AFRICAN JOURNAL OF EDUCATIONAL ASSESSORS

ISSN e-2536-751x, ISSN p-2536-7501

Benchmark Journals

Instructional Scaffolding and Blended Learning Strategies on Science Students' Retention on Plastic Waste Management in Uyo, Akwa Ibom State

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Abstract
The study is an empirical examination of instructional scaffolding and blended learning strategies on science students' retention on plastic waste management in Uyo Local Government Area of Akwa Ibom State. Three research questions and three null hypotheses guided the study. The design of the study was quasi-experimental. The sample size of one hundred and fifty-three (153: 80 males and 73 females) science students from a population of 1,489 Senior Secondary School students offering science in all the 15 public secondary schools in Uyo Local Government Area were used. The sample was selected using purposive sampling technique. Three secondary schools were randomly selected as intact groups for the study. Retention Test of 50 multiple choice items on Plastic Waste Management was used for data collection. The reliability of Retention Test on Plastic Waste Management was determined using Kuder-Richardson 21 (KR-21) with a reliability index of .82. Mean and Standard Deviation was used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the null hypotheses at .05 level of significance. Results indicated significant differences in the mean retention scores of science students when taught plastic waste management using instructional scaffolding, blended learning and expository strategies. There are no significant differences in the mean retention scores of male and female science students taught plastic waste management using treatment strategies. It was also found that there are no significant interaction effects of teaching strategies and gender on science students' retention on plastic waste management. It is concluded that the three strategies investigated, instructional scaffolding, blended learning and expository strategies were effective in facilitating students' retention in the concept of plastic waste management in science. Based on the findings, it is recommended that science teachers should make effective use of instructional scaffolding, blended learning and expository strategies in teaching the concept of plastics waste management in science.

Keywords: Blended, Instructional, Management Retention Plastic

Introduction

Science is a dynamic subject which aims at equipping students with appropriate scientific attitudes, competences and abilities to apply scientific knowledge to challenges of life. Over decades, science has undergone rapid changes and has made significant impact on human lives, and this has led to production of antibiotics and vaccines, disease-resistance crops, organs-transplant and gene manipulation (Manyi-Loh *et al.*, 2018). The knowledge of science has helped

in finding solutions to vital concerns such as increasing world food supply, controlling pest and diseases, environmental protection and management as well as studying the science of microorganisms, such as viruses causing global pandemic like corona virus. The impact of science on living organisms is wide and this is to ensure the required standard of living for both plants and animals (Werner, 2020). Science play key roles in industrialization and development of many sectors of the economy, such as industrial, chemical production, biotechnology that uses microorganisms and enzymes to produce goods for industry, including plastics, food, agricultural and pharmaceutical products. Science equip students with useful concepts, principles, theories and safety that enable them face the challenges around them before and after graduation. It also equips students in the area of environmental science such as biodiversity, conservation, climate change, renewable energy, natural resource management, air pollution and plastic waste management (Udo, 2024).

Plastic waste otherwise known as plastic pollution is the accumulation of plastic objects on the earth surface that, adversely, affects plants, wildlife habitat and humans. It is the significant amount of plastic not recycled that ends up in landfills. Plastic waste constitutes two major categories of useful plastics, namely: Thermoplastics and thermoset plastics (Kibria *et al*., 2023). There are several types of thermoplastics, namely: Polyethylene terephthalate (PET), low density polyethylene (LDPE), high density polyethylene (HDPE), poly vinyl chloride (PVC), polypropylene (PP), polystyrene (PS) and Mix plastics. Polyethylene terephthalate wastes are form of thermoplastics wastes recycled into various products such as plastic lumber, containers, polyester fibers for clothing, carpeting or even new plastic bottles. It can also be repurposed into durable materials like outdoor furniture, playground equipment and construction materials. However, it can have environmental and health effects when disposed improperly. It can contribute to pollution and negatively affect the ecosystems. To minimize this environmental challenge, effective plastic wastes management should be taught to students to inculcate a sense of responsibility, environmental stewardship and sustainable practices.

Plastic waste management is the systematic handling, disposal and recycling of plastic waste materials to minimise negative environmental impact. It involves the strategies and practices aimed at reducing plastic wastes generation, promoting recycling and reuse, and ensuring proper disposal of plastic wastes to mitigate pollution and preserve natural resources (Amit, 2023). It encompasses various aspects, including collection, sorting, processing and treatment of plastic wastes. Saimin *et al.* (2022) stated that plastic wastes management is the process of managing the plastic waste generated and processing it to make it reusable. It is the proper management of plastic waste in a way that is environmentally friendly and help in the proper utilization of plastic materials. Improper disposal of plastic waste poses significant threats to the environment and plastic materials can take hundreds of years to decompose, leading to pollution of land, water bodies and ecosystems. To enable students' understanding of plastic waste management, appropriate use of instructional teaching strategies are employed to improve students' retention.

