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EDITORIAL

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We are grateful to the contributors and hope that our readers will enjoy reading these contributions.

Prof. Josephine N. Okoli
Editor-in-Chief

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EFFECT OF GENERATIVE LEARNING MODEL ON SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT IN ECOLOGICAL CONCEPTS IN ONITSHA EDUCATION ZONE.

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Abstract

The study investigated effect of generative learning model on secondary school students' academic achievement in ecological concepts in Onitsha Education Zone. Two research questions guided the study and two null hypotheses were tested at 0.05 level of significance. The study is quasi-experimental research, adopting specifically the non-randomized control group research design. The population of the study was 3155 (1230 males and 1925 females) Senior secondary year one (SS1) students offering biology. A sample of 100 students (43 males and 57 females) drawn using a multistage sampling procedure involving random and purposive sampling techniques was involved in the study. The instrument for data collection was Ecology Achievement Test (EAT) validated by three experts. The reliability coefficient for EAT was found to be 0.98 using Kuder-Richardson formula 20 (KR-20). Data for the study were collected using EAT through pretest and posttest. The data obtained were analyzed using Mean and standard deviation to answer the research questions, while Analysis of Covariance (ANCOVA) was used to test the hypotheses. The findings of the study revealed among others that there was a significant difference in the mean achievement scores of students taught ecological concept using generative learning model and those taught using expository method. It was recommended among others that seminars and workshop should be organized by education stakeholders to orient biology teachers on how to use like generative learning model in teaching.

Keywords: Generative Learning model, expository method, achievement and gender

Introduction

Science education is the teaching and learning of science. It is an intellectual and practical discipline concerned with the teaching and learning and assessment of scientific content, science process and nature of science (Obialor, 2016). It is concerned with the dissemination of scientific knowledge and the methods of instruction to create a society that is scientifically literate (Okoli, 2023). Science education occupies the essential position in developing resources needed for scientific and technical development of any nation. The Federal Republic of Nigeria (FRN) in its National Policy on Education (FME, 2014) identified the goals of science education to include: Acquisition of knowledge, skills, inquiry and rational mind for conduct of good life, produce scientist for national development, service studies in technology and the cause of technological advancement, provide knowledge and understanding of the complexity of physical world as well as the forms and conduct of life. These could be achieved by teaching and learning of science concepts. Science Education is offered in secondary schools as Basic Science and Technology, Mathematics, Computer studies, Agricultural Studies, Physics, Chemistry and Biology.

Biology is one of the key science subjects required for advancement in science and human technology. Biology is defined as the study of living things ranging from microscopic cellular molecules to the biosphere which live on the earth surface. It is a natural science concerned with the study of life and living organisms including their structure, function, growth, evolution and distribution (Nwuba and Osuafor, 2021). It is the basis for the survival of mankind because there is no area of human existence that does not encompass the usage of Biology. Okenyi (2015) describes Biology as a body of knowledge pivotal for the successful understanding of other fields of science such as botany, anatomy, physiology, microbiology, medicine, agriculture, pharmacy, and biotechnology to mention just a few. Unfortunately, it has been observed that students' academic achievement in biology has been fluctuating and unsatisfactory. Reports from Chief Examiners highlighted by other scholars indicates an unsatisfactory academic achievement. This implies that students' academic achievement in Biology is consistently below average and expectations. The Chief Examiners' report also identified that technical terms and scientific words were wrongly spelt, many candidates failed to adhere to the guidelines regarding biological drawings involving poor drawing of ecology diagram, poor understanding of ecology concepts and poor achievement on questions related to ecology as candidate's weakness in biology. This invariably leads to students' unsatisfactory achievement in the subject. To improve the

students' academic achievement in Biology, the teachers need to employ learner-centric instructional techniques in teaching ecological concepts.

Ecology is the study of the relationship of organisms with their environment. Cary Institute of Ecosystem Studies (2018), defined ecology as the scientific study of processes influencing the distribution and abundance of organisms, the interactions among organisms and the transformation and flux of energy and matter. According to Adesoji (2008) all aspect of science especially ecology could be said to be problem solving and students have varying ability when they are confronted with problems to solve. Therefore, the ability of the students to understand ecological concept would improve their achievements in biology.

