Flashcard and Scaffolding Instructional Approaches on Students' Academic Performance in Chemistry in Oron Local Government Area

Edem, Etim A. and Udofia, Sabbath A.
Department of Science Education
Akwa Ibom State University, Mkpat Enin, Nigeria

Abstract

This study investigated the effects of flashcard and scaffolding instructional approaches on students' academic performance in Chemistry in Oron Local Government Area. A quasi-experimental research design was adopted for the study. The population of the study consisted of 1300students of Senior Secondary School Two (SS2) in the five (5) public secondary schools in Oron Local Government Area. A sample size of 95 students was used for the study. A Simple random sampling technique was used to select 2 co-educational public secondary schools out of the 5 public secondary schools in the study area. In each of the selected schools, an intact class was used. The instrument used for data collection was the Chemistry Performance Test (CPT). An expert in measurement and evaluation, and a chemistry education lecturer subjected the instrument to face and content validation. A reliability coefficient of 0.85 was obtained using Kuder-Richardson formula-20 (KR-20). Mean and standard deviation were used to answer the research questions while independent t-test statistics were used to test the hypotheses at a 0.05 level of significance. The findings showed that students taught the concept of Unsaturated hydrocarbon using a scaffolding instructional approach performed academically better than students taught using a flashcard approach. The finding also showed no significant difference in the mean performance scores between male and female students taught the concept of unsaturated hydrocarbon using flashcard and scaffolding instructional approaches. Based on the study's findings, it was concluded that the scaffolding instructional approach enhanced students' academic performance in Chemistry than the flashcard instructional approach in Oron Local Government Area. It is recommended among others that Science educators should prioritize the use of scaffolding instruction in teaching complex concepts, as it has been proven to enhance student understanding and performance.

Keywords: Flashcard, scaffolding, instructional approaches, academic performance and gender

Introduction

Chemistry, at its core, examines the complex molecular interactions that govern the natural world from the air we breathe to the materials we rely on through fundamental laws and principles. Understanding these principles is essential for advancing knowledge and solving real-world problems. By exploring the building blocks of matter, chemists unlock innovations across medicine, energy, and materials science. Such understanding underpins advances in fields from pharmaceuticals to environmental remediation. At the heart of this inquiry, chemistry seeks to elucidate the composition, properties, and reactions of matter (Udofia & Davis Sambo 2016).

Chemistry stands as the cornerstone of scientific progress, unlocking the mysteries of matter and equipping learners with the tools to understand the physical world. As a central science, it forms the foundation for disciplines like biology, physics, medicine, and environmental science, while also branching into specialized subfields such as materials chemistry, organic chemistry, biochemistry, and environmental chemistry that address targeted applications (Sunday et al., 2025; Umanah & Sunday, 2022). One of its most impactful branches is the organic chemistry which investigates hydrocarbons-carbon-based molecules integral to modern life. Hydrocarbons from gasoline to pharmaceuticals underscore chemistry's role in driving innovation through their transformation in chemical reactions (Udofia, 2024). For secondary school students, particularly in a resource-rich country like

Nigeria, understanding hydrocarbons, their types, such as saturated and unsaturated hydrocarbons, is not only academically enriching but also practically empowering.

Unsaturated hydrocarbons, characterized by one or more carbon–carbon double or triple bonds, play vital roles in modern chemistry and industry (Udofia & Eshiet 2007): Unlike their saturated counterparts, these molecules are highly reactive, making them key building blocks for a wide range of chemical transformations. Ethene and propene, for instance, are polymerized into plastics (e.g., polyethylene, polypropylene) used in packaging, automotive parts, and more. Beyond industrial applications, unsaturated hydrocarbons are central to the synthesis of alcohols, detergents, resins, and pharmaceuticals. Their presence also provides insight into the structural behaviour of organic molecules, enhancing students' understanding of key concepts like molecular bonding, isomerism, and functional group reactions. In educational contexts, especially in senior secondary chemistry, mastering unsaturated hydrocarbons builds a strong conceptual foundation for advanced studies in organic chemistry and equips learners with the knowledge to connect classroom theories to real-life applications (Udofia & Asanga 2017).