Retention is the ability to possess, use, keep information and reproduce past experiences. It is the act of retaining and the ability to recall and recognize what has been learnt or experienced over a long period of time. Retention is a person's ability to transfer new information into long-term memory to make it is easy for recall and put that knowledge to use in the future. It is making new knowledge stick for a long time and it is a process or ability to retain and remember things and experiences learned by an individual at a later time. Ugwu *et al*. (2020) indicated that appropriate coding of incoming information provides the index that may be consulted so that retention takes place without an elaborate search in the memory lane. Instructional strategies contribute to quality and level of retention in terms of meaningful, concreteness and image evolving characteristic (Valderama & Oligo, 2021). A students' retention rate in science depends on the ability to organize information in a manner that would ensure easy recall. However, effective teaching strategy such as instructional scaffolding may directly influence students' retention by promoting deeper learning, engagement and understanding.

Instructional scaffolding is the support given during the learning process tailored to the needs of students with the intention of helping the students achieve their learning goals. It is the role of teachers to support the learners' development and provide support structures to get to the next stage or level. Instructional scaffolding is a temporary support structure put in place to assist students in accomplishing new tasks and concepts they could not typically achieve on their own (Chris, 2023). As a learner gains control of these new learning, the teacher withdraws the support gradually as the learner becomes increasingly able to complete the task alone. The teacher then plans and provide further support on new learning. In using scaffolding, the teacher's job is to help bridge the gap between what a student already knows and what the students will learn next. It ensures that students are supported and not left on their own to gain understanding. The support is removed when the student is ready. Hance (2021) posited that the combination of one or more of the innovative modes of instruction with the expository method for science lessons can improve communication by presenting information in engaging ways. Amobi and Uche (2022) and Gongden (2022) stated that both instructional scaffolding and blended learning strategies significantly enhance students' retention in science when compared with expository strategy. Hence, instructional scaffolding strategy could be combined with blended learning strategy to enhance students' retention in science.

Blended learning is a form of learning that combines the best of direct classroom learning and learning through the internet by using interactive content, assessments and real-time collaboration. It is a program that uses more than one method to communicate information in order to activate learning outcomes by the interaction between both student and teacher (Dickfos *et al*., 2019). Blended learning is a teaching strategy that integrated e-learning into traditional classroom learning, using computer, intranet or smart phone classroom, where the teacher meets the student face-to-face and interaction between students and teachers is built into the course design (Kavitha & Jaisingh, 2018). It is the use of online sites and apps to deliver a portion of the

curriculum while the teacher facilitates instruction (Gurley, 2018). Blended learning is the transfer of right skills to the right person at the right time by matching the right learning technologies with the right learning style for the purpose of achieving the learning objectives (Shamsuddin & Kaur, 2020). Owston and York (2018) opined that blended learning is realized in teaching and learning environments where there is an effective integration of different mode of delivery, models of teaching and styles of learning which are adopted as a strategy and systematic approach to the technology combined with face-to-face interaction. Udoh and Udo (2020) added that in a blended learning environment, expository teaching strategy can be utilized during face-to-face sessions for direct instruction, while online components provide opportunities for interactive activities and discussions.

Expository strategy is a didactic teaching approach in which the teacher presents information to students while the students merely listen. It is a teacher-centered and a pressure learning approach that the teacher uses to deliver a preplanned lesson to the students with or without the use of instructional materials. Expository strategy is sometimes, called deductive teaching, because the teacher often begins with definition of the concepts or principles, illustrates them and unfolds their implications. However, Eze and Osuyi (2018) opined that expository teaching method is the most commonly used method for teaching science, because it helps the teacher to take a large number of students at a time and cover a lot of grounds, but may not promote excellence and hard work. It is a way of transferring learning materials through oral explanation that is accompanied by other learning methods even though only complementary in nature (Auwal, 2018). In this strategy, learning materials are given directly by teachers while students are not obliged to find the materials themselves. Learning materials are in a certain way fixed, because expository strategy only emphasizes on oral lecturing regardless of their gender.

