



## Impact of the 7E Teaching Model on Secondary School Students' Academic Achievement in Biology in Ilorin, Nigeria

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The continuous advocacy by scholars in science education on the shift from teachers' conventional teaching to a more innovative teaching instruction that aligns with the global teaching trends in this 21<sup>st</sup> century leads to the emergence of the learning cycle teaching model in Education. This study examined the impact of the 7E teaching model on enhancing secondary school students' academic achievement in biology in Ilorin. A quasi-experimental design was employed, involving a sample of 226 biology students in public secondary schools in Ilorin town. A purposive sampling technique was used to select the secondary schools in the Ilorin district. Data collection was carried out using a Biology Concepts Test (BCoT). The data analysis was conducted using mean and ANCOVA. The results indicate a significant difference between the students exposed to the 7E instructional model and those taught using the conventional teaching method, leading to the rejection of the null hypothesis. It was therefore recommended, among suggestions, that Teachers should adopt the 7E model as a teaching approach in Science and Biology to enhance students' conceptual understanding and improve academic achievement.

**Keywords:** Impact, 7E, Teaching model, Academic, Achievement, Biology

### Introduction

Biology is one of the natural sciences offered at both secondary and tertiary levels in Nigeria. It is made up of several disciplines, among which are Botany, Zoology and Microbiology and sub-disciplines; Genetics, Ecology, Anatomy, Embryology, Physiology, Molecular Biology, Biochemistry, Space Biology, Paleontology, Cytology, and Taxonomy (Ndu et al., 2010; Edna, 2014). Biology as a subject is offered at the senior school level and is one of the sciences chosen by students for the senior school certificate examination in Nigeria. Therefore, better Conceptual understanding and academic achievement in this subject are very important. To achieve this, teachers need to employ innovative strategies to teach, to motivate and encourage critical thinking and more conceptual understandings of this subject. According to Jibril et al. (2021), science education scholars have emphasized the adoption of student-centred innovative instructional strategies in the 21<sup>st</sup> century to meet up with global changes in education. Thus, this study adopted the learning cycle model.

Learning cycle teaching approach is an inquiry-based instructional model that has been proven to enhance learning and demonstrates effectiveness in formal settings. It is based on Piaget's theory of intellectual development. This model of teaching offers a systematic method for students to develop their understanding through firsthand experiences with science (Maier et al., 2006). The learning cycle model is a structured inquiry instructional teaching-learning strategy that is in logical sequential phases. The learning cycle, which first evolved from three phases (exploration, invention, and discovery). The three phases of the Learning Cycle were introduced by Lawson and Karplus (2002). According to Byee (1997), these three phases were later expanded to five phases (Engage, Explore, Explain, Elaborate and Evaluate) by the Biological Science Curriculum Study(BSCS) in 1992. Finally, in 2003, Eisenkraft expanded the 5E model into the 7E framework, incorporating the phases: Elicit, Engage, Explore, Explain, Elaborate, Evaluate, and Extend. The 7E instructional model has become a widely recognized framework for fostering active learning and student-centered instruction in an educational environment. The 7E instructional model consists of seven sequential phases, each beginning with letter "E": Elicit, Engage, Explore, Explain, Elaborate, Evaluate, and Extend. Each of these phases aids the instructor's well-reasoned, structured and organized instructions to enable the learners to achieve understanding of the scientific concept, explores and deepens the understanding towards application to a new situation (Sadi & Cakiroglu, 2010). The 7E learning is a constructivist student-centric model. The phases of instruction details the ideas, concepts and

skills required for the conceptual understanding of content in a formal setting. The 7E learning phases are based on prerequisite knowledge and the cooperation of learners for the construction of the new knowledge. (Gupta et al., 2024). Based on the backdrops, this study adopted the 7E teaching model to examine its impact on students' academic achievement in biology.

