the science subjects taught at the senior secondary level of Nigerian Educational system, it is closely related to other sciences such as chemistry and biology but is perceived generally to be difficult, vast mathematical and experimental (Torigoe 2008). Physics is one branch of sciences that was develop through the steps of observation, problem formulation, formulation of hypotheses and testing through experimentation, conclusion as well as the discovery of theories and concept. Physics learning has a very important role in order to establish a scientific attitude, analytical thinking, and foster the creativity of students (Ashiq, Muhammad, & Azra, 2011).

Teaching and Learning of physics is confronted with challenges such as poor instructional strategies, inadequate instructional materials among others which lead to negative consequences on the technological advancement of the nation (Mekonnen, 2014). These consequences include lack of skilled

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man power which discourage investors into the country, joblessness due to poor industrialization, high dependence on foreign products because of inability of people to make local production due to lack of creativity among others. Other challenges include the improper choice of instructional materials by teachers, appropriate teaching methods to be used and the assessment strategies to determine students' achievement especially in secondary schools where the foundation is laid (Demkov, 2009). To teach Physics effectively, teachers need to employ methods including students-centered methods that will enable the students to learn more, retain more and apply what is learned by engaging in significant and appealing activities, and 5E learning cycle may be good in this aspect.

Learning cycle is a concept of how students learn from experience. A learning cycle has a number of stages or phases, the last of which can be followed by the first. Learning cycle model was originated from Piaget's mental functioning model. The first version of the model included three phases initially called preliminary exploration, invention and discovery (Karplus & Their, 1969) but they were revised to exploration, concept introduction and concept application to increase the expressiveness (Hanley, 1997). As the learning cycle started to be implemented and investigated over years, the model was modified regardless of this conceptual foundation of the approach (Bybee, Taylor, Gardner, Scotter, Powell, Westbrook & Landes, 2006). Educators and researchers extended the phases of model to increase the emphasis on some issues and different versions of the model were emerged as 3E, 4E, 5E and 5E. Among them, 5E learning cycle instruction is the broad one encompassing seven phases each starting with the same letter; Elicit, Engagement, Exploration, Explanation, Elaboration, Evaluation, and Extension. In most cases, you will start with the "Elicit", here you can find out where the students by eliciting responses from them, this can be done in a variety of ways such as quick test, quizzes, this is also a good opportunity to deal with students' misunderstandings, the next is the "Engage" stage, this comes before or after the elicit stage, in this stage you want to engage interest and curiosity, raise the big question and provide the Hook for why the students want to learn. During the "Explore" stage, pupils should be given opportunities to work together, independent of you, their teacher to explore, following the explore stage the next is the 'Explain' of the lesson, during this stage the teacher will explain what the students had discovered in the

explore stage to help them build a concept. 'Elaborate' this is the stage where students test their conclusions through which they arrive at a different event by means of smaller experiments in addition to the activities/experiments conducted. This process provides students with the chance to improve their knowledge of concepts. In the 'Evaluate' phase students attempt to find answers to different questions based on data and evidences, considering the concepts they acquired during application. Teacher evaluates students more formally. It is important that students receive feedback and apply it to other contexts, in the 'Extend' phase students are asked to relate the existing concepts with other areas of real life and/or with other concepts/subjects to transfer the knowledge and skills they acquired. This study tries to ascertain whether 5E teaching strategy will improve students' academic achievement in physics by aiding in reducing their wrong perceptions towards Physics (Gulsum, 2014)

Academic achievement is the extent to which learners have gained from a particular course of instruction. Academic Achievement is the measure of what a person has accomplished after exposure to an educational program as said by Lucy (2015). Studies conducted by Ezeudu (2013) and Okoye (2012) reported that active participation of students during teaching and learning increases students' academic achievement. The students' academic achievement corresponds to their performance in school subjects as symbolized by a score on an achievement test (Jimoh, 2010). Fatokun, Egeya and Uzoечи (2016) and Okeke (2011) found that the students' achievement is dependent on several factors among which are learning environment and instructional methods. Teachers with good teaching strategy challenge students to work at a higher intellectual level, attain sound academic achievement for better outcome. In this study, the researcher intends to prepare physics learning activities based on 5E teaching strategy and determine its ability and efficacy in enhancing students' achievements as regard to gender.