Gender is the socially constructed roles, behaviours and expectations associated with being male or female and how these factors influence learning experiences, participation and outcomes. It is a wide range of biological, behavioural, physical and mental characteristics regarding to and differentiating the female and male population (Okeke, 2020). Hence, gender is an aspect concerning the responsibilities, roles, opportunities, constraints and needs of males and females in all aspects of social context (Omotosho, 2019). It is the different socio-cultural stereotyped roles and responsibilities expected of boys and girls. Ullah and Ullah (2019) opined that there is an acknowledged problem of female under retained when compared with male counterparts, apparently, under equivalent conditions; this problem of female under retained appeared to be more pronounced in science and mathematics. Lane *et al.* (2022) stated that it is crucial to recognize that individuals vary widely and any challenges in mathematics and science subjects are not inherently tied to gender but rather influenced by a range of factors, including personal interest, teaching methods and societal expectations. Some research works have shown contradicting evidence in students' retention in sciences due to gender. For instance, Nwankwo and Achufusi (2019) asserted that gender had no significant influence on students' retention in science students

while Egara and Mosimege (2023) observed that gender had significant influence on students' retention in sciences. Whereas, Pius *et al.* (2023) reported that there are no significant interaction effects of gender on students' retention. However, Okeke (2018) observed that there are significant interaction effects of gender on students' retention.

Statement of the Problem

Plastic waste has become an environmental menace. Students drink and litter plastic waste in their school environment and do not know that these plastic waste materials block drains, sewage pipes and open surfaces become an eyesore, causing untold hazards to living things. Researchers in science education have continually sought for better teaching strategies that would provide a bridge between concepts that seem difficult, abstract and unfamiliar. The concept of plastic waste management is not an exception. Nigeria as a developing nation make use of non-biodegradable solid wastes such as plastics and nylon. Plastic wastes are littered everywhere after use. The lack of waste management culture by students could be traced to the teaching strategies used in delivering the lessons which may affect students' retention when this concept is examined. It is on this basis the study examined instructional scaffolding, blended learning and expository strategies on science students' retention on plastic waste management in Uyo, Akwa Ibom State.

Purpose of the Study

The study examined instructional scaffolding, blended learning and expository strategies on science students' retention on plastic waste management in Uyo Local Government Area, Akwa Ibom State. The specific objectives of the study were to:

i. examine the differences among the mean retention scores of science students taught plastic waste management using instructional scaffolding, blended learning and expository Strategies.
ii. ascertain the differences among the mean retention scores of male and female science students taught plastic waste management using instructional scaffolding, blended learning and expository strategies.
iii. assess the interaction effects of teaching strategies (instructional scaffolding, blended learning and expository) and gender on science students' retention scores on plastic waste management.

Research Questions

i. What differences exist among the mean retention scores of science students taught plastic waste management using instructional scaffolding, blended learning and expository strategies?
ii. What differences exist among the mean retention scores of male and female Science students taught plastic waste management using instructional scaffolding, blended learning and expository strategies?

iii. What are the interaction effects of teaching strategies (instructional scaffolding, blended learning and expository) and gender on science students' retention scores on plastic waste management?

Null Hypotheses

The following null hypotheses were raised and tested at 0.05 level of significance

i. There are no significant differences among the mean retention scores of science students taught plastic waste management using instructional scaffolding, blended learning and expository strategies.

ii. There are no significant differences among the mean retention scores of male and female science students taught plastic waste management using instructional scaffolding, blended learning and expository strategies.

iii. There are no significant interaction effects of teaching strategies (instructional scaffolding, blended learning and expository) and gender on science students' retention scores on plastic waste management.

Methodology

The design of the study is quasi-experimental with non-randomised pretest, posttest control group. Intact classes were used to avoid disruption of normal class lessons.

The study was conducted in three co-educational public secondary schools in Uyo Local Government Area in Akwa Ibom State, Nigeria. The population consisted all the 1,489 Senior Secondary One student offering science in all the 15 public secondary schools in Uyo Local Government Area of Akwa Ibom State.

The sample size was one hundred and fifty-three (153: 80 males and 73 females) Senior Secondary One students in three secondary schools. Purposive sampling technique was used to select three schools from the 15 public secondary schools. The selected schools met the criteria; having qualified science teachers and availability of dumpsites filled with plastic waste materials. These selected schools were assigned as experimental group one and was treated with instructional scaffolding strategy and experimental group two treated with blended learning strategy and control group with expository strategy. Three intact classes of experimental group one, experimental group two and a control group.

