

# Impact of 5E Learning Strategy on Pre-Service Biology Teachers' Achievement in Population Education in Southwest, Nigeria

**Asaaju, O.A,**
Department Of Special Education & Curriculum Studies
Adeyemi College of Education
Ondo, Ondo State, Nigeria
E-mail: modadeola64@yahoo.com
Phone: +234802311116

## ABSTRACT

This study determined the impact of 5E learning strategy on pre-service biology teachers' achievement in population education in southwest, Nigeria. The study adopted the pretest-posttest control group quasi-experimental design. Two federal colleges of education were randomly assigned to one experimental and one control group. The experimental group was exposed to 5E learning strategy while the control group was exposed to conventional strategy. The instruments used for data collection were: Population Education Achievement Test (PEAT), Team Based Learning Instructional Guide (TBLIG), 5E Instructional Guide (5ELIG), Conventional Strategy Instructional Guide (CSIG) and Research Assistant Evaluation Sheets (RAES). Treatment lasted eight weeks. Data collected were analysed using Analysis of Covariance, and Bonferroni post hoc test at 0.05 level of significance. There was significant main effect of treatment on pre-service teachers' achievement in population education ($F(2,376) = 12.257$; $p<0.05$, partial $\eta 2 = 0.061$). Pre-service teachers in 5E Learning Strategy (5ELS) treatment had the highest adjusted post-achievement mean score in population education while the Conventional Strategy (CS) control Group had the least adjusted post-achievement mean scores in population education. 5E learning strategy was found effective in improving pre-service Biology teachers' achievement in population education

**Keywords**: Team-based and 5E learning strategies, Pre-service teachers' Achievement, Population Education

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## 1. BACKGROUND TO THE STUDY

The significance of biology can be the key to the formation of a healthy biosphere where all living things and nonliving things have a balanced interaction (Bio Explorer, 2017). Moreover, many of the most pressing issues in the 21st century such as, preventing and treating formidable diseases like AIDS and feeding a rapidly expanding world population have biological roots (Onyegebu, 2008). Hence, appropriate teaching and learning of Biology is crucial to the interdependence of human being as an entity and as a member of a population group and his/her interrelationship with the environment in which that population exists. Population education is one of the compulsory Biology courses offered in Nigeria's colleges of education and its introduction into the Nigerian school system essentially stemmed from the phenomenal growth rate of the country's population and the need to discourage attitude favouring rapid population growth (Ogunyemi, 1995). Also, as a calculated effort to educate the public or individual on the need for reliable national population concerns which directly affect Nigeria's plan for a present or future socio-economic development (Etim, 1995). Population education is an educational programme which provides for the study of population situation in the family, community, the nation and the world (Nigerian Educational Research and Development Council (NERDC), 2004). Therefore, population education in the school curriculum is vital to addressing population and family life issues and as an important aspect of many personal, community, and national decisions (Toolkits, 2015).



The general objectives of population education for learners at any level are deep understanding of the relationships of population processes with social reality, increased concern and responsibility for social welfare, and greater skill in dealing with population related problems (UNESCO, 1983). Therefore, population education should create in young people and adults the awareness of the interrelationships between population and development, quality of life, such as the environment, resources, health, education, employment and other social services, as well as traditional beliefs and practices (Kondo, 1994). Available data and studies have described the Nigerian population as one that is gradually but steadily attaining an explosive state, the ripple effects of which are becoming more evident than ever though not being given the desired attention and urgency it deserves. Despite the significance of population education and accruable benefits, it is commonly observed in many countries (Nigeria inclusive) that the knowledge of the simple facts of population change, let alone the complex interrelationships with other parameters, is very low even among educated people (Pandey, 1999).

Ajiboye (1996) also observed that most of the Nigerian school teachers teaching population education were found not to be familiar with appropriate strategies for teaching the subject and therefore lack expertise in the use of such strategies. Findings from studies (Monika, 2013; Kavita, 2002) have revealed that school teachers have poor knowledge of population education. Implication is that these teachers would not teach beyond what they know about population education. Poor achievement in biology has been recurring over the years and this has been attributed to factors such as application of wrong and ineffective instructional strategies (Ekon and Edem, 2015; Owiti, 2011), teacher quality (Fagbayi, 2015), overcrowded classrooms (Nbina, 2012), lack of infrastructure (Sabejeje, Olaniyan, Osungbemiro and Adebola (2011), overloaded curriculum (Potyrala, 2008), teachers' styles of teaching (Çimer, 2004) among others. However, one major problem militating against the effective teaching of courses (population education inclusive) in Nigeria's tertiary institutions is the use of lecture method adopted by lecturers to teach (Aremu and Salami, 2013; Agoro, 2012; Saint, Hartnett and Strassner, 2003; Adegbile, 2002).