Academic Achievement refers to an instructional goal or task that a learner has accomplished through his/her academic effort or hard work. It also means a reward for completing a particular task or meeting an objective after class instructional delivery. According to Steinmayr, Meibner, Weidinger and Wirthwein (2017), academic achievement represents achievement outcome that indicate the extent to which a learner has accomplished specific goals in instructional environment, specifically in schools, colleges and universities. Drew (2023) described academic achievement as the examination marks, teachers awarded grades and percentages in academic disciplines gained by students. Thus, the need to investigate an effective teaching strategy such as generative learning model that could enhance students' achievement in Ecological needs to be investigated on.

Generative learning model (GLM) is a student-centered approach based on the principle that any learning environment that affords learners to be active participants stimulates thinking and can improve learning compared to the conventional teaching method which impede students' active participation (Adeyemi and Awolere, 2016). GLM is hinged on the assumption that learning is a generative activity which makes learners actively construct their own knowledge by restructuring their schemas to align the new information being processed with the previously learned materials. It facilitates learners' understanding of the instructional contents for possible reuse in another situation. According to Larchner, Jacob, and Hoogerheide (2021), generative learning model, unlike the others, is capable of facilitating learning by mapping, which is the ability of the learners to arrange words and link these words using graphic organizers for easy understanding and applications of such knowledge. It also promotes learning by drawing with the intent of selecting relevant information (concepts) from the text and produce drawing to show interrelationship among the concepts. In addition, it

facilitates learning by imaging which means creation of mental pictures of the contents/materials being learned in the mind/brains of the learners. This means that GLM may cater for most of the students' shortcomings in the learning of Biology especially in the area of ecological drawing and representation of ecological concepts as mental images in their brains unlike conventional teaching methods.

Conventional teaching method is one of the oldest and commonest method that fosters rote learning. It is teacher-centered and does not improve creativity. Conventional teaching method includes Expository teaching method. Expository teaching method is when a teacher directs students to learn through memorization and recitation techniques, thereby not developing their critical thinking, problem solving and decision-making skills (Sunal, 2015). According to Paris (2014), advantages of expository method of teaching include; faster coverage of content. Content can be covered in a relatively shorter time than the modern method of teaching. An instructor has a lot of material that he is required to teach in limited time frame among others. It involves the teacher doing all the talking with little or no input from the students and negligence of individual differences among learners is also inevitable. Thus, it is imperative to investigate on a teaching strategy that could enhance students' academic achievement in Ecological concepts irrespective of their genders.

Gender is the state of being male or female, especially when considered with reference to social and cultural difference, rather than biological ones. Nwuba, Egwu and Osuafor (2022) defines gender as the fact of being male or female. Okeke in Uba (2016) posited that the consequences of gender stereotyping cut across economic, social, political and educational development, especially in the areas of biology. This issue has caused a lot of controversy over the years, as research on gender in learning science has remained inconclusive. This study sought to determine a suitable way of teaching ecology in the classroom, to enable the students have the best understanding of the concept irrespective of their gender. Therefore, the researcher sought to determine the effect of GLM on academic achievement of secondary school students in ecology in Onitsha Education Zone of Anambra State.

Research Questions
The study was guided by the following research questions:
  1. What is the difference in the mean achievement scores of SS1 students taught ecological concepts using Generative learning model and that of those taught using expository teaching method (ETM)?

2. What is the difference in the mean achievement scores of male and female students taught ecological concepts using GLM?

Hypotheses

The following hypotheses were tested at 0.05 level of significance;

1. There is no significant difference in the mean achievement scores of SS1 students taught ecological concepts using GLM and that of those taught using ETM.
2. There is no significant difference in the mean achievement scores of male and female students taught ecological concepts using GLM.

Methodology

This study is a quasi-experimental study, adopting specifically a non-randomized control group research design. The population of the study consist of 3155 (1230 males and 1925 females) Senior secondary year one (SS1) students offering biology in the 26- government owned secondary schools in Onitsha Education Zone of Anambra State. The sample size was made up of 100 students from two Government co-educational secondary schools in Onitsha Education Zone using purposive and simple random sampling technique. The experimental group was tagged group A, while the control group was tagged group B. There were 23 males and 27 females' students in group A, making it a total of 50 students in the group. There were also 50 students in group B which consist of 20 males and 30 female students. The instruments used for data collection was Ecology Achievement Test (EAT). The instrument was adapted by the researcher from WAEC past questions from 2010 to 2023. The instrument consists of forty multiple- choice questions. Each item has 4-option lettered A-D. The test was based on the unit of study in SS1 Biology Curriculum used for the study. The EAT was used for pretest and after the treatment. Kuder-Richardson formula 20 (KR-20) was used to determine the internal consistency of the instrument and a coefficient of 0.98 was obtained. Data for the study were collected using EAT through pretest and posttest. Mean and standard deviation were used to answer the research questions, while Analysis of Covariance (ANCOVA) was used to test the hypotheses at $p \leq 0.05$. ANCOVA was used to test the hypotheses.