The instrument for this study was Retention Test on Plastic Waste Management. It consisted fifty (50) multiple choice items with four (4) options A - D with only one correct answer and three distracters from the concept of plastic waste management. Each correct answer on the Retention Test on Plastic Waste Management was scored one (1) mark. The total mark earned was 50 marks.

The instrument was validated by three experts. The experts were one lecturer in Animal and Environmental Studies Department, an expert in Science Education and one expert in Psychological Foundations of Education all in the University of Uyo. To ensure content validity,

test blue-print was used as a guide in the development of the items. Reliability of the instrument was conducted using a sample of thirty (30) Senior Secondary One science students selected from the target population who did not participate in the main study. Kuder-Richardson 21 (KR-21) was used in determining the reliability of the Retention Test on Plastic Waste Management with a reliability index of .82.

Experimental Procedure

Each of the classes was assigned to experimental group one, two and control group respectively. Research assistants were subjected to one-week training using prepared lesson packages. Experimental group one and group two were taught plastic waste management using Instructional scaffolding and blended learning strategies. Students were arranged in small groups of 5-10 members. Plastic waste management content were taught: types of plastic waste, sources of plastic waste, uses of plastic wastes, sorting plastic waste based on colour and size, environmental impact of plastic waste, plastic waste management by incineration, landfill and recycling. Students watched videos, pictures and charts and were allowed to practice and reflect on what they have learned on plastic waste management. After the teachings in each of the week, the research assistant urged the students to take a short, open-book quiz in order to ascertain the students' level of comprehension on the concept. Based on their responses, the research assistant showed the students more examples of plastic waste management and answer students' questions. The students then retook the quiz without notes. The research assistant then gradually removed the scaffold as the students' masters the concept of plastic waste management. Treatment lasted for four weeks. Students in the control group were taught the same lesson contents on plastic waste management.

To avoid possible interaction between experimental groups and the control group, different schools were used for the study. At the end of the treatment session, three weeks after Retention Test on Plastic Waste Management was administered to the groups under the supervision of research assistants. This helps to assess the retention rate of the three teaching strategies investigated.

The data obtained from the retention test were anlysed using Mean, Standard Deviation and Analysis of Covariance (ANCOVA). Mean and Standard Deviation was used to answer the research questions while ANCOVA was used to test the null hypotheses at .05 level of significance.

Results and Discussions

Research Question 1: What are the differences among the mean retention scores of science students taught plastic waste management using instructional scaffolding, blended learning and expository strategies?

AFRICAN JOURNAL OF EDUCATIONAL ASSESSORS
ISSN e-2536-751x, ISSN p-2536-7501
Benchmark Journals

Table 1: Mean and Standard Deviation showing the retention scores of science students taught plastic waste management using instructional scaffolding, blended learning and expository strategies

		Post test		Retention Score				
Strategies	N	$\bar{X}$	SD	$\bar{X}$	SD	Mean Diff	% loss	% retained
Scaffolding	51	45.82	2.72	43.26	3.41	2.56	5.59	94.41
Blended learning	53	42.02	2.89	38.53	3.83	3.39	8.31	91.69
Expository strategy	49	34.18	3.24	29.58	5.15	4.60	13.46	86.54

Data in Table 1 shows the mean retention scores of science students taught plastic waste management using instructional scaffolding, blended learning and expository strategies. Science students taught plastic waste management using instructional scaffolding strategy scored significantly higher (94.41%) than those taught with blended learning (91.69%) and expository strategies (86.54%). From the results, blended learning reported a higher percentage retention (91.69%) compared with expository strategy (86.54%). Therefore, there are differences among the mean retention scores of science students taught plastic waste management using instructional scaffolding, blended learning and expository strategies in favour of instructional scaffolding and blended learning strategies.

Research Question 2: What are the differences among the mean retention scores of male and female science students taught plastic waste management using instructional scaffolding, blended learning and expository strategies?

