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COMPARATIVE IMPACT OF ADVANCE-ORGANIZER AND CONCEPT-MAPPING ON PERFORMANCE AMONG SECONDARY SCHOOL STUDENTS OF BIOLOGY IN TARABA, NIGERIA.

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ABSTRACT
This research investigated the impact of Advance Organizers (AO) and Concept Mapping (CM) on the academic performance of secondary school biology students in genetics in the Jalingo Education Zone, Taraba State, Nigeria. The research aimed to assess how these instructional strategies affect students' performance of genetics. The paper adopted a quasi-experimental design with intact classes, utilizing pre-test and post-test data to measure performance gains. The sample comprised 150 students drawn from a population of 800 students drawn from eight randomly selected schools, divided into two comparative experimental groups (AO) and (CM).Data analysis was conducted to answer the research question using descriptive statistics and testing hypothesis with ANCOVA. Results revealed that both AO and CM significantly enhanced students' academic performance, with Concept Mapping showing a stronger impact. The paper concludes that incorporating AO and CM into biology teaching can improve student engagement and learning outcomes, particularly in complex topics like genetics. Therefore AO and CM are recommended for teaching Biology at the secondary school level.

Keywords: Advance Organizers, Concept Mapping and Academic Performance, Genetics.

Introduction

Education at the secondary school level is supposed to be the bedrock and foundation toward higher education in tertiary institutions. It is an investment as well as an instrument that can be used to achieve more rapid economic, social, political, technological, scientific, and cultural development in the country. The National Policy on Education (2013) stipulated that secondary education is an instrument for national development that fosters the worth and development of the individual for further education and the development of the society at large. Education is the cornerstone of economic and social development in every nation.

Advance organizers are pedagogic devices that bridge the gap between what learners have already known and what learners need to know. They were first formally introduced by Ausubel in 1960 to test the hypothesis that learning unfamiliar verbal material can be facilitated by the advance introduction of relevant subsuming concepts. Ausubel (1968) defined advance organizers as "appropriately relevant and inclusive introductory materials introduced ahead of learning and presented at a higher level of abstraction, generality, and inclusiveness" (Ausubel, 1968). An advance organizer helps teachers' present information so that students will better understand and remember it. It can be defined as a tool used to introduce the lesson topic and illustrate the relationship between the concepts students are about to learn and the information they have already learned. Advance organizers are a type of teaching strategy that is utilized to better ensure information presented to students is understood, retained, and connected to previous lessons.

A concept map is a visual tool or diagram that illustrates the relationships between different concepts so you can better understand their connections. Concept maps show both teachers and students how to focus on a number of key ideas when working on learning assignments (Mesrabadi *et al*., 2015). Biology is the study of life whether it's a plant, animal, or microorganism. Biology explains the changes in the human body. Humans, scientifically known as Homo sapiens, have similar characteristics with apes but are more developed in terms of body shape and posture, speech, and reasoning. Being considered the highest form of animals, humans have bodies that are complicated

to comprehend. But by studying biology, everyone will know the reasons behind the sudden changes happening in their respective bodies. For instance, when kids unexpectedly grow taller and experience changes in their physical appearances and sleeping patterns, it means that their bodies have started releasing hormones in preparation for their puberty stage.
Students' performance in biology in the Senior Secondary Certificate Examination (SSCE) has been unsatisfactory over many years. Various reasons have been attached to this problem by scholars. Dinah (2013) concluded that the availability of textbooks, laboratory apparatus, and other learning resources contribute significantly to the performance of students in biology examinations. He added that students with a positive attitude towards the subject register better performance than those who have a negative attitude.

Concept of Advanced Organizers Teaching Strategy and students performance

An advanced organizer is information presented by and an instruction that helps the student organize new incoming information Mayer as quoted by Uzzaman, Choudhary and Qamar (2015). This achieved by directing attention to what is important in the coming material highlighting relationships and providing a reminder about relevant prior knowledge (Woolfolk, Winnie & Shapka, 2010).
Ausubel (1968) as cited in Kirkman & Shaw (2007) defined advanced organizers as appropriate, relevant and inclusive introductory materials introduced in advance of new learning and presented at a higher level of abstraction, generality and inclusiveness. The information presented at after it. The organizers serve to provide the ideation scaffolding for the stable incorporation and retention of the more detailed and differentiated materials that follow. An advance organizer can be information that is presented prior to the learning that can be used by the learner to organize and interpret new incoming material.
There are several benefits of advance organizer to students across the curriculum (Dell'Olio, 2012). That the flexibility of advance organizer make 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 achievement (Konecki & Sciller) as quoted by (Uzzaman *et al*., 2015).