Results

The results of the analyzed data were presented in tables based on the research questions.

Research Question 1: What is the difference in the mean achievement scores of SS1 students taught ecology using Generative Learning Model and that of those taught using expository method?

Table 1: Mean and Standard deviation of Pretest mean and posttest mean scores of students taught ecology using GLM and ETM

Groups	N	Pretest Mean	Pretest SD	Post-test Mean	Posttest SD	Gain Mean
GLM (Expe)	50	27.38	9.90	46.50	10.50	19.12
ETM(Cont.)	50	26.16	11.20	28.55	10.50	2. 39
Mean Diff.		1.22		17.95		16.73

Table 1 shows that secondary students taught Ecological concept using Generative Learning model had a pretest mean of 27.38 with SD of 9.9 and a post-test mean of 46.5 with SD of 10.50. The difference between the pretest and posttest mean was 19.12. Group taught ecological concept using expository method had a pretest mean of 26.16 with SD of 11.20 and a post test of 28.55 with SD of 10.5. The main gain reflects the improvement from pretest to post- test was 19.12 for generative learning model and 2.39 for the expository method group. The results revealed that students taught using generative learning model achieve higher than those taught using expository method. This indicates that teaching Biology using GLM increases students' academic achievement in ecological concept than ETM.

Research Question 2: What is the difference between the pretest and posttest mean achievement scores of male and female SS1 students taught ecological concept using generative learning model?

Table 2: Pretest and posttest difference in the mean achievement scores of male and female students taught ecological concept using generative learning model (GLM).

Gender	N	Pretest Mean	Pretest SD	Post-test Mean	Posttest SD	Gain Mean
Male	23	35.31	6.70	36.70	6.40	1.39
Female	27	33.87	4.18	35.98	4.97	2.11
Mean Difference		1.44		0.72		0.72

Results in Table 2 show that the male and female students taught ecological concept using generative learning model had a pretest mean of 35.31 with SD of 6.70 and a posttest mean of 36.70 with SD of 6.4 while the female has a pretest mean of 33.87 with SD of 2.18 and a posttest mean of 35.98 with SD of 3.97. The difference between the pretest and posttest mean achievement was 0.72. The result shows that male and female students taught ecological concept using generative learning model achieves higher but the female students, despite starting slightly lower recorded a higher mean gain compared to males. This indicates that GLM have a stronger effect on female students' achievement scores (2.11) than their male counterparts (1.39).

H0₁: There is no significant difference in the mean achievement scores of students taught ecological concept using generative learning model and that of those taught using expository method**.**

Table 3: ANCOVA of the significant difference in the mean achievement scores of students taught ecological concept using generative learning model and those taught using expository method

Source	SS	DF	MS	F-value	P-value	Decision
Corrected Model	20705.305	2	10352.65	619.97	0.000	
Intercept	2722.332	1	2722.332	162.93	0.000	
Pretest	11039.230	1	11039.230	660.64	0.000	
Group	8477.032	1	8477.032	507.94	0.000	Significant
Error	1952.620	117	16.689			
Total	191633.000	120	-			
Corrected Total	22657.925	119	-			

Table 3 that with respect to the groups taught ecological concept using generative learning model and those taught using expository method, an F-ratio of 507.939 as obtained with associated probability value of .000. Since the associated probability value of 0.01 was less than 0.05 set as level of significance, the null hypothesis (HOI) which stated that there is no significant difference in the mean achievement scores of students taught ecological concept using generative learning model and those taught using expository method is rejected. Thus, inference drawn therefore is that there was a significant difference between the mean achievement scores of students taught ecological concept using generative learning model and those taught using expository method.

H0$_2$: There is no significant difference between the mean achievement scores of male and female students taught ecological concept using generative learning model.

Table 4: ANCOVA of the significant difference between the mean achievement scores of male and female students taught ecological concept using generative learning model.