Ajayi and Babjid (2024) examine the efficacy of the 7E-Learning strategy on physics students' achievement in practical. The study employed a quasi-experimental design. A purposive sample technique was employed to select 169 Senior Secondary (SS2) physics students. Research instruments were the 7E instructional strategy and the WAEC Physics Practical Achievement Test (WPPAT). Data were analyzed using mean, standard deviation and ANCOVA. The results indicated that students in the experimental group achieved higher performance than those in the control group. Iqbal et al. (2024) studied the impact of the 7E instruction on students' academic achievement in physics. The research was a quasi-experimental design. The study involved 10th-grade physics students at public high and higher secondary schools in the Sargodha district. Two secondary schools were randomly selected in Sargodha City, out of 11 girls' and 15 boys' schools. Two control groups and two experimental groups were involved in the study. The instrument was the Achievement Test in Physics (ATP). Data collected were analyzed using an independent samples t-test and ANOVA. The study revealed a significant difference between the experimental group and the control groups in favour of the experimental group. The study employed a quasi-experimental design, focusing on 10th-grade physics students from public high and higher secondary schools in the Sargodha district. Two secondary schools were randomly selected from a pool of 11 girls' and 15 boys' schools in Sargodha City. The research included two control groups and two experimental groups. The Achievement Test in Physics (ATP) was used as the primary instrument for data collection. Data analysis, conducted using an independent samples t-test and ANOVA, revealed a significant difference in performance, favoring the experimental group over the control group.

Mekonnen et al. (2024) studied the effect of the 7E instructional model integrated with computer animations on students' conceptual understanding and misconceptions about food making and plant growth. A quasi-experimental design was adopted for the study. The study investigated the effectiveness of the 7E learning cycle model combined with computer animation (CA) compared to conventional teaching methods. The experimental group received instruction using the 7E model with CA, while the control group was taught traditionally. Data collection involved a two-tiered conceptual understanding multiple-choice test and semi-structured interviews. ANOVA and MANOVA analyses revealed that the 7E model with CA significantly enhanced conceptual understanding and reduced misconceptions. Additionally, no statistically significant difference was found between male and female students' performance. Jack and Ogunleye (2024) examined the effect of the 7E Instructional Strategy in the achievement of students in Chemistry. The study was a quasi-experimental design. The sample comprised 200 students, i.e. 146 males and 56 females. The instrument used in the study was the non-testing lesson plans, and a testing teacher-made chemistry achievement test (CAT). The study analyzed the collected data using mean, standard deviation, and ANCOVA. The results revealed a statistically significant difference in the mean achievement scores between students taught Chemistry using the 7E instructional model and those taught through the conventional guided discovery strategy. However, no statistically significant difference was observed based on gender. Based on these findings, the study concluded that the 7E instructional model is a more effective strategy for enhancing students' learning and achievement in Chemistry.

Ibrahim et al. (2022). The study investigated the impact of the 7E learning cycle on the performance of Senior Secondary School slow learners in Katsina on the cell concept. The study employed a Solomon four-group design, where one experimental and one control group underwent both pre-testing and post-testing, while the other two groups were only post-tested. Schools were selected using a simple random sampling technique, while a purposive sampling method was used to choose 5,459 SSII Biology students in Katsina Metropolis based on the Student Intelligence Quotient Ability Test (SIQAT) and past academic performance. Data collection was conducted using the Cell Performance Test (CPT), and the data were analyzed using mean, standard deviation, and an independent t-test. The results indicated a significant difference between slow learners exposed to the 7E learning cycle in the experimental group and those taught using conventional methods, with the 7E group performing notably better. The study concluded that the 7E learning cycle improves students' understanding of cell concepts.

Wodaj and Belay (2021) examined the impact of the 7E instructional model combined with metacognitive scaffolding on students' conceptual understanding of human biology concepts and their misconceptions. The study employed a quasi-experimental design, incorporating a pre-test, treatment, and post-test. The sample included four purposely selected schools, along with four classes and their respective teachers. ANOVA results indicated

that the 7E instructional model effectively enhanced students' comprehension of biology concepts while reducing misconceptions. Marfilinda (2020) investigated the effect of the application of the 7E Learning Cycle Model on the learning outcomes of the basic science concepts of second-grade students of elementary school. The study utilized a quasi-experimental design with a randomized pretest-posttest control group approach. The target population comprised all students enrolled in the Primary Teacher Education program at a private university college in Padang. The sample included 24 students in the control group and 28 in the experimental group. Data were collected through a learning outcome test. The findings revealed differences in student learning outcomes when applying the 7E instructional model.