Advance Organizer Teaching Strategy and Students' Performance

The use of advance organizer teaching strategy has been argued by researchers to link previous knowledge with the new learning. Some researchers believed that the gap between prior knowledge and new learning can be closed and students are able to understand better and retain more when advance organizer are used. The use of advance organizer is not a teaching method on its own but a teaching strategy needed to help clarify the science concepts the students are trying to attain. Studies have revealed that advance organizer favours higher performance and retention abilities and facilitate acquisition of more scientific concepts. Advance organizer teaching strategy is a tool or mental learning aid that helps students integrate new information with their existing knowledge. They are devices that activate relevant schemes or conceptual learning patterns to enable new information more readily subsumed into the learners existing cognitive structures. Mayer opined that giving students a diagram before listening to a passage leads to better retention of materials: recall was enhanced for conceptual information in the lesson. Advance organizer is used to provide support for new information. Teachers are to start with a ''Big picture'' of the incoming content. Ausubel, quoted by Samuel *et al*. (2013). Advance organizer teaching strategy takes different forms such as cards, maps, descriptions with pictures. Frowcharts, story maps, venn-diagrams and questions, orals and visuals (Owoeye, 2017). In the work of Wachanga, Armba and Mbuga as quoted by Ranaweera (2018). It was found out that the use of advance organizer teaching strategy enhances chemistry learning in mole concept topic.
Graphic organizers leads to an improvement in students' attitude towards leaning (Made, 2010). This submission could also be applicable in student' performance and retention ability.

Similarly, a study by Korur, Toker and Eryilmaz (2016) on the effects of integrated online advance organizer teaching strategy in students' science achievement and attitude established that the use of advance organizer improved students' attitude the results of this Study are in agreement with that of Akinbola (2015) who established that the use of advance Organizers teaching strategy leads to positive attitude towards physics learning as well as Improve performance and retention. Advance organizer teaching strategy improves students' Motivation towards learning biology (Keraro & Shihusa 2009) which in turn leads to a positive attitude towards learning. According to Akibobola (2008) advance organizer improved Students' attitude towards learning biology. UNESCO (2017) argues that effective teaching Methods improves students' self-confidence and interest in biology. This implies that a positive attitude towards learning biology is developed when learners are helped to connect prior knowledge with new knowledge. Students' attitude and interests towards science play a very big role in their learning of scientific concepts.

Concept Mapping Teaching Strategy and Students' Performance

Student retention is important because it gives you a measurable metric to refer to so that you can better understand why students leave before graduating or without finishing their programs. Low retention rates indicate students are struggling. A student can be retained for various reasons. Generally, poor grades, attendance, and a negative change in attitude towards schooling can help educators identify students who may need assistance. Student retention is a combination of retention strategies, personal issues, and circumstantial factors. It is not always in the schools' power to control retention rates.

Statement of the Problem

The role of secondary education is to lay the foundation for further education, and if a good foundation is laid, there are likely to be no or fewer problems at subsequent levels. Hence, the declining performance of secondary school students has been attributed to many issues such as poor interest, parental factors, low academic achievement, environment, and the like (Aremu & Sokan, 2013).

The declining rate of performance of secondary school students in Biology in Nigeria, particularly in Taraba State, is a problem of serious concern among science educators and examination bodies such as the West African Examination Council (WAEC) and National Examination Council (NECO). As the enrolment of biology students increases over the years, the level of passes is not encouraging. This consistent poor performance of students in the NECO/S.S.C.E. Biology examination also indicates that many students cannot gain admission into Biology-related courses in higher institutions. Science educators have identified factors such as inadequate instructional materials, teachers' poor improvisation skills, and lack of specialty and competency, among others, as some of the causative factors of low performance in Biology.

They have also proffered recommendations such as the use of inquiry-based, cooperative, and jigsaw instructional strategies, use of advance organizers, and concept mapping, among others, as the way forward. However, despite these efforts, students' performance and retention in biology have not shown appreciable improvement (Okoro, 2012). Therefore, it is based on this background that the researcher saw the need to investigate the comparative impact between advance organizers and concept mapping on the academic performance of secondary school students in Biology in Jalingo Education Zone, Taraba Niigeria.