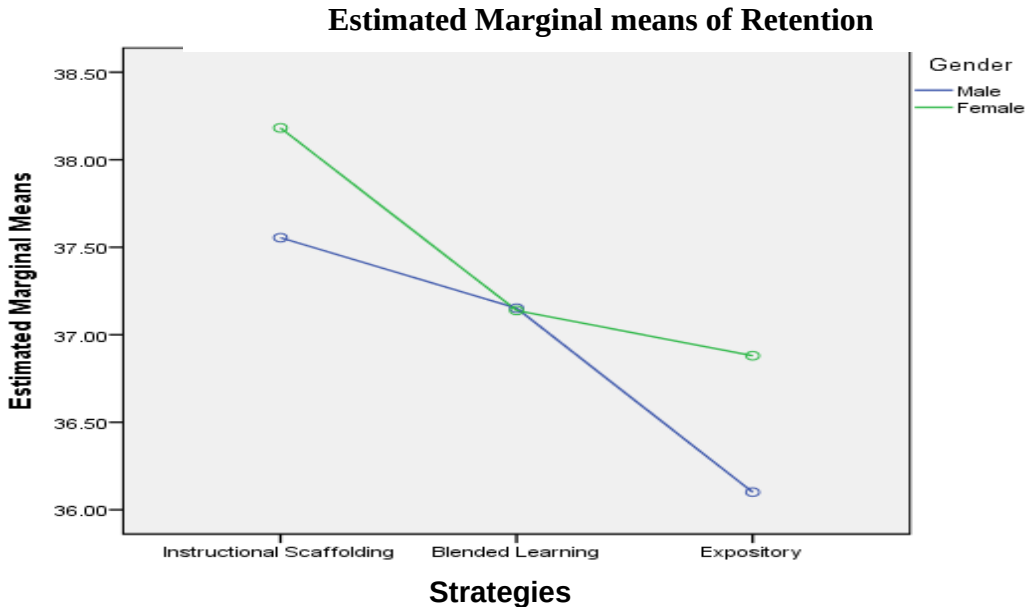
Table 2: Mean and Standard Deviation scores showing the retention scores of male and female science students taught plastic waste management using instructional scaffolding, blended learning and expository strategies

			Post test score		Retention score				
Strategies	Gender	N	$\bar{X}$	SD	$\bar{X}$	SD	Mean Diff	% loss	% retained
Scaffolding	Male	24	45.52	2.57	42.61	2.59	2.91	6.39	93.61
	Female	27	46.07	2.85	43.81	3.94	2.26	4.91	95.09
Blended learning	Male	27	42.07	3.02	38.59	4.06	3.48	8.27	91.73
	Female	26	41.96	2.81	38.46	3.64	3.50	8.34	90.66
Expository strategy	Male	29	34.85	3.91	30.75	4.56	4.10	11.76	88.24
	Female	20	33.73	2.70	28.80	5.44	4.93	14.62	85.38

Data in Table 2 shows the differences among the mean retention scores of male and female science students taught plastic waste management using instructional scaffolding, blended learning

and expository strategies. The results show that there are mean loss in retention scores of male and female science students taught plastic waste management using instructional scaffolding, blended learning and expository strategies as the differences shows as follows 6.39, 4.91; 8.27, 8.34 and 11.76, 14.62; whereas the mean retention scores of male and female taught with the three teaching strategies reported gain retention as follows 93.61, 95.09; 91.73, 90.66 and 88.24, 85.38 respectively. The findings show that the percentage retention scores by female students taught using instructional scaffolding were higher than their male counterparts taught using instructional scaffolding and blended learning strategies, but lower using expository strategy.

Research Question 3: What are the interaction effects of teaching strategies (instructional scaffolding, blended learning and expository) and gender on science students' retention on plastic waste management?



Covariates appearing in the model are evaluated at the following values: Post-Test =

Figure 1: Plot for the interaction effects of interaction effects of teaching strategies and gender on science students' retention on plastic waste management.

Figure 1 is the plot for the interaction effects of teaching strategies and gender on science students' retention on plastic waste management. The plot shows that female science students taught using instructional scaffolding strategy gained a higher retention mean scores of 43.81 than their female counterparts taught using blended learning strategy (38.46) and expository strategy (30.75). Result also shows that male science students taught using instructional scaffolding strategy had retention scores of 42.61 than their counterparts taught using blended learning (38.59) and expository strategy (28.80). This indicates that both male and female science students taught

plastic waste management using blended learning strategy performed better than those taught using expository strategy. This implies no interaction effects of teaching strategies (instructional scaffolding, blended learning and expository) and gender on science students' retention on plastic waste management.

Testing of Hypotheses

Null Hypothesis 1: There are no significant differences among the mean retention scores of science students taught plastic waste management using instructional scaffolding, blended learning and expository strategies.