Despite the importance of unsaturated hydrocarbons in chemistry, multiple studies have highlighted that Nigerian secondary school students face significant challenges in understanding these concepts (Moses, Agyei, Sarpong, & Mohammed, 2024). The West African Examinations Council (WAEC) Chief Examiners' reports from 2022–2024 have noted that students' inability to accurately depict the formation of carbon–carbon double or triple bonds in unsaturated hydrocarbons has led to poor academic performance. The report revealed that a significant number of students fail to meet the minimum required scores in chemistry, raising concerns about the quality of STEM education and its impact on future scientific and technological advancements. It further highlights several deficiencies among students, including a weak conceptual understanding of chemistry, difficulty in applying knowledge to problem-solving tasks (Abasi & Ado, 2021). These shortcomings directly contribute to students' underperformance in chemistry, ultimately affecting their overall academic achievement. Additionally, students struggle with identifying organic compounds capable of undergoing cracking and substitution reactions, indicating a broader difficulty with unsaturated hydrocarbon concepts and diminishing student interest (Udofia, Sambo & Udonqwo 2017). Researchers attribute poor performance and low interest to abstract content and ineffective, often teacher-centered pedagogy (Udofia & Sambo 2021; Abasi, 2018). Research reveals that the ineffective teaching approaches employed by the teacher among other factors contribute to poor performance among students, and as a result of this there has been persistent poor performance of students in Chemistry (Ekpo, Utibe & Udofia, 2024; Oyalchirome & Akpan, 2024; Abasi, 2018). The notable frequency of student failures in Chemistry prompts substantial inquiries into the teaching and learning methods employed. While attributing low academic performance to various factors, the situation remains disconcerting.

Educators and researchers in education have sourced for innovative teaching approaches which can curb the state of poor performance among students. Such approaches include; demonstration, game-based, collaborative learning, multiple resources, constructivist models, guided discovery (Ekpo, Utibe & Udofia, 2024; Abasi & George, 2025; Edem, Akpan & Udofia, 2023; Akpan, Umanah & Udofia, 2025; Edoho & Abasi, 2019) as well as flashcard instructional approaches (Willie, Abasi & Ojoko, 2025). The instructional approaches employed by the teacher plays vital role in the acquisition of skills and meaningful learning (Abasi, 2018). Umoetuk and Akpan,

(2023), Fatokun, Egya and Uzoechi (2016) asserted that teachers have the capacity to modify teaching strategies, effectively enhancing students' comprehension and performance while also minimizing the abstract nature of science concepts. Beyond instructional limitations, disparities in access to quality education further widen the achievement gap. Students from well-resourced schools are adequately equipped, teachers employ interactive strategies and they tend to outperform those in under-resourced institutions (Edem, Akpan & Udofia, 2023). Additionally, variations in students' prior knowledge, school location, learning styles, and motivation contribute to differences in academic achievement as well as their critical thinking (Udofia, Akpan, Babayemi & Ekpo, 2025). Akpan, Atabang and Udofia (2025) noted that students need supportive, empowering and enabling technology driven environment to make learning interesting and retentive. Therefore, Chemistry teachers should adopt innovative teaching approaches such as flipped classroom, jigsaw, blended learning, peer-led, drill practice as well as scaffolding and flashcard teaching approaches that will enhance students' academic performance in Chemistry.

Flashcards instructional approach is an activity-based approach that makes use of a set of cards bearing information such as words or numbers, formulas, picture, a sentence or subject matter on either or both sides, used in the classroom for the purpose of teaching and learning of concepts (Willie, Abasi & Ojoko, 2025; Astuti, 2015). They are set of cards on which are written items to be studied. According Umanah and Sunday (2022) flashcards are used as a learning drill to aid memorization by way of spaced repetition and are useful for drilling new letters, syllables, words, and other information. Flashcards are frequently used by students to study and learn course material (Udofia & Sambo 2022). This study seems justifiable as the use of flashcard would be expected to promote learning because flashcards are designed to encourage retrieval practice. This occurs as students flip through the prompts on one side of the flashcard and attempt to recall the answer recorded on the back of the card. Many studies have found that retrieval practice increases the retention of information (Little & McDaniel, 2015).

The use of flashcards instructional approach facilitates students' involvement in the class work by sharing answers, participating in the lesson, interacting with each other, utilizing the new words, working on the vocabulary and pronunciation. It makes learning fun and enjoyable, increases the learners' ability to memorize, analyze a problem and enrich vocabulary (Udofia, Akpan, Babayemi & Jonah (2024). Apart from the cognitive side, the use of flashcards increases the learners' self-confidence, develop good and effective communication and enhance creativity (Singh, 2022). Flashcards are efficient ways to study because they allow the learner to focus on the most important information. Instead of reading through long paragraphs or textbooks, they can quickly review key terms and concepts with flashcards. This can save a lot of time and helps learners to study more effectively. According to Senzaki, Hackathorn, Appleby and Gurung (2017) in their studies, suggested that flashcards implemented instructional approach can help students achieve deeper levels of processing, such as comprehension and application, in a self-directed manner, which benefits students' academic performance.