Aim and Objective

The main purpose of this research is to investigate the comparative impact of advance organizers and concept mapping on the academic performance of secondary school Biology students in Jalingo Education Zone, Taraba, Nigeria. Specifically, the paper sought to:

i. Identify advance organizers and concept mapping and their impact on the academic performance of secondary school students in genetics.

Research Questions

The paper will be guided by the following research questions:

i. What is the impact of advance organizers and concept mapping on secondary school students' academic performance?

Statement of Hypothesis

The following null hypothesis is formulated for the study. The null hypothesis was tested at the 0.05 level of significance:

H_{01}: There is no significant difference between the impact of advance organizers and concept mapping on the academic performance of secondary school students in biology.

Theoretical Framework

The study hinged on Meaningful learning theory by David Paul Ausubel (1968). Ausubel's cognitive theory centers on the process of meaningful learning occurs when the new knowledge is consciously linked to existing concepts that is, sub-sumers or what the leaner already knows (Ausubel, 1968). Meaningful learning is, achieving deep understanding of complex ideas that are relevant to students' life. In other works, when what is learned can be related clearly to what is already know, this will optimize meaningful, learning. Ausubel concluded that where the sub-sumer' does not exist, he recommended the use of what he calls ''advance organizers" organizer is in the form of introductory materials presented in advance of the learning itself, to link already known materials to the new material to be learnt.

Ausubel asserts that ''the most important single factor influencing learning is what the learner has already known" (Ausubel, 1978). He advocates good quality expository teaching which involves: presenting what is to be learn to learner in more or less final form According to him, the information should be organized and stated in such a way that is can be Easily related to student's existing knowledge scheme. Ausubel also stated that any individual's Perception of stimuli will be a function of background experiences. This similar to Piaget's Observation that every child's cognitive structure is unique. This emphasizes that teachers need to take into account a particular learner's thinking process at a particular time and situation.

Ausubel sees value in learning through discovery just as Brunner believes that, there is a legitimate place for good-quality learning. Rote learning on the other hang is the type of Learning that occurs in the absence of Subsumer which is not rooted deeply in the students' memory lane, rote learning makes forgetting early thereby making retention to be difficult.

The implication of Ausubel theory for biology teaching is that, biology teachers world be able to relate the new material to that the learner knows. Biology teachers' would be able to Effectively teach topics like genetics by using advance organizers as materials to create Meaningful learning which will serve as Subsumer for the students and employing the practice During subsequent teaching process. Students will use that is previously learnt and prepare in advance of what topic or concepts that will be treated next, thus furnishing them with the Relevant references bearing in mind however its relevance to what the students already know.

Research Design

The research design that was used in this study is the quasi-experimental, non-equivalent pre-test and post-test group design. In this design, intact classes were used because the design is dependent upon the natural setting in which the researcher found in the schools.

The pre-test was used for determining equivalent groups among the sample before the research work. The post-test was used to determine the performance gain after 4 weeks of treatment. Quasi-experimental is used because it allows the manipulation of experimental variables or factors in order to investigate any the impact treatment on the experimental groups. That is, to discover the effect

the independent variable have on the dependent variable. (Bamidele, 2004). The students in their intact classes were assigned into the experimental groups.
Graphics Representation of Research Design:
EG1 ⟶ O1 ⟶ (AO) ⟶O2
EG2 ⟶ O1 ⟶ (CM) ⟶O2

Where:
EG1: Experimental Group 1
EG2: Experimental Group 2
O1: pre-test to determine group equivalence before treatment
O2: post-test to determine performance after treatment
AO: Advance - organizer
CM: Concept mapping

Population
The targeted population of this study consisted of eight hundred (800) SS2 Biology students from the eight (08) public senior secondary schools offering Biology in Jalingo Education Zone of Taraba State for the 2024/2025 academic session (Taraba State Teaching Service Board (TSB), 2022).

Sample and Sampling
The sample size for the research consisted of a total of one hundred and fifty (150) students, randomly drawn from eight (8) schools which constituted the sample of this research. The multi-stage random sampling technique was used to constitute the sample for the research. In the first instance, one education zone was selected from the education zones in Taraba State through simple random sampling which is in Jalingo Educational Zone.
Secondly, one Local Government Area (LGA) was selected out of the two LGAs within the selected Jalingo Education Zone through simple random sampling which is Jalingo LGA. From the selected LGA, two schools were purposively selected. Two government schools with two SS2 Biology classes were used for the study. The choice of a school with at least two streams of SS2 classes enables the researcher to pick two classes at random for treatment.