### Statement of the Problem

In a bid to eliminate misconceptions and enhance conceptual understandings, as well as improve students' academic achievement in science and biology in particular. Scholars have employed several teaching and learning methods. These methods emphasise students' activeness in process of learning and critical thinking in the learning process. These teaching strategies prevent rote learning and aid meaningful understanding of the content of instruction. Several Researchers have employed different strategies to aid the teaching of the concept, including the learning cycle model. This prompts the Researcher to try out this innovative instruction, particularly the 7E model of teaching some biology concepts. Research findings have confirmed the effectiveness of the 7E model, with several studies demonstrating its significant impact on students' academic achievement (Brown & Garcia, 2024; Lee & Gupta, 2023; Kosobameji, 2022). Therefore, the present study intends to examine the effect of the 7E teaching model on students' performance in biology. This is to test its effectiveness based on the studies reviewed. Also, the location of the study was different from the reviewed studies. Importantly, during the past decades, studies on gender stereotypes have yet to produce a conclusive result. Considering the foregoing, this study on the 7E learning cycle and gender was examined to affirm the direction of this instruction.

### Research Questions

This study seeks to answer the following research questions:

1. What are the differences in the academic achievement of students taught using the 7E teaching model compared to those taught using the conventional method?
2. How does the academic performance of male and female students differ when taught using the 7E teaching model?

### Hypotheses

The following null hypotheses will be tested at a 0.05 level of significance:

1. There is no statistically significant difference in the academic achievement of students taught using the 7E teaching model and those taught using the conventional method.
2. There is no statistically significant difference in the academic achievement of male and female students taught using the 7E teaching model.

### Methodology

The study employed a quasi-experimental design with a non-equivalent, non-randomized pretest-posttest control group approach. The sample consisted of 226 students from intact classes in two public secondary schools in Ilorin City. A purposive sampling technique was used to select Senior School Two (SSII) Biology students for the study. The sampled students were not preparing for the WASSCE. Biology teachers' qualifications, school location were criteria considered for the selection of schools. A researcher-designed Biology Concepts Test (BCoT) was used for the collection of data. The Research instruments were given to five experienced Biology teachers who have been marking Senior Schools Certificate Examinations for more than 10 years, and two Biology educators from the Department of Science Education, University of Ilorin, Nigeria, for face and content validity. In addition, the draft of the BCoT was reviewed by an expert in measurement and evaluation to ensure the quality and standard of the items. The instrument's reliability was assessed using the test-retest method, conducted over a three-week interval on students from a non-participating school. A reliability of 0.72 was obtained using the Pearson product-moment correlation coefficient.

### Procedure for Data Collection

Permission to conduct the study in the selected schools was obtained by submitting an introduction letter to the school principals for approval. After being given permission, the researcher was introduced to the Biology teachers of the school's training. All students were given consent forms to be completed and returned to the Research assistants of each school. These consent forms were given to seek students' consent to participate in the study.

Pretests were administered to the participating students in both experimental and control groups before the commencement of the teaching. This was used to determine the students' prerequisite knowledge of genetics as well as the equivalence of the groups. The experimental groups were taught using the 7E model, and the control group was taught using with Conventional method. A posttest was administered to all the groups at the end of the exercise.

## Results

Data collected from the study were analyzed with descriptive and inferential statistics. All the research questions were answered with mean and research hypothesis were tested with ANCOVA at 0.05 level of significance.

**Research Question 1:** What are the differences in the academic achievement of students taught using the 7E teaching model compared to those taught using the conventional method?

Table 1 revealed the mean achievement scores for the 7E teaching model and conventional method groups. The result revealed 7e teaching model group has an approximate mean score of 42.58 and convention method group has an approximate mean of 21.46. This showed that 7E teaching model improves students' achievement in BCoT.

Table1: *Mean results for the Groups*

Groups	N	X
7E model	114	53.58
Conventional method	112	31.46

**Hypothesis 1:** There is no statistically significant difference in the academic achievement of students taught using the 7E teaching model and those taught using the conventional method.