Gender is the socially/culturally constructed characteristics and roles which are associated to males and females in any society. The gender study in science education has been contradictory results (Adeyemi & Ajibade, 2011). Ezech (2013) reported that the controversies on gender difference in the students' academic achievement have continued to be inconclusive. There have been a number of studies of gender on academic performance in science. Bichi (2002) defined gender as amount of muscularity or

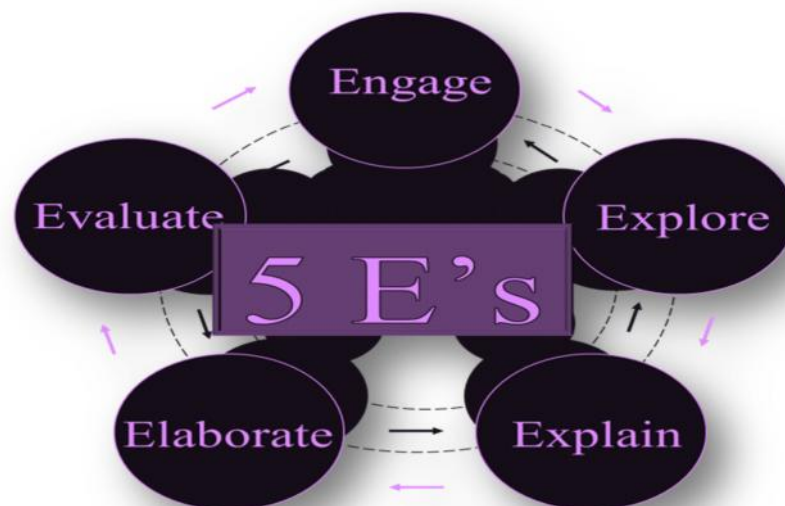
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ferminity in an individual. Researches on gender and academic performance such as that of Usman (2010), Ibrahim (2012), Olorukooba, Lawal & Jiya (2012) and Umar (2013), observed that boys achieved better than girls, but studies by Bichi (2002), Adedayo 2004, Atadoga (2005), Lawal (2009), Bunkure (2012) and Dahiru (2013) pointed out that girls achieved better than boys. Some studies (Okwara, Anyagh & Ikyaan, 2017; Omwirhiren, 2015) revealed that gender influences students' conceptual understanding of science subject in favor of boys. According to Okeke (2007). Studies held by (Okoyefi, 2014; Okorei & Ezech, 2016) found that girls students performed better than boys counterparts. Literature was reviewed on the causes of these controversial findings and found that teaching strategy is the major cause of gender difference in students' academic achievement in science (Jacob & Linus, 2017; Okurumeh, 2016). Because of controversial results with respect to students' academic achievement with respect to gender in science subject especially Physics; The researcher is inspired to conduct this study to observe the interaction effect of 5E instructional strategy and gender on the students' academic achievement in physics. Thus the study, will use 5E teaching strategy to prepare physics learning

experiences, teach experimental group and ascertain its effectiveness in improving students' academic achievement as well their perception in physics.

CONCEPT OF 5E

5E learning cycle model's name comes from the number of its phases and the initials of each phase Altunay (2004). These five phases are Engage/Enter, Explore, Explain, Elaborate and Evaluate. The 5E learning cycle model is a constructivist model which provides learning a new concept or comprehension deeply a known concept. This model which increases students' merak of research, by satisfying expectations of students, consists of active research's skills and activities that are necessary for knowledge and comprehension Ergin, Ünsal and Tan, (2006). 5E model motivates students to be included into a topic by several phases of learning, to explore a subject, to be given a definition for their experiences, to obtain more detailed information about their learning and to evaluate it (Wilder and Shuttleworth, 2005). The 5 E's allows students and teachers to experience common activities, to use and build on prior knowledge and experience, to construct meaning, and to continually assess their understanding of a concept. The model are represented in figure 1



Engage: Activity which will focus student's attention, stimulate their thinking, and access prior knowledge. Here Student asks questions such as: Why did this happen? What do I already know about this? What have I found out about this? And students Shows interest in the topic.

Explore: Activity which gives students time to think and investigate/test/make decisions/problem solves, and collect information. Perform an Investigation Read Authentic Resources to Collect Information, solve a Problem and Construct a Model.

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Explain: Activity which allows students to analyze their exploration Student's understanding is clarified and modified through a reflective activity such as Student Analysis & Explanation, Supporting Ideas with Evidence, Structured Questioning, Reading and Discussion, Teacher Explanation, Thinking Skill Activities: compare, classify, and error analysis.

Elaborate: Activity which expands and solidifies student thinking and/or applies it to a real-world situation Problem Solving, Decision Making, Experimental Inquiry, and Thinking Skill Activities: compare, classify, and apply.