Table 3: Summary of ANCOVA testing differences among the mean retention scores of science students taught plastic waste management using instructional scaffolding, blended learning and expository strategies

Source	Type III Sum of Squares	Df	Mean Square	F-value	P-value	Decision at p<0.05
Corrected Model	6306.591	3	2102.197	270.735	0.000	*Sig
Intercept	28.067	1	28.067	3.615	0.059	
Retention test	1474.056	1	1474.056	189.839	0.000	
Strategies	14.068	2	7.034	2.906	0.044	
Error	1156.952	149	7.765			
Total	218626.000	153				
Corrected Total	7463.542	152				

***Sig = Significant at p<0.05**

Data in Table 3 shows the summary of Analysis of Covariance (ANCOVA) differences among the mean retention scores of science students taught using instructional scaffolding, blended learning and expository strategies respectively. The calculated F-value for the main effect of instructional strategies at 2, 152 is 2.90, while its corresponding calculated level of significance is .04 alpha. This level of significance is less than .05 in which the decision is based. The null hypothesis is rejected, hence there is a significant difference among the mean retention scores of science students taught plastic waste management using instructional scaffolding, blended learning and expository strategies.

Null Hypothesis 2: There are no significant differences among the mean retention scores of male and female science students taught plastic waste management using instructional scaffolding, blended learning and expository strategies.

AFRICAN JOURNAL OF EDUCATIONAL ASSESSORS
ISSN e-2536-751x, ISSN p-2536-7501
Benchmark Journals

Table 4: Summary of ANCOVA testing the differences among the mean retention scores of male and female science students taught plastic waste management using instructional scaffolding, blended learning and expository strategies

Source	Type III Sum of Squares	Df	Mean Square	F-value	P-value	Decision at p<0.05
Corrected Model	6299.843	2	3149.922	406.023	0.000	*Not Sig
Intercept	227.797	1	227.797	29.363	0.000	
Retention test	6105.960	1	6105.960	787.054	0.000	
Strategies	824.646	2	412.323	1.768	0.112	
Gender	7.321	1	7.321	0.944	0.333	
Error	1163.699	150	7.758			
Total	218626.000	153				
Corrected Total	7463.542	152				

***Not Sig = Not Significant at p>0.05**

Data in Table 4 shows the summary of Analysis of Covariance (ANCOVA) for differences among the mean retention scores of male and female science students taught plastic waste management using instructional scaffolding, blended learning and expository strategies. The calculated F-value for the main effect of instructional strategies at 1, 152 is 0.94, while its corresponding P-value level of significance is .33 alpha. This level of significance is greater than .05 in which the decision is based. The null hypothesis is retained, hence there are no significant mean retention scores of male and female science students taught plastic waste management using instructional scaffolding, blended learning and expository strategies.

Null Hypothesis 3: There are no significant interaction effects of teaching strategies (instructional scaffolding, blended learning and expository) and gender on science students' retention on plastic waste management.

AFRICAN JOURNAL OF EDUCATIONAL ASSESSORS
ISSN e-2536-751x, ISSN p-2536-7501
Benchmark Journals

Table 5: Summary of ANCOVA testing the interaction effects of teaching strategies (instructional scaffolding, blended learning and expository) and gender on science students' retention on plastic waste management

Source	Type III Sum of Squares	Df	Mean Square	F-value	P-value	Decision at p<0.05
Corrected Model	6318.609	6	1053.101	134.290	0.000	*Not Sig
Intercept	23.397	1	23.397	2.984	0.086	
Retention test	1422.149	1	1422.149	181.350	0.000	
Strategies	14.682	2	7.341	0.936	0.394	
Gender	8.054	1	8.054	1.027	0.313	
Strategies * Gender	4.505	2	2.253	0.287	0.751	
Error	1144.933	146	7.842			
Total	218626.000	153				
Corrected Total	7463.542	152				

***Not Sig = Significant at p>0.05**

Data in Table 5 shows the summary of Analysis of Covariance (ANCOVA) for the interaction effect of teaching strategies (instructional scaffolding, blended learning and expository) and gender on science students' retention on plastic waste management. The calculated F-value for the main effect of instructional strategies at 2, 152 is 0.28, while its corresponding calculated level of significance is .75 alpha. This level of significance is greater than .05 in which the decision is based. The null hypothesis is retained, hence there are no significant interaction effects of teaching strategies (instructional scaffolding, blended learning and expository) and gender on science students' retention on plastic waste management.

Discussion of Findings

Findings of the study shows that there are significant differences among the mean retention scores of science students taught plastic waste management using instructional scaffolding, blended learning and expository strategies. Science students taught plastic waste management using instructional scaffolding and blended learning strategies performed higher than expository strategy. The calculated F-value for the main effects of instructional strategies at 2, 152 is 2.90, while its corresponding calculated level of significance is .04 alpha. This level of significance is less than .05 in which the decision is based. The null hypothesis is rejected, hence there are significant mean retention scores of science students taught plastic waste management using instructional scaffolding, blended learning and expository strategies. The significant difference might be due to the fact that instructional scaffolding and blended learning strategies helped to bridge the gap between what students already know and what the students will learn next. The result is in line with the findings of Amobi and Uche (2022) and Gongden (2022) that carried out

investigation on the effects of instructional strategies on retention in science and found that both instructional scaffolding and blended learning strategies significantly enhance students' retention in science.