Scaffolding instructional approach is the support given to a student by a teacher throughout the learning process. It refers to an approach in which teachers offer a particular kind of support to students as they learn and develop a new concept or skill. Omoniyi and Torru (2018) define scaffolding as an instructional approach that enables students to solve a problem, carryout a task or achieve a goal through a gradual shedding of outside assistance. It also refers to variety of instructional techniques used to move a student progressively toward stronger

understanding and, ultimately, greater independence in the learning process (Omoniyi & Torru, 2018). The use of scaffolds in teaching and learning to support and guide the learner is compared to the scaffolds in building construction where the scaffolds provide both adjustable and temporal support to the building under construction. The support and guidance provided to learners facilitate internationalization of the knowledge needed to complete the task. This support is weaned gradually until the learner is independent (Doyle & Tagg, 2023).

Scaffolding instructional approach allows students to experience student-centered learning, which tends to facilitate more efficient learning than teacher-centered learning. It provides sufficient support to promote learning with a deeper level of understanding when concepts and skills are being first introduced to students. These supports may include resource, compelling task, templates and guides, and/or guidance on the development of cognitive and social skills. Instructional scaffolding could be employed through modeling a task, giving advice, and/or providing coaching (Akani, 2015). In Scaffolding instructional approach, teaching involves a communication process where presentation and demonstration by the teacher is contextualized for the learner. The performance of the study is coached, articulate and elucidated by the learner as support is gradually being removed (Alake & Ogunseemi, 2013).

In Scaffolding, the teachers' support must be to the current level of the students' performance and should either be at the same or a slightly higher level. A teacher acts contingently when he/she adapts the support in the way or another to a group of students (Bansal, 2017). These supports are gradually removed as students develop autonomous learning strategies, thus promoting their own cognitive, affective and psychomotor learning skills and knowledge. Scaffolding approach evolves as the teachers evaluate the learners' initial level of ability and then through continued feedback throughout the progression of the learning task (Robinson & Daniel, 2017). Onah (2022) in his findings showed that students taught using scaffolding instructional approach performed academically better. The findings of Omoniyi (2017) revealed that scaffolding approach had a significant positive effect in promoting students' conceptual understanding and performance when compared with the effect of lecture method of instruction. Awodun (2019), Chukwuagu (2016), Bansal (2017) and Nwali (2014) also confirm the effectiveness of scaffolding instructional approach on students' academic performance. Many researchers have reported gender disparity with respect to students' academic performance. Therefore, the influence of gender on students' academic performance would be considered in this study.

Gender is a socio-cultural construct that gives the differentiated roles and responsibility of men and women in a particular society. This implies that gender determines the role, which one plays in a society (Obanje, 2014). Gender has remained a burning issue and has also remained relevant in education because it has been linked to performance and participation in certain professions (Umar, Bolarin-Akinwande & Bichi, 2022). Many stressed that science, technology and their related disciplines are male-reserved, while art and humanities are female reserved. This belief makes boys appear to have a natural positive attitude towards science and technical subjects while girls show more inclination to arts and humanities. The problem is even compounded by the fact that most science educators give masculine outlook to science subjects such as chemistry and physics (Akpan, 2022; Onah, 2022), encouraging females to go rather for home economics, social studies, marketing which they consider to be more female friendly science subjects.

In the realm of education, gender imbalance is perceived as a structural inequality between males and females. Despite numerous studies exploring gender differences and academic performance, findings have been inconclusive and inconsistent (Enemarie, Ogbeba & Ajayi, 2019; Babayemi, Ahmed, Yisau & Babalola, 2016). Akpan, et al., (2023), Akpan et al., (2025) Consequently, researchers have underscored the necessity to investigate the potential effects of gender on students' academic performance in Chemistry, given the persistent lack of clarity in previous research, the present study also aims to investigate the effect of gender on the academic performance of students in Chemistry when exposed to flashcards and scaffolding instructional strategies.

Statement of the Problem

Despite the relevance of Chemistry, in the development of nation and how important it is in daily life activities. Students still develop poor performance towards some science subject even when they know that the world now is full of science and technology. This poor performance found among students has been attributed to the ineffective teaching strategies employed by the teachers. It was also found that, students are unfamiliar with the use of simple laboratory equipment, inadequate exposure to laboratory techniques, lack of observational skills, simple tests/experiments and teacher use of conventional teaching methods among others. While attributing low academic performance to various factors, the situation remains disconcerting. However, the low performance in Chemistry in external examinations has been traced to the use of conventional teaching method that does not put into consideration students' activities in teaching and learning processes. Conventional method, which militate against students' participation and engagement in the learning process and results in their poor performance is still commonly used by Chemistry teachers in Nigeria. Therefore, there is need to search for better approaches that will demystify Chemistry and enhance students' performance in the subject. This prompted the quest for an innovative approach that will improve students' academic performance in Chemistry. The question then is, will the students exposed to flashcard instructional approach perform academically better than those exposed to scaffolding instructional approach? Conversely, will the students exposed to scaffolding instructional approach perform academically better than those exposed to flashcard instructional approach? Therefore, this study seeks to investigate the effect of flashcard, scaffolding instructional approaches on students' academic performance in Chemistry.

