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EFFECT OF PICTORIAL ADVANCED ORGANIZERS ON STUDENT ACADEMIC PERFORMANCE IN BIOLOGY IN JALINGO EDUCATION ZONE TARABA STATE

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Abstract
This study examined the effect of Pictorial Advanced Organizers on students' academic performance in Biology within the Jalingo Education Zone, Taraba State. A quasi-experimental design was employed to compare the performance of students taught using Pictorial Advanced Organizers and those taught using the Conventional Instructional Method. The targeted population for this study comprised of 5,361 Secondary school students of Biology (SSII), 2,617 male and 2,774 respectively. The sample size was 203 SSII students. Multi-stage random sampling technique was used in determining the schools. Two of the schools were designated as experimental group while the other as control group and intact was used to determine the sample size. The instrument used was Advanced Organizers Performance Test (AOPT) adopted by the researcher. The AOPT consists of 40 multiple choice Biology test items with four options (A-D) from which the students were to select the correct answer. A reliability index of 0.85 was obtained using Kuder Richardson's (KR_{20}) formula. The data collected in this study was analyzed using descriptive statistics (Mean and Standard Deviation) to summarize and describe the data, and Analysis of Covariance (ANCOVA) was employed to test the hypotheses at a 0.05 significance level. The results indicate that students exposed to Pictorial Advanced Organizers demonstrated a higher mean gain score (13.12) compared to those taught with the Conventional Instructional Method (6.39). Furthermore, gender-based analysis revealed that both male and female students benefited from the use of Pictorial Advanced Organizers, with mean gain scores of 13.98 and 11.98, respectively. In contrast, the mean gain scores for males and females in the Conventional Instructional Method group were 6.54 and 6.24, respectively. Statistical analysis using ANCOVA showed a significant difference between the two instructional methods, $F(1, 200) = 274.876$, $p < 0.05$, with an effect size ($\eta^2 = .579$), indicating that 57.9% of the variance in students' performance was attributable to the instructional method. These findings suggest that Pictorial Advanced Organizers significantly enhance students' academic performance in Biology compared to conventional methods. The study recommends integrating Pictorial Advanced Organizers into Biology instruction to improve students' comprehension and learning outcomes.

KEYWORDS*: Pictorial Advanced Organizers, Academic performance, Biology Education, Conventional instructional method*

Introduction
The teaching and learning process is known to be as old as man on earth. It has been carried out by human beings and even by animals to teach their young ones for successful adjustment to existing conditions in their environments. Learning is a purposeful, conscious and complex process which involves a complex interactive system including environmental, social, motivational, emotional and cognitive factors (Khan & Rehman, 2020), and the learning process takes place in different subjects including biology as a field of science.

Biology is a natural science subject consisting of contents from microscopic organisms to the biosphere, encompassing the earth's surface and all living things. Considering its characteristics and importance, Akindele (2009) stated that Biology is a standard subject of instruction at all levels of our educational system from primary to tertiary level. It is one of the core subjects at Secondary

School Certificate Examination (SSCE) whose study is very relevant to man's successful living. Thus, there are different teaching strategies used in teaching biology which include different technique and methods among which are Pictorial Advanced Organizers, concept mapping, active learning, inquiry-oriented learning or inquiry-based methods with mobile devices for learning, self-directed study, computer-assisted testing/assessment. The use of these techniques varies with different teaching methods and also on the basis factors such as the type of learning objectives, nature of the subject, age of students, and number of students in a class. Quite remarkably, poor academic performance by the majority students is fundamentally linked to application of poor and ineffective teaching methods by teachers to impact knowledge to learners (Omondi, 2019). Khan et al., (2018) views the use of inappropriate teaching methods as a major cause for students' poor performance in science examinations. In fact, Igboegwu, (2012) stated that most of the methods like lecture and discussion methods used in teaching have been described as inappropriate and uninspiring. However, the use of pictorial advanced organizers has positive impact on students' academic performance in biology (Agbeyenku, 2015). It enhances the learning of the students as it can also be called linking agents; they link the previous knowledge to the newly learnt knowledge. It is designed to indicate the relevant prior knowledge of a learner and it is usually presented at a higher level of abstraction, generality and inconclusiveness than that of the planned lesson. There are several additional benefits of Advanced Organizers to students across the curriculum. The flexibility of advanced organizers makes it easy to appropriately modify them for students with special needs, and that they explicitly inform students what they will be learning, thus, reducing the possible stress of the unknown which has been shown to negatively impact student performance.