From Table 2, the calculated F-value is 237.542 at a 0.05 level of significance. The computed significance level is lower than the table value of 0.05 ( $p < 0.05$ ); the null hypothesis is rejected. Since the significance value ( $p = .004$ ) for "Groups" is less than 0.05, the null hypothesis is rejected. This confirms a significant difference in academic performance between students taught using the 7E Model and those taught using conventional methods, favoring the 7E model.

Table 2: ANCOVA Analysis Result of the 7E teaching model and conventional methods

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	10076.679 <sup>a</sup>	2	5038.340	141.808	.000
Intercept	39980.405	1	39980.405	125.132	.000
Pretest	306.066	1	306.066	8.614	.000
Groups	987.809	1	978.809	237.543	.004
Error	7923.038	223	35.529		
Total	326802.000	226			
Corrected Total	17999.717	225			

a. R Squared = .560 (Adjusted R Squared = .556)

**Research Question 2:** How does the academic performance of male and female students differ when taught using the 7E teaching model?

Table 3 reveals the mean scores of male as 45.15 and female as 45.42 This implies that both gender group performed positively after treatment.

**Table 3: Mean results for the 7E teaching model based on students' gender**

Gender	N	X
Male	49	45.15
Female	63	45.42
<b>Total</b>	<b>114</b>	

**Hypothesis 2:** There is no statistically significant difference in the academic achievement of male and female students taught using the 7E teaching model.

Table 4 shows that the calculated F-value is 0.763, with a significance level of 0.91. Since the significance value ( $p = 0.91$ ) is greater than 0.05 ( $p > 0.05$ ), the null hypothesis is not rejected. This indicates that there is no statistically significant difference in academic achievement between male and female students taught using the 7E Model. Therefore, the 7E teaching model is equally effective for both genders.

**Table 4: ANCOVA Analysis of the Post-Test of Male and Female Senior School Students in the 7E Model Group**

Source	Type III sum of squares	df	Mean square	F	Sig.	Remark
<b>Corrected model</b>	142.024 <sup>a</sup>	2	71.012	3.823	.025	
<b>Intercept</b>	35360.971	1	35360.971	1.9033	.000	
<b>Pretest</b>	130.531	1	130.531	7.026	.009	
<b>Gender</b>	1.694	111	1.694	.091	.763	NS
<b>Error</b>	2024.896	114	18.577			
<b>Total</b>	215057.000	113				
<b>Corrected Total</b>	2166.920					

a. R squared = .006 (Adjusted R squared = .048)

## Discussion

The findings of this study revealed that the 7E teaching model significantly enhances students' engagement, comprehension, and overall academic achievement in Biology compared to the conventional teaching method. The results indicate that students who were taught using the 7E teaching model had a better grasp of biological concepts than those instructed through conventional methods. Furthermore, the study revealed that students exposed to the 7E teaching model performed significantly better in Biology Conceptual Tests (BCoT) than their counterparts in the conventional method group. This suggests that the 7E model improves students' conceptual understanding, as reflected in the rejection of the first null hypothesis, which stated that there is no significant difference in academic achievement of students taught using the 7E teaching model and those taught using conventional methods. These findings are consistent with previous research conducted by Ajayi and Babjide (2024), Jack and Ogunleye (2024), Kosobameji (2022), Abdullahi et al. (2021), and Kencana et al. (2020), all of which support the effectiveness of the 7E Model in enhancing student achievement. Regarding gender differences, the results of this study indicate that there is no significant difference in academic achievement between male and female students taught using the 7E Learning Model. This aligns with the findings of Kosobameji (2022), who also concluded that gender does not influence students' academic achievement. The fact that no significant difference was observed between male and female students exposed to the 7E model confirms that the approach is inclusive and unbiased, making it an effective instructional strategy for all students, regardless of gender.

## Conclusion

The study supports the 7E teaching model as an effective instruction to conventional methods, as it enhances students' understanding and academic achievement in Biology. Additionally, the model promotes gender equality in learning outcomes, reinforcing its effectiveness across diverse student populations.

## Recommendations

1. Teachers should adopt the 7E model as a teaching approach in Science and Biology to enhance students' conceptual understanding and minimize misconceptions, leading to improved academic achievement.
2. Educational institutions and policymakers should provide regular training and workshops to equip teachers with the necessary skills to effectively implement the 7E teaching Model in classroom instruction.

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