Findings of the study also shows that there are no significant differences among the mean retention scores of male and female science students taught plastic waste management using instructional scaffolding, blended learning and expository strategies. Instructional scaffolding, blended learning and expository strategies had mean loss in retention scores of male and female science students taught plastic waste management; whereas there were differences in the mean retention scores of male and female taught with the different teaching strategies reported gain. The results also indicated that the percentage retained scores by female students were higher than that of the male using instructional scaffolding and blended learning strategies but lower using expository strategy. Therefore, there are no significant differences among the mean retention scores of male and female Science students taught plastic waste management using instructional scaffolding, blended learning and expository strategies. This might be due to the fact that both male and female students have the capacity to retain any learned science concept in as much as they are taught using appropriate instructional strategies; instructional scaffolding, blended learning and expository strategies to demonstrate high retention level across gender lines. This study is in line with the findings of Nwankwo and Achufusi (2019) that gender had no significant influence on students' retention in science. However, this study is contrary to the study Egara and Mosimege (2023) that gender had significant influence on students' retention in sciences. Study findings on treatment, gender and retention showed no significant interaction effects of teaching strategies (instructional scaffolding, blended learning and expository). From the results, female science students taught using instructional scaffolding and blended learning strategies gained higher mean retention scores than their female counterparts taught using expository strategy. Result also shows that male science students taught using instructional scaffolding and blended learning strategies retained better than their male counterparts taught using expository strategy. This implies that there are no interaction effects of instructional strategies and gender on science students' retention on plastic waste management. Therefore, the null Hypothesis was retained. This implies that gender do not combine with the three teaching strategies to affect the students' retention in the concept of plastic waste management. The findings of the study are in line with that of Pius *et al.* (2023) that there are no significant interaction effects of gender on students' retention. However, this study is contrary to the findings of Okeke (2018) that there are significant interaction effects of gender on students' retention.

Conclusion

Based on the findings of the study, it is hereby concluded that the three instructional strategies investigated, instructional scaffolding, blended learning and expository strategies are effective in facilitating students' retention in the concept of plastic waste management in science. Also,

students' gender had no significant influence on students' retention. However, the interaction effects investigated shows no significant interaction.

Recommendations

i. Science teachers should make effective use of instructional scaffolding and blended learning strategies in teaching the concept of plastics waste management.
ii. Science teachers should be trained on how to utilize instructional scaffolding and blended learning strategies in delivery lessons.
iii. Curriculum planners should ensure the incorporation of instructional scaffolding and blended learning strategies in the teaching and learning of plastic waste management to concretize learning retention.

References

Amit, S. T. (2023). Plastic waste management: Current processes, initiatives and challenges. https://www.unep.org (Retrieved on 3rd June 2023).

Amobi, U. V. & Uche, E. D. (2022). Effects of instructional scaffolding on students' academic achievement in science in Ogidi Education Zone of Anambra State. *Irish Journal of Educational Practice*, 5(5), 1-10.

Auwal, A. (2018). Effects of teaching method on retention of biology knowledge in senior secondary schools of Bauchi Local Government Area, Nigeria. *International Journal of Science and Technology Educational Research*, 4(4), 63-69.

Chris, C. (2023). What is scaffolding in education? https://www.linkedin.com org (Retrieved on 19th January 2024).

Dickfos, J., Cameron, C. & Hodgson, C. (2019). Blended learning: Making an impact on assessment and self-reflection in accounting education. *International Journal of Emerging Technologies in Learning*, 14(17), 114-132.

Egara, F. O. & Mosimege, D. M. (2023). Gender difference in secondary school students' retention in Algebra: A computer simulation approach in Udenu Local Government Area in Enugu State. *Eurasia Journal of Mathematics, Science and Technology Education*, 19(7), 1-12.

Eze, T. I. & Osuyi, S. O. (2018). Effects of problem-based teaching method on student students' academic performance in electrical installation and maintenance works in technical colleges in Edo State. *International Journal of Development and Sustainability*, 7(2), 666-678.

Gongden, E. J. (2022). Improving chemistry students' achievement and retention in chemical kinetics using blended learning strategy in Jos, Plateau State, Nigeria. *International Journal of Education and Evaluation*, 8(6), 1-8.