While Derek (2007) identified persistent use of conventional strategy as one of the major shortcomings affecting the learning and higher achievement in science subjects, Iheonu (2005) described the strategy as one in which teachers talk about science and students read about science. The conventional strategy gives few opportunities to students to apply knowledge thereby resulting in a lack of in-depth learning (Jones, 2007). In other words, knowledge is not retained and in turn not transferable to new situations either in the class or outside of it. Consequently, there has been a call for a shift in pedagogical paradigm by the Federal Republic of Nigeria through the National policy on Education aligning that: "Educational activities shall be learner-centred for maximum self-development and self-fulfilment, teaching shall be practical, activity-based, experiential, and IT supported (FRN, 2014: 15).

Despite the call for a shift in pedagogy (FRN, 2014), lecturers in Nigeria's colleges of education still do not use activity-based strategies in teaching and do not allow the pre-service teachers to plan and present such methods while in training (Aremu and Salami, 2013). This ease of use of the conventional strategy has made it very popular and acceptable among lecturers in colleges and universities though research evidence has shown that conventional strategy is ineffective in encouraging deep learning, it still appears to be the dominant strategy in higher education (Lammers and Murphy, 2002). Pandek (2005) submitted that 65% to 80% of university instructors spend their class time lecturing to a passive student audience with little or no focus on group development, active-learning, and/or cultivating problem-solving skills. Though the conventional strategy is useful in covering large amount of material in a short period of time, it does not allow for student engagement and often encourages simple memorisation of the content rather than application (Touchet and Coon, 2005; Di Leonardi, 2007).

Several scholars (Brame, 2016; Nelson and Crow, 2014; Eison, 2010) have established that active-learning strategies can improve student attitude and increase learning outcomes. A typical example of active learning strategy considered in this study is the Biological Sciences Curriculum Study (BSCS) 5E which consists of five phases namely Engage, Explore, Explain, Elaborate and Evaluate. It is a constructivist learning strategy for planning and implementing science (Skamp and Peers, 2012). The 5E learning strategy was designed and developed by Rodger W. Bybee in the 1980s specifically to provide a model that promotes a constructivist strategy for science education. Since then, the BSCS 5E learning cycle has become increasingly popular in the science education community in an effort to improve curriculum by creating cohesive lesson sequences. The grounding of the 5E in what is known about how human beings learn makes it widely applicable to instruction at all cognitive levels (Tanner, 2010).



In spite of the 5E's wide acceptance and popularity outside Nigeria, available documented literature showed that most Nigerian researchers that adopted the strategy did so at either the primary or secondary school level but yet to be adopted in the teaching of population education in Nigeria's colleges of education. Researchers (Erdal, 2015; Abdi, 2014; Madu and Ezeamagu, 2013, Opara and Waswa, 2013) have used the strategy in different subject disciplines and recorded improved learning outcomes in contrast to the conventional lecture method. Erdal (2015) investigated the effect of the 5E learning cycle in which the simulations were integrated on pre-service science teachers' achievement in 'photoelectric' subject. Four sophomore level classes with their 140 students participated in the research and a quasi-experimental design was used.

The classes were randomly assigned into one of the two treatment groups. Results indicated that the instruction developed for the experimental group affected participants' post-achievement and post-open-ended examination scores significantly. Ibrahim (2015) investigated the impact of 5E learning cycle on attitude, retention and performance in genetics among 110 Pre-NCE Biology students with varied abilities in two federal colleges of education, North-West Zone, Nigeria using a pre-test post-test control group quasi-experimental. The findings showed that pre-NCE Biology students exposed to 5E learning cycle in genetics concepts in all the ability levels had higher mean performance scores and also retained more than those in the control group exposed to lecture method of instruction.

Abdi (2014) determined the effects of the 5E learning cycle on students' academic achievement in science lesson on 40 fifth grade students selected through purposively sampling from two different classes in Kermanshah, Iran. There was significant difference in the achievement levels of the students instructed through the 5E learning strategy and the students in the traditional teaching group. Madu and Ezeamagu (2013) found from a study that pupils in the 5E group acquired more mathematics principles related to the key concepts in the fraction unit. They learned more of the ideas related to mathematics and they used both the ideas and symbols when they express what they have learned. Opara and Waswa (2013) investigated the efficacy of the learning cycle on 430 students' achievement in Chemistry adopting a pre-test-post-test control group quasi-experiment design in Bureti district, Kenya, Finding showed that the mean achievement scores for the experimental group taught through the 5E learning cycle had a higher mean score of 30.74 as against 23.81 for the control group taught by traditional method. From the reviewed literature, the 5E strategy has been used to teach various concepts but yet to be used to teach population education to pre-service Biology teachers in colleges of education especially in Nigeria. It is against this background that this study determined the impact of the 5E learning strategy on NCE pre-service Biology teachers' knowledge of population education in colleges of education in the South-west Nigeria.