Instrumentation
The instrument that was used for this research was the Genetics Performance Test (GPT). The instrument contains 40 multiple-choice objective questions. The questions were adapted from past West African Senior School Certificate Examinations (WASSCE), National Examinations Council (NECO), and Unified Tertiary Matriculation Examinations (UTME) which are known to have high validity and reliability. Each question has four (4) options (A to D) where one option is the correct answer in each case.
The Genetics Performance Test (GPT) was used for pre-test and post-test. The two schools sampled were assigned to the Experimental Group One (EG1) - Advance Organizer, and Experimental Group Two (EG2) - Concept Mapping, respectively.

Validity of the Instrument
The GPT was subjected to face and content validation to ensure that the instrument measures what it intends to measure. Three experts (two from the Science Education Department and one from Test and Measurement, Department of Educational Foundations) from the Faculty of Education, Taraba State University, Jalingo, validated the instrument. Based on the comments and suggestions of the experts, corrections and modifications were made to the instrument (GPT).

Reliability of Instrument

A pilot test of the instrument was conducted at Government Day Secondary School Garin Atiku, opposite Referral Hospital Mutun Biyu, Gassol Local Government, Taraba State, Nigeria, as these schools were not part of the actual research. The aim was to estimate the reliability and workability of the research instrument. The researcher trained one research assistant to enable him to acquire the necessary skills for the pilot testing. The research assistant was trained on lesson planning and method of administering the instruments.

The instrument contains 40 multiple-choice questions. An intact class of forty (40) SS2 students was used for this purpose. Biology students who were used for the pilot testing of the instrument were given one hour (60 minutes) to answer all the items. Data obtained from the Genetics Performance Test (GPT) were used to test the reliability of the instrument using the split-half method of testing reliability at the 0.05 significance level. The result of the reliability analysis indicates that the Spearman-Brown Coefficient to test the internal consistency was 0.84. Hence, the instrument is considered reliable for data collection for this research work.

Method of Data Analysis

The research question was answered using descriptive statistics of Mean and Standard Deviation. The hypothesis was tested at the 0.05 level of significance using the ANCOVA (Analysis of Covariance). The choice of the statistical tool addresses the initial difference that might occur due to pretest. The pre-test and post-post-test scores of the Experimental Groups were subjected to Analysis of Covariance (ANCOVA).

DATA PRESENTATION AND ANALYSIS

This segment provides a detailed presentation of the data, including the pretest and posttest statistics for both instructional strategies (Advance Organizers and Concept Mapping), as well as the results of hypothesis testing and the estimated marginal means.

Table 1: Group Statistics for Pretest Scores AO & CM

Grouping	N	Mean	Std. Deviation	Std. Error Mean
Experimental Group 1 (AO)	50	14.7400	2.06832	0.29251
Experimental Group 2 (CM)	50	14.9000	1.59399	0.22542

Table 1 shows pretest scores for both the experimental groups are similar, with the experimental group 1 having a mean of 14.74 and the experimental group 2 slightly higher at 14.90. The standard deviation for the experimental group 1 (2.06832) is higher than the experimental group 2 (1.59399), indicating more variability in the experimental groups pretest scores. Both groups have similar sample sizes (50 each), and the standard error is also greater for the experimental groups.

Table 2: Independent Samples Test for Pretest Scores (Advance Organizer)

Levene's Test for Equality of Variances	F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference
Equal variances assumed	2.575	0.112	-0.433	98	0.666	-0.16000	0.36929	-0.89285 to 0.57285
Equal variances not assumed			-0.433	92.027	0.666	-0.16000	0.36929	-0.89344 to 0.57344

Table 2 presents the results of an independent samples t-test that compares the pretest scores between the Experimental Groups. The Levene's Test for Equality of Variances shows a p-value of 0.112, which is greater than the commonly used significance level of 0.05. This suggests that the assumption of equal variances between the two groups is not violated, and we can proceed with

the t-test results under the assumption of equal variances. The t-value of -0.433 with a p-value of 0.666 indicates that there is no significant difference between the pretest scores of the two groups. The mean difference of -0.16 is negligible, with a 95% confidence interval for the difference ranging from -0.89285 to 0.57285, further suggesting that the observed difference is not statistically significant. Therefore, it can be concluded that the two groups had equivalent pretest scores, and any observed differences in posttest performance would be due to the experimental treatment rather than pre-existing group differences.