Gurley, L. E. (2018). Educators' preparation to teach, perceived teaching presence and perceived teaching presence behaviors in blended and online learning environments. *Online Learning*, 22(2), 197-220.

Hance, M. (2021). How to utilize the combination learning model? https://www.graduateprogram.org (Retrieved on 6th June 2022).

Kavitha, R. & Jaisingh, W. (2018). A study on the student experiences in blended learning environments. *International Journal of Recent Technology in English,* 7(48), 277- 298.

Kibria, G., Masuk, I., Safayet, R., Nguyen, Q. & Mourshed, M. (2023). Plastic waste: Challenges and opportunities to mitigate pollution and effective management. *International Journal of Environmental Research*, 6(5), 1-20.

Lane, C., Kaya-Capocci, S., Kelly, R., O'Connell, T. & Goos, M. (2022). Fascinating or dull female students' attitudes towards mathematics and science subjects and careers. *Frontiers Psychology Journal*, 6(5), 231-242.

Manyi-Loh, C., Mamphweli, S., Meyer, E. & Okoh, A. (2018). Antibiotic use in biology and its consequential resistance in environmental sources: Potential public health implications. *National Center for Biotechnology Information*, 23(4), 686-795.

Nwankwo, M. C. & Achufusi, N. N. (2019). Gender difference in physics conceptual change and retention scores: A case study of Meta conceptual teaching approach in Abakiliki Education Zone of Ebonyi State, Nigeria. *Journal of International Academic Research for Multidisciplinary Impact Factor*, 7(7), 20-33.

Okeke, O. J. (2018). Interaction effects of gender and treatment on mean retention score of chemistry students taught using mend mapping teaching strategy in Enugu State, Nigeria. *International Journal of Research in Engineering and Applied Sciences*, 8(10), 1-18.

Okeke, O. J. (2018). Interaction effects of gender and treatment on mean retention score of chemistry students taught using mend mapping teaching strategy in Enugu State, Nigeria. *International Journal of Research in Engineering and Applied Sciences*, 8(10), 1-18.

Omotosho, B. J. (2019). African union and gender equality in the last three years: Some issues and prospects for consideration. *Journal of Integrated Social Sciences,* 5(1), 92-104.

Owston, R. S. & York, D. N. (2018). The nagging question when designing blended courses: Does the proportion of time devoted to online activities matter. *Internet and Higher Education Journal*, 2(3), 22-32.

Pius, P. O., Nnoli, J. N. & Onuigwe, B. U. (2023). Gender and retention of secondary school students taught radioactivity with computer animated instructional package in Ogidi Education Zone of Anambra State, Nigeria. *Unizik Journal of Educational Research and Policy Studies*, 16(5), 1-7.

Saimin, H. W., Waqas, A. A., Nikolai, I. V., Abdeliazim, M. M. & Ahmed, F. D. (2022). Plastic waste management strategies and their environmental aspects: A scientometric analysis

and comprehensive review. *International Journal of Environmental Research and Public Health*, 19(8), 45-56.

Shamsuddin, N. & Kaur, J. (2020). Students' learning style and its effect on blended learning. *International Journal of Evaluation and Research in Education*, 9(1), 195-202.

Udo, A. E. (2024). Instructional scaffolding strategy and Biology students' academic performance on plastic waste management in Uyo Local Government Area, Akwa Ibom State, Nigeria. *International Journal of Education and Science Development*, 5(6), 49-69.

Udoh, A. I. & Udo, M. E. (2020). Effects of blended learning and expository instructional strategies on senior secondary school students' performance based on the concept of atomic structure in Eket Local Government Area, Akwa Ibom State. *International Journal of Multidisciplinary and Current Educational Research*, 2(5), 361-371.

Ugwu, L., Tau, A. & Gwamna, S. (2020). Impacts of discussion method on performance and retention in biology among senior secondary students in Katsina State, Nigeria. *International Journal of Multidisciplinary and Current Education Research*, 2(6), 76-83.

Ullah, R. & Ullah, H. (2019). Boys versus girls' educational performance: Empirical evidences from global North and global South. *Africa Education Research Journal*, 7(4), 163-167.

Valderama, J. & Oligo, J. (2021). Learning retention in mathematics over consecutive weeks: Impact of motivated forgetting. *International Journal of Evaluation and Research in Education*, 10(4), 1245-1254.

Werner, A. (2020). Complexity of life and its dependence on the environment. https://link.springer.com (Retrieved on 4th May 2023).