### 1.1 Statement of the Problem

The inclusion of population education in the curriculum of College of Education pre-service Biology teachers was one of the calculated efforts by the Federal Government of Nigeria to tackle rapid population growth rate in Nigeria by equipping them with adequate knowledge with which they would be able to teach population education and related subjects at the basic level of education especially. While available data on pre-service Biology teachers depict poor achievement in population education, studies also have shown that practising teachers have inadequate knowledge of population education and related issues. Implication is that their would-be learners and learners respectively may not rise above the knowledge of their teachers. There is therefore the need to explore active learning strategy such as the 5E learning cycle which is not only learner-centred and activity based but, encourage self-directed learning, increase learner engagement to remediate performance deficiencies of pre-service biology teachers in Nigeria's colleges of education.

### 1.1 Objective

The main objective of this study is to determine the impact of 5E learning strategy on pre-service biology teachers' achievement in population education in Southwest, Nigeria



## 2. METHODOLOGY

### 2.1 The Research Design

The study adopted the pretest posttest control group quasi experimental design. The participants consisted of intact classes of 200 level NCE pre-service Biology teachers in two Federal Colleges of Education in South-west, Nigeria but were randomly assigned to experimental and control groups. Three topics - Factors accounting for population growth- causes of population change in Nigeria, Solutions to problems of population growth, Birth control measures including male and female reproductive organs, controversies and consequences, Reproductive behaviour (early marriage, pre-marital sex, teenage pregnancy and consequences) formed the focus of the study.

### 2.2 Research Instruments

Three research instruments- Population Education Achievement Test (PEAT), 5E Instructional Guide (5ELIG), Conventional Strategy Instructional Guide (CSIG), and Research Assistant Evaluation Sheets (RAES). Population Education Achievement Test (PEAT) was designed and developed by the researcher to measure the knowledge of pre-service biology teachers. 40 multiple choice items were generated around the six levels of knowledge, comprehension, application, analysis, synthesis and evaluation of Bloom's (1956) taxonomy of cognitive objectives. Kuder Richardson-20 formula was used to perform a reliability coefficient test and 0.80 was obtained. The 5E instructional guide is a stimulus instrument designed by the researcher in line with the five phases that make up the conceptual model for the strategy and its implementation.

The instrument was subjected to face and content validity in terms of appropriateness, curriculum relevance, precision, and ease of use and conformity with the five phases of the strategies. Valuable suggestions made by these lecturers informed the final production of the instrument. The conventional strategy instructional guide also is a stimulus instrument that was used for the control group. The instrument was validated and corrections, amendments and suggestions were taken into consideration for improved quality of the instrument. Research Assistant Evaluation Sheet (RAES) for 5E was designed by the researcher in conformity with the steps involved in the implementation of the 5E strategy and what research assistants were expected to do.

### 2.3 Research Procedure

Lecturers handling BIO 213: Population Education constituted the research assistants for the study and were trained for two weeks on 5E learning strategy which involved in-depth discussion and demonstration sessions by the researcher on the modalities for, and step by step implementation. Though lecturers for the control group were not trained as they adopted the familiar conventional strategy to teach their group, nevertheless, they were equally briefed on the purpose of the study and what was expected of them. All research assistants in the two groups were given copies of the instructional guides and take-home materials as appropriate for their groups after the training sessions to complement their own regular lesson notes.

The third week was used for the administration of pre-test on the participating pre-service teachers by the researcher, research assistants and the facilitators. Population Education Achievement Test (PEAT) was administered. Treatment lasted eight weeks during which participants in the experimental group were exposed to the 5E learning strategy and those in the control group were taken through the conventional strategy. Administration of PEAT was done in the 12th week as post test. Data collected were analysed using descriptive statistics of mean and standard deviation while the inferential statistics of Analysis of Covariance (ANCOVA) was used to determine group differences, with the pre-test scores as covariates. Estimated Marginal Mean (EMM) was used to determine the actual source of the significant differences Bonferroni Post-hoc test was used to find the magnitude of the differences in the various groups where there is significant effect. The hypothesis was tested at 0.05 level of significance.



## 3. DATA PRESENTATION

H01: There is no significant main effect of treatment on pre-service Biology teachers' achievement in population education.