Performance is a multidimensional construct composed of the skills, attitudes, and behaviour of the learner that contributes to academic success in the classroom (Hijazi 2019). It is the indicative and response abilities that express, in an estimated way, what a person has learned as a result of a process of education or training. It is the extent to which a student, teacher, or institution has attained their short or long-term educational goals. The status of Biology performance in external examination in Nigeria by nigerianstat.gov.ng in 2020 revealed that, only 1.53 million candidates sat for the West African Senior School Certificate Examination, which is a decline of 3.25% compared to 1.58 million in 2019. Despite Biology having higher enrolment due to its compulsory status, it had a poor performance, fluctuating and sometimes descending trends (Owolabi & Oyeniyi, 2020). However, the appropriate use of instructional strategy is known to improve the retention ability of students.

Retention is the ability to recall things learned previously. Several factors are known to influence retention of learned materials. Aminu (2017) revealed that anything aiding learning should improve retention. Ochonogor (2017) stated that in-depth retention and achievement in science, technology and mathematics is an important need that is becoming highly felt by the Nigerians populace.

Despite the importance of Biology in understanding the natural world and addressing global challenges, many students in Nigerian secondary schools continue to struggle with the subject, resulting in poor academic performance in both the internal and external examination. The problem of students' poor performance and retention in Biology is a major one that requires urgent and serious attention. The teaching and learning of Biology in Nigeria, has been characterized by many differing viewpoints about the necessity of different types of reforms and methods in its teaching. One therefore, wonders why all the methods used so far, have not been able to reverse this ugly trend of poor performance. The West African Secondary School Certificate Examination (WASSCE) revealed that only 15% passed with A1-C6 in 2020-2023. The conventional teaching methods used in most Biology classrooms, which often rely on verbal instructions and text-based materials, may not be effective in engaging students and promoting meaningful learning. It is against this background that this study seeks to investigate the effect of Pictorial Advanced organizers on students' academic performance in Biology in Jalingo Education Zone Taraba State.

To this end, the study looks at the performance of students exposed to Pictorial Advanced Organizers and students exposed to Conventional Instruction Method; Retention ability of students exposed to Pictorial Advanced Organizers and students exposed to Conventional Instruction Method

Research Methods

The study employed quasi experimental with pretest, posttest, post-post-test experimental and control groups. Both the experimental and the control groups were pre-tested to ensure group equivalence, thereafter exposed to treatment for 6 weeks and at the end of which post-test was administered to determine students' performance and two week later, post-post-test was administered to determine their retention level. The study was conducted in Jalingo Local Government Area, Taraba State. 5,361 SSII students. The targeted population for this study comprised of 5,361 Secondary school students of Biology (SSII), 2,617 male and 2,774 respectively. The sample size was 203 SSII students. The multi-stage random sampling technique was used in determining the schools. Two of the schools were designated as experimental group while the other as control group and intact was used to determine the sample size. The instrument used was Advanced Organizers Performance Test (AOPT) adopted by the researcher. The AOPT consists of 40 multiple choice Biology test items with four options (A-D) from which the students were to select the correct answer. The items covered topics taught for the duration of the study which include Food chain, Food web, Ecological pyramid and Aquatic habitats. This was administered to the experimental and control groups as pretest and posttest. To reduce the effect of pretest and posttest, the questions were reshuffled and administered in a different random order in the posttest. The instrument was validated by three science education experts from Taraba State University, Jalingo, who reviewed its content and provided feedback that was incorporated to enhance its accuracy and validity. A reliability index of 0.85 was obtained using Kuder Richardson's (KR_{20}) formula. The instruments were administered to the subjects accordingly before and after the treatment. Two intact classes were used for six weeks, with one class taught using Pictorial Advanced Organizers and the other using Conventional Instruction Method. The data collected in this study was analyzed using descriptive statistics (Mean and Standard Deviation) to summarize and describe the data, and Analysis of Covariance (ANCOVA) was employed to test the hypotheses at a 0.05 significance level.