Source	SS	DF	MS	F-value	P-value	Decision
corrected Model	5702.86[a]	2	2851.428	175.00	.000	
Intercept	1952.36	1	1952.361	119.80	.001	
Pretest	779.02	1	779.021	47.80	.000	
GROUP	4923.84	1	3602.699	302.20	.000	Significant
Error	814.96	50	16.299			
Total	45860.00	53				
Corrected Total	6517.81	52				

In Table 4, It shows that with respect to the students' male and female taught ecological concept using generative learning model, an F-value of 302.20 was obtained with P-value of .000. Since the associated Probability value of 0.00 was less than 0.05 as level of significance, the null hypothesis (H02) which stated that there will be no significant difference between the mean achievement scores of male and female students with taught ecological concept using generative learning model is rejected. Thus, inference drawn therefore is that there was a significant difference between the mean achievement scores of male and female students taught ecological concept using generative learning model. This indicates that gender significantly influenced students 'achievement when taught using GLM.

Discussion

The findings of this study showed that the Generative Learning Model (GLM) significantly enhanced students' achievement in Biology**,** particularly in ecological concepts, when compared with the traditional Expository Method. Students taught using the GLM recorded substantially higher mean achievement gains than those

taught with the expository approach. This indicates that the GLM is a more effective instructional strategy for promoting meaningful learning and improving academic achievement in Biology. The effectiveness of the GLM can be attributed to its learner-centred nature, which actively engages students in generating ideas, making connections between prior and new knowledge, and reorganizing concepts in meaningful ways. Such active cognitive processes promote deeper understanding of ecological concepts, unlike the expository method, which largely encourages passive learning (Ogunleye & Babajide, 2011; Awolere, 2015; George & Abumchukwu, 2021; Onanuga, 2016).

The findings of this study are consistent with those of earlier researchers who reported the effectiveness of the GLM and similar learner-centred strategies in improving students' academic achievement. For instance, Ogunleye and Babajide (2011) reported that students exposed to generative instructional strategies in Physics achieved significantly better than their counterparts taught with conventional methods. Similarly, Awolere (2015) found that generative learning strategies improved students' achievement and practical skills in Biology. George and Abumchukwu (2021) observed that the GLM significantly enhanced students' achievement in Chemistry, while Onanuga (2016) reported similar results in Biology, showing that students taught with generative learning strategies recorded higher posttest scores compared to those exposed to traditional methods. These studies reinforce the conclusion of the present research that GLM is an effective instructional strategy for improving achievement in science-related subjects, including Biology.

With respect to gender, the findings revealed that both male and female students benefited from instruction using the GLM, as evidenced by improvement in their posttest scores. This suggests that the GLM is generally effective in enhancing students' understanding of ecological concepts irrespective of gender. However, the results further indicated a significant gender effect, with female students recording higher mean achievement gains than their male counterparts, despite starting with slightly lower pretest scores. This implies that the GLM had a relatively stronger impact on female students' academic achievement (Achor, Wude, & Duguryil, 2013; Adolphus & Omeodu, 2016).

The observed gender difference aligns with the findings of Nweke, Abonyi, and Omebe (2014), who reported that student-centred instructional approaches are more effective

than traditional teaching methods with respect to gender. The finding is also consistent with Olorukooba (2016) and Ezeudu and Obi (2018), who reported that gender differences in achievement were reduced or minimized when students were exposed to learner-centred strategies such as cooperative learning and generative approaches. These scholars argued that such strategies promote active participation, peer interaction, and problem-solving, thereby creating a learning environment that supports the academic success of both male and female students (Karim, Maries, & Singh, 2025).

Conclusion
The study determined the effect of the generative learning model on SS1 students' achievement in ecological concepts. Findings revealed that students taught with the generative learning model achieved significantly higher than their counterparts taught with the expository method. While gender differences were observed in the findings. In conclusion, the generative learning model enhances students' academic achievement more effectively than expository method regardless of gender.

Recommendations
Based on the findings of the study, it is recommended that:
1. Biology teachers should adopt the use of generative learning model in order to improve students' achievement in learning biology.
2. Seminars and workshop should be organized by education stakeholders to orient biology teachers on how to use innovative instructional approach like generative learning model in teaching.
3. Curriculum planners should seek to include generative learning model when reviewing the Biology curriculum to enhancing active participation of students

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