Evaluate: Activity which allows the teacher to assess student performance and/or understandings of concepts, skills, processes, and applications any of the Previous Activities Develop a Scoring Tool, Performance, and Assessment; Produce a Product, Journal Entry, and Portfolio,

Statement of the Problem

The problems of under achievement of science subjects such as Physics have been a general problem (Adeyemo, 2011). According to Otuka, (2016), the achievement of candidate in senior secondary school Certificate Examination (SSCE) in the past, had been low and this seems to remain the same till now. Students generally perceived physics as conceptually difficult, abstract, uninteresting and just suitable for only talented and gifted students (Awodun & Ojo, 2013). Lack of laboratory equipments, lack of teachers' interest in improvisation or utilizing accurate or appropriate teaching methods.

In view of these, the researcher's attention was drawn to investigate the effects of 5E teaching strategy on students' academic achievements in physics in secondary schools of Rano education Zone, Kano state.

Objectives of the Study

The main objectives of the research are to:

1. Determine the difference in if any in secondary school Physics students' academic achievement when taught using of 5E learning strategy and conventional methods.
2. Find out whether there is gender difference among secondary school physics students' academic achievement when exposed to 5E learning strategy.

Research Questions

The research questions put forward for the purpose of this research are:

1. Is there any significant difference in secondary school Physics students' academic achievement when taught physics using of 5E learning strategy and conventional methods.
2. Is there any significant gender difference among secondary school physics students' academic achievement when exposed to 5E learning strategy?

Research Hypothesis

1. There is no significant difference in the academic achievement mean scores of secondary school physics students exposed to 5E learning strategy and those taught using conventional teaching method.

METHODOLOGY

The study utilized quasi experimental and control groups design involving pretest and post-test. This is made of two groups; experimental and control. According to Creswell (2012), a quasi-experimental design is a type of experimental design that does not provides for full control of extraneous variables, primarily because of lack of random assignment of subjects to group. The Experimental Group (EG) will be exposed to 5E learning cycle, and the Control Group (CG) will also be exposed to lecture method. A pretest (O_1) will be administered to the two groups to determine the equivalence of performance of students prior to the treatment. This is to be followed by a posttest (O_2) which will be administered after the treatment for a period of six weeks to determine the 5E learning cycle students' academic achievement among secondary schools, Rano, Kano State.

The Target population of this study comprised of all government-own senior secondary school SS II physics students, whose ages ranges from 14 – 16 years, dichotomized on the basis of gender.

According to Ministry of Education Kano State, there were 2,340 SSII Physics in the thirty-nine (39) public senior secondary schools in Rano zone. From the population of the study, two intact classes from two secondary schools were sampled and randomly assigned to Experimental and Control groups respectively. Namely: Government Secondary School Rano and Government Girls secondary school Bunkure.



Table 1: List of sampled schools and number of SSII Physics students

| S/N | Group | Schools | Male | Female | Total |
|--------------|--------------|-----------------|------|--------|-------|
| 1 | Experimental | G.G.S.S Bunkure | - | 49 | 49 |
| 2 | Control | G.S.S Rano | 67 | - | 67 |
| Total | | | 67 | 49 | 116 |

Physics Achievement Test (PAT) was the main instrument used for data collection. The PAT was Adapted from WASCCE 2012, 2013 and 2014 past question papers and used for both pre-test and post-test to determine the achievement levels. The instruments contain two parts. Part I consist personal data (e.g gender, school) and part two of twenty five multiple choice questions with four options to choose the correct option, only one will be correct and the remaining three served as destructors. These questions were selected from past West Africa Senior School Certificate Examination (WASCCE, 2012, 2013 and 2014). The items covered the units taught. The topics chosen were Heat energy, Gas laws and waves. They were selected because they formed a good representation of major in physics. Reports 2013 – 2017 identified some difficult concepts in physics which include: electric circuit, waves and optics, projectile motion, heat energy, gas laws and electromagnetic fields.

The PAT instrument with the marking scheme were validated by two senior lecturers in Science and Technology Education Bayero University, Kano and a Physics teacher with minimum of five years' experience

The scores obtained from the pilot study was used to determine the reliability coefficient of the PAT. The study employed test-retest method on the scores obtained from the pilot study and it was found to be 0.76. This is in line with Tuckman (1978) in Atadoga's (2001) recommendation. The reliability coefficient was found using the Pearson's Product Moment Correlation (PPMC).