Results

Research Question One: What are the mean performance scores of students exposed to Pictorial Advanced Organizers and students exposed to Conventional Instruction Method?

Table 1 shows the mean scores and standard deviations in the performance scores of students taught biology using Pictorial Advanced Organizers and those taught with Conventional instructional method. Results indicate that the mean scores of students in the Pictorial Advanced Organizers group is 16.45 in pretest and 29.57 in posttest, and their standard deviations are 2.640 and 3.341 for performance test. Students in the Conventional instructional method group had the mean scores of 16.22 in pretest and 22.61 in posttest respectively with the standard deviations of 2.3380 and 2.622. It was further observed that the mean gain scores for Pictorial Advanced Organizers and Conventional instructional method are 13.12 and 6.39 respectively. This implies that the use of Pictorial Advanced Organizers favoured students more than Conventional instructional method.

Table 1: Mean performance score of students taught with Pictorial Advanced Organizers and those taught with Conventional instructional method

Group	N	Pretest		Posttest		Mean Gain
		Mean	Std. Dev	Mean	Std. Dev	
Pictorial Advanced organizer	104	16.45	2.640	29.57	3.341	13.12
Conventional Instructional method	99	16.22	2.382	22.61	2.622	6.39
Mean Differences		0.24		6.96		6.73

Research Question Two: What are the mean retention scores of students exposed to Pictorial Advanced Organizers and those exposed to Conventional Instruction Method?

Table 2 shows the mean retention scores and standard deviations of students taught Biology using Pictorial Advance Organizers compared to those with Conventional instructional method. It is observed that the mean retention scores of students in the Pictorial Advance Organizers group is 29.57 in posttest and 28.39 in post-posttest, while their standard deviations are 3.341 and 2.609 for retention. Students in the Conventional instructional method group have the mean retention scores of 22.61 and 20.80 in posttest and post-posttest respectively and standard deviations of 2.622 and 2.395. It was further observed that the mean difference in retention for Pictorial Advance Organizers method group and Conventional instructional method group is 7.56. This implies that the students in the Pictorial Advance Organizers group retained knowledge of what they were taught than their counterparts in the Conventional instructional method group.

Table 2: Mean retention scores of students exposed to Pictorial Advance Organizers and those exposed to Conventional instructional method

Group	N	Pretest		Retention	
		Mean	Std. Dev	Mean	Std. Dev
Pictorial Advanced organizer	104	29.57	3.341	28.39	2.977
Conventional Instructional method	99	22.61	2.622	20.80	2.395
Mean Differences		**6.93**		**7.59**	

Hypothesis One: There is no significant difference between the performances mean scores of students taught Biology concepts with Pictorial Advanced Organizers and those taught using Conventional Instruction Method.

Table 3 is one-way ANCOVA between groups' analysis of covariance which compared the effects of Pictorial Advance Organizers and Conventional instructional method on students' performance in Biology. The result F (1, 200) = 274.876, P = .000 < 0.05 shows that the two groups differ significantly. Thus, the null hypothesis is rejected. Therefore, there is significant difference between the performances mean scores of students taught Biology concepts with Pictorial Advance Organizers compared to those taught using Conventional instructional method. The effect size (eta square = .579) indicates that 57.9% of the difference in the mean score is based on the treatment used

Table 3: One-way ANCOVA for Mean performance score of students taught Biology concepts with Pictorial Advance Organizers and those taught with Conventional instructional method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2522.965a	2	1261.482	143.513	.000	.589
Intercept	2335.938	1	2335.938	265.749	.000	.571
Pretest	65.164	1	65.164	7.413	.007	.036
Treatment	2416.158	1	2416.158	274.876	.000	.579

Error	1758.001	200	8.790
Total	143335.000	203	
Corrected Total	4280.966	202	

a. R Squared = .589 (Adjusted R Squared = .585)

Hypothesis Two: There is no significant difference between the retention mean scores of students taught Biology concepts with Pictorial Advanced Organizers and those taught using Conventional Instruction Method.