**Table 1: Analysis of Covariance (ANCOVA) of Post-Achievement by Treatment, Self-Efficacy and Cognitive Ability**

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared |
|---|---|---|---|---|---|---|
| Corrected Model | 1510.967[a] | 24 | 62.957 | 3.751 | 0.000 | 0.193 |
| Intercept | 9527.818 | 1 | 9527.818 | 567.687 | 0.000 | 0.602 |
| Pre-Achievement | 0.009 | 1 | .009 | 0.001 | 0.982 | 0.000 |
| Treatment | 411.445 | 2 | 205.723 | 12.257 | 0.000* | 0.061 |
| Error | 6310.629 | 376 | 16.784 | | | |
| Total | 262261.000 | 401 | | | | |
| Corrected Total | 7821.596 | 400 | | | | |

a. R Squared = .193 (Adjusted R Squared = .142) *denotes significant difference at 0.05

**Table 2: Estimated Marginal Means for Post-Achievement by Treatment and Control group**

| Treatment | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| 5E Learning Strategy (5ELS) | 28.69 | 0.789 | 27.143 | 30.245 |
| Conventional Strategy (CS) | 23.77 | 0.594 | 22.599 | 24.933 |

**Table 3: Bonferroni Post-hoc Analysis of Post-Achievement by Treatment and Control Group**

| (I) Treatment | (J ) Treatment | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| 5E Learning Strategy | Conventional Strategy | 3.9714* | 55277 | .000 | 2.6422 | 5.3007 |
| Conventional Strategy | 5E Learning Strategy | -3.9714 | .55277 | .000 | -5.3007 | -2.6422 |

*denotes significant difference at 0.05

## 4. DISCUSSION OF FINDINGS

Table 1 shows that there is significant main effect of treatment on pre-service teachers' achievement in population education ($F(2,376) = 12.257$; $p<0.05$, partial $\eta 2 = 0.061$). The effect size is 6.1%. Table 1 reveals that the post achievement mean scores in population education pre-service Biology teachers exposed to 5E Learning Strategy (5ELS) were significantly different from those exposed to the Conventional Strategy (CS) in their post-achievement scores in population education. This means that there is a significant difference in the mean post-achievement scores of pre-service teachers in population education due to the treatment. Thus, hypothesis 1a was rejected. In order to determine the magnitude of the significant main effect across treatment groups, the Estimated Marginal Means of the treatment groups were carried out and the result is presented in Table 2.

Table 2 revealed that the pre-service biology teachers in 5E Learning Strategy (5ELS) treatment had the highest adjusted post-achievement mean score in population education (28.69) while the Conventional Strategy (CS) control Group had the least adjusted post-achievement mean scores in population education (23.77). This order is represented as 5ELS > CS. Table 3 shows how the Bonferroni Post-hoc test was used to find the magnitude of the differences between the two groups where there was significant effect. Table 3 revealed that the post-achievement mean scores in population education of pre-service Biology teachers exposed to 5E Learning Strategy (5ELS) was significantly different from their counterparts taught using the Conventional Strategy (CS) in their post-achievement scores in population education. This implies that both 5E learning strategy was the main source of the significant difference in treatment.

Finding from the study showed that there was a significant main effect of treatment on pre-service Biology teachers' achievement in population education. It could be deduced from these results that 5ELS was effective at improving pre-service Biology teachers' achievement in population education when compared to CS because 5E is an active learning strategy which gave pre-service teachers opportunities to think, reflect, and interact with the course materials in a meaningful way (Eison, 2010).

The findings were consistent with the findings from previous studies by Madu and Amaechi (2012), Opara and Waswa (2013), Madu and Ezeamagu (2013), Abdi (2014), and Erdal (2015), Ibrahim (2015) on the effectiveness of 5E learning strategy in enhancing students' learning outcomes in science than those taught using the conventional strategy. In particular, the finding also supports finding by Ibrahim (2015) who reported that pre-NCE Biology students exposed to 5E learning cycle in genetics concepts had higher mean performance scores than those in the control group exposed to lecture method of instruction. Findings also support the theoretical assumption that science, by nature, is a collaborative endeavour, and will require extensive skills in working collaboratively (Miller and Tanner, 2015) and that of Light (1990) who reported that students in teams did significantly better in all measures of their Biology course than students who studied alone.

## 5. CONCLUDING REMARKS

On the basis of the findings of this study, it could be concluded that 5E learning strategy as an active, participatory, self-directed, involving and engaging strategy afforded pre-service Biology teachers the opportunity to work together as teams with a common goal to succeed. The strategy has been found effective in enhancing pre-service Biology teachers' achievement in population education.

## 6. CONTRIBUTIONS TO KNOWLEDGE

Based on the reviewed literature and findings from this study, the following recommendations are suggested:

1. Lecturers handling BIO 213: Population Education in Nigeria's colleges of education should the 5E learning strategy to enhance pre-service teachers' achievement in population education as this would help lecturers tackle the issues of overloaded curriculum and overcrowded classes; the strategy is group-based and dwells on the theory of cooperative learning.
2. The Federal Ministry of Education (FME), National Commission for Colleges of Education (NCCE) and National Teachers' Institute (NTI) should come together to organise intensive training and re-training of teachers and teacher-educators on the use of active learning strategies such as 5E learning strategy.



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