The researcher visited the sampled schools, introduced himself to the principals and Physics teachers because their assistance will be required for

smooth movement of the study. Pretest was first carried out on the students in both the groups to observe if there was any significant difference in their achievement scores. The 5E teaching strategy was used, so students in the experimental group will be taught using the strategy for six weeks. Each lesson took 60 mins. The researcher used Conventional Teaching Method (CTM) to teach the subjects in the control group. Six lessons were taught each lesson will take 60mins. The topics to be taught was the same as those taught to the experimental group.

Post-test administration of Physics Achievement Test (PAT) was carried out on the subjects in both the experimental and the control groups in order to determine their level of physics achievement is that context. The response of the subjects to Physics Achievement Test was scored using marking scheme each correct response will be scored one point that is maximum score of 30 marks.

RESULTS

The study was conducted on 116 SS II, in two schools Government Secondary School Bunkure as the experimental group with forty-nine (49) Government Secondary School Rano as Control group with sixty-seven (67).

Hypotheses Testing

The null hypothesis formulated for the purpose of this research was tested at 0.05 Level of significance. It is restated thus: *There is no significant difference in the academic achievement mean scores of secondary school physics students exposed to 5E learning strategy and those taught using conventional teaching method.*

Table 2: Independent Sample z-test for post-test mean achievement scores of the experimental and control groups

| Group | N | Mean(X) | SD | DF | Z-Cal. | p-Value | Decision |
|--------------|----|---------|--------|-----|--------|---------|----------|
| Control | 67 | 15.0896 | 3.8953 | 114 | 3.415 | 0.001 | Rejected |
| Experimental | 49 | 17.6939 | 4.2681 | | | | |

Table 2 shows the independent sample z-test analyses for post-test mean achievement scores of control and experimental groups, the observed p-value is 0.001 which is less than 0.05 with df = 114,

therefore the null hypothesis is hereby rejected because the observed p-value is less than the significant level p-value (0.05). Hence, there is significant difference between the mean

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achievement scores of secondary school Physics students taught using 5E learning strategy in favour of experimental group (z -cal = 3.145, df = 132, $p=0.001<0.05$).

SUMMARY OF FINDINGS

Based on the outcome of the analysis, the following are the major findings from the study.

- i. There is significant difference between mean achievement scores of Physics students taught using 5E learning strategy and those taught using conventional method of teaching.
- ii. There is no significant difference between mean achievement scores of male and female Physics students taught using 5E learning strategy.

DISCUSSION OF RESULT

Based on the findings from this study, it was found that there is significant difference in mean achievement between secondary school students taught Physics using 5E learning strategy and those taught using conventional method of teaching in favour of those taught using 5E learning strategy, this implies that the use of 5E learning strategy in teaching physics enhances the academic achievement of the students. This finding is in agreement with the findings of Kanli & Yagbasan (2008), Muhammad (2015), Naade, Alamina & Okwelle (2018) and Meryem (2018) who found out students learning through 5E learning strategy have higher achievement than those who learnt through conventional teaching method. This is so because of the strategies and the steps followed and observed in the experimental group that is those taught using the 5E learning strategy, where all the phases were observed which are elicit, engage, elaborate, explore, explain, evaluate and extend. So the researcher is mindful at all case and carries everyone in the group along.

It was also observed in the study that there is no significant difference between in mean achievement scores of male and female Physics students taught using 5E learning strategy. This implies that in respect to gender difference, there is no any significant difference between the male and female students exposed to 5E learning strategy, this result is in accordance with the findings of Bunkure (2012), Özlem (2006), this is so in this study because in the 5E learning strategy, the students were allowed to interact especially in the phase of engagement, but the finding contradicts with the finding of

Muhammad (2015) where it was found that there is significant difference with respect to gender in favour of female students. .

CONCLUSION

Based on the findings of the study, the following conclusions were drawn.

- i. The use of 5E learning strategy in teaching Physics concepts improves students' academic achievements.
- ii. The strategy (5E learning strategy) helps in improving the academic achievement of both male and female students as indicated as no significant gender difference in academic achievement of Physics students taught using 5E learning strategy.
- iii. The 5E learning strategy is gender friendly with respect to perception scores of the male and female students exposed to the learning strategy.

Contributions to Knowledge

The results of this study provided the following contributions to knowledge:

- i. The study established that 5E learning strategy improves students' academic achievement in Physics.
- ii. The study also established that 5E learning strategy is one of the gender friendly teaching strategy.
- iii. The study also established that 5E learning strategy helps in improving physics students' perception positively.
- iv. The study also established that 5E learning strategy improves students' performance among both male and female physics students.
- v. Moreover, this study has added more literature on the existing knowledge in the study area.

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