Table 3: Estimated Marginal Means for Posttest Scores (Advance Organizer)

Grand Mean	Std. Error	95% Confidence Interval
54.711	0.667	53.387 to 56.034

Table 3 above shows that the grand mean for the posttest scores is 54.711, with a standard error of 0.667. This score falls within the 95% confidence interval of 53.387 to 56.034, indicating that the true mean posttest score is likely to be between these values. This suggests a consistent effect or outcome across the population measured, and the relatively narrow confidence interval indicates a high level of precision in the estimate of the grand mean.

Table 4: Group Statistics for Pretest Scores CM & AO

Grouping	N	Mean	Std. Deviation	Std. Error Mean
Experimental Group Concept Mapping	50	14.46	1.568	0.222
Experimental Group Advance Organizer	50	14.90	1.594	0.225

The pre-test scores for the experimental group 1 using concept mapping have a mean of 14.46, while the experimental group 2 has a mean of 14.90. Both groups show similar variability, with standard deviations of 1.568 and 1.594 respectively. The standard errors of the means are also close, at 0.222 for the experimental group 1 and 0.225 for the experimental group 2.

Table 5: Independent Samples Test for Pretest Scores (Concept Mapping)

Levene's Test for Equality of Variances	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference
Equal variances assumed	0.001	0.974	-1.392	98	0.167	-0.440	0.316	-1.067 to 0.187
Equal variances not assumed			-1.392	97.973	0.167	-0.440	0.316	-1.067 to 0.187

Table 5 presents the results of an independent samples t-test conducted on pretest scores for two groups. Levene's test for equality of variances shows a value of 0.001 with a significance of 0.974, which indicates that the assumption of equal variances between the groups holds. This means that the variability in scores is similar between the two groups. The t-test results further show that the t-value is -1.392 with 98 degrees of freedom and a p-value of 0.167. This p-value is greater than the common alpha level of 0.05, suggesting that there is no significant difference between the two groups on the pretest scores. The mean difference between the groups is -0.440, which is quite small, and the 95% confidence interval for the difference ranges from -1.067 to 0.187, further supporting the conclusion that the groups are not significantly different. Therefore, it can be concluded that, before any intervention, the experimental groups had similar baseline knowledge levels.

Table 6: Tests of Between-Subjects Effects for Posttest Scores (Concept Mapping)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	9831.118	4	2457.779	60.257	0.000
Intercept	2346.577	1	2346.577	57.531	0.000
Pretest	109.862	1	109.862	2.693	0.104
Gender	213.738	1	213.738	5.240	0.024
Group	9535.474	1	9535.474	233.780	0.000
Gender * Group	24.167	1	24.167	0.592	0.443
Error	3874.882	95	40.788		
Total	322842.000	100			
Corrected Total	13706.000	99			
R Squared				0.717	
Adjusted R Squared				0.705	

Table 6 presents the results of the analysis of variance (ANOVA) conducted to determine the effects of various factors on posttest scores. The corrected model explains a significant portion of the variability in posttest scores, with a large F-value of 60.257 and a p-value of 0.000, indicating that at least one of the factors pretest score or their interactions has a significant effect on the posttest scores. The intercept is highly significant (F = 57.531, p = 0.000), confirming that the model is well-fitted. The pretest score variable has a p-value of 0.104, which is above the 0.05 threshold, indicating that the pretest score does not significantly predict posttest scores, suggesting that any initial differences in scores were not a major factor in explaining posttest performance. The group variable (whether participants used concept mapping or not) has a highly significant effect (F = 233.780, p = 0.000), confirming that the concept mapping intervention had a substantial impact on performance. The model's R-squared value is 0.717, meaning that about 71.7% of the variability in posttest scores can be explained by the model, indicating a strong effect of the factors considered.

Conclusion

Based on the findings of this study, it can be concluded that the use of advance organizers and concept mapping significantly enhances the academic performance of secondary school biology students, particularly in the domain of genetics. These strategies provided a structured approach to learning, aiding students in better organizing and retaining complex biological concepts. The results suggest that both advance organizers and concept mapping are effective instructional tools that can be incorporated into biology teaching to improve student outcomes.

Given the positive outcomes of this paper, it is clear that biology teachers should be encouraged to adopt these methods (AO & CM) especially when teaching difficult topics such as genetics.

Recommendations

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

1. Teachers should incorporate advance organizers and concept mapping into their teaching methods to improve students' performance of complex topics in biology, particularly genetics.
2. Educational policymakers should support the integration of innovative instructional strategies like advance organizers and concept mapping in the teaching of science subjects, by providing teachers with adequate resources and professional development opportunities through seminars and workshops.

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