Table 10 is one-way ANCOVA between groups' analysis of covariance which compared the effects of Pictorial Advance Organizers and Conventional instructional method on students' retention. The result F (1, 200) = 57.301, P = .000 < 0.05 shows that the two groups differ significantly. Thus, the null hypothesis is rejected. Therefore, there is a significant difference between the retention mean scores of students taught Biology concepts with Pictorial Advance Organizers and those taught using Conventional instructional method. The effect size (eta square = .223) indicates that 22.3% of the difference in the mean score is based on the treatment used.

Table 4: ANCOVA analysis for Mean retention score of students taught Biology concepts with Pictorial Advance Organizers and those taught using Conventional instructional method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	4089.110[a]	2	2044.555	1341.957	.000	.931
Intercept	36.097	1	36.097	23.693	.000	.106
Pretest	1169.862	1	1169.862	767.847	.000	.793
Treatment	**87.301**	**1**	**87.301**	**57.301**	**.000**	**.223**
Error	304.712	200	1.524			
Total	128089.00	203				
Corrected Total	4393.823	202				

a. R Squared = .931 (Adjusted R Squared = .930)

Discussion of findings

The results showed that students taught using Pictorial Advance Organizers had a significantly higher mean performance score (29.57) compared to those taught using Conventional instructional method (22.61). This suggests that Pictorial Advance Organizers is a more effective instructional method for improving students' performance in Biology. The higher mean performance score for Pictorial Advance Organizers can be attributed to the fact that this method provides students with a clear and concise visual representation of complex biological concepts, making it easier for them to understand and retain the information. The findings of the above study agree with the studies conducted by Akgün (2017) and Agbeyenku (2015) whose studies find out that student taught using Pictorial Advanced Organizers performed better than those tough using Conventional Instructional Method. The study's findings suggest that Pictorial Advanced Organizers (PAO) is a more effective instructional method for improving students' performance in Biology compared to the Conventional Instructional Method. This is consistent with several other studies that have investigated the

effectiveness of PAO in improving student learning outcomes. For instance, Kaya (2017) found that students who were taught using pictorial advanced organizers showed significant improvement in their problem-solving skills and scientific literacy compared to students who were taught using traditional methods. Similarly, Akhtar et al., (2023) found that the use of pictorial advance organizers had a positive impact on students' learning outcomes in biology.

The results also showed that students taught using Pictorial Advanced Organizers had a significantly higher mean retention score (28.39) compared to those taught using Conventional Instructional Method (20.80). This implies that Pictorial Advanced Organizers is not only effective for improving students' performance but also for promoting long-term retention of biological concepts. The higher mean retention score for Pictorial Advanced Organizers can be attributed to the fact that this method helps students to organize and structure their knowledge in a way that makes it easier to recall and apply. The findings of this study agree with findings from studies carried out by Chen (2017), Owolabi and Oyeni (2020), Hassan (2021) whom in their separate studies revealed that students taught using Pictorial Advance Organizers performed better than those tough using Conventional instructional method. The findings of the study suggest that Pictorial Advance Organizers (PAO) is effective not only for improving students' performance but also for promoting long-term retention of biological concepts. This is consistent with several other studies that have investigated the effectiveness of PAO in improving student learning outcomes. For instance, Korur et al., (2016) found that students who were taught using pictorial advance organizers showed significant improvement in their long-term retention of scientific concepts compared to students who were taught using traditional methods. Similarly, Akhtar (2018) found that the use of pictorial advance organizers had a positive impact on students' retention of biological concepts.

CONCLUSION

Based on the findings of the study, it can be concluded that Pictorial Advance Organizers is a more effective instructional method than Conventional instructional method for improving students' performance and retention in Biology

RECOMMENDATIONS

Based on the findings of the study, the following recommendations are made:

1. Teachers should adopt the use Pictorial Advanced Organizers as an instructional method for teaching Biology, as it has been shown to be more effective than the Conventional Instructional method.
2. Government, Educational administrators and authorities should intentionally provide Biology teachers with training and resources to effectively implement Pictorial Advance Organizers strategy during instructions.
3. Educators should consider the interaction between instructional methods and students' gender when designing instruction and assessing students' learning.
4. Educators should regularly monitor students' progress and adjust their instructional strategies to meet the unique needs of their students.

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