Purpose of the Study

The purpose of this study is to investigate the effect of flashcard and scaffolding instructional approaches on students' academic performance in Chemistry in Oron Local Government Area. Specifically, this study seeks to:

1. Determine the difference in the mean performance scores of Chemistry students taught unsaturated hydrocarbon using flashcard and scaffolding instructional approaches.
2. Determine the difference in the mean performance scores between male and female Chemistry students' when taught unsaturated hydrocarbon using flashcard instructional approach.
3. Ascertain the difference in the mean performance scores between male and female Chemistry students' when taught unsaturated hydrocarbon using scaffolding instructional approach.

Research Questions

1. What is the difference in the mean performance scores of Chemistry students taught unsaturated hydrocarbon using flashcard and scaffolding instructional approaches?
2. What is the difference in the mean performance scores between male and female Chemistry students' when taught unsaturated hydrocarbon using flashcard instructional approach?
3. What is the difference in the mean performance scores between male and female Chemistry students' when taught unsaturated hydrocarbon using scaffolding instructional approach?

Hypotheses

1. There is no significant difference in the mean performance scores of Chemistry students taught unsaturated hydrocarbon using flashcard and scaffolding instructional approaches.
2. There is no significant difference in the mean performance scores between male and female Chemistry students' when taught unsaturated hydrocarbon using flashcard instructional approach.
3. There is no significant difference in the mean performance scores between male and female Chemistry students' when taught unsaturated hydrocarbon using scaffolding instructional approach.

Methods

This study employed quasi-experimental pretest-posttest design. This study in the context of this design employed two experimental groups; experimental group 1 and experimental group 2. The study was carried out in Oron Local Government Area of Akwa Ibom State, Nigeria. The population of the study consisted of 1300 Senior Secondary School Two (SS2) students in the five public secondary schools in Oron Local Government Area. A sample of 95 Chemistry students from two public secondary schools was used for the study. Simple random sampling technique was used in selecting the two (2) secondary schools out of 5 public secondary schools in the study area. In each of the schools sampled intact class was used, one intact class was assigned to experimental group 1 and the other intact class to experimental group 2. Chemistry Performance Test (CPT) was used as an instrument for data collection. The CPT contained 20 multiple choices question having options from A to D, based on the concepts of unsaturated hydrocarbon. The instrument was validated by three lecturers of Test, Measurement and Evaluation in Department of Science Education, Akwa Ibom State University. The reliability of the instrument was determined using a sample of 20 Senior Secondary Two (SS2) Chemistry students selected from a school in the study area but was not part of the sample for the study. The scores obtained were analyzed using the Kuder Richardson Formula-20 and a reliability coefficient of 0.85 was obtained. Two chemistry teachers from the sampled schools served as research assistants on the use of the lesson packages for the experimental groups I and II respectively. The lesson package for the experimental group I was designed using flashcard instructional model while experimental group II lesson package was based on scaffolding approach. Pretest was administered to students in the two groups before treatment started. Students in experimental group I were taught the concept of unsaturated hydrocarbon using flashcard instructional approach while students in experimental group II were taught using scaffolding approach. The treatment lasted for two weeks after which the CPT was reshuffled and administered as post-test to students in the two groups. Pretest and Post-test scripts from the two groups were

collected, scored and used for data analysis. The research questions were answered using mean and standard deviation while the hypotheses were tested using independent t-test at 0.05 level significance.

Results

Research question one: What is the difference in the mean performance scores of Chemistry students taught unsaturated hydrocarbon using flashcard and scaffolding instructional approaches?

Table 1: Mean and standard deviation of students' pretest posttest scores based on instructional approaches (N=95)

Instructional Approaches	N	Pretest		Posttest		Mean difference
		Mean	SD	Mean	SD	Scores
Flashcard	50	4.76	1.954	12.80	2.115	8.04
Scaffolding	45	4.40	1.398	14.23	3.042	9.83

The result in Table 1 above revealed that the performance mean difference scores (9.83) of Chemistry students taught the concept of Unsaturated hydrocarbon using scaffolding instructional approach is greater than the mean achievement difference scores (8.04) of those taught using flashcard instructional approach. This indicates that students taught with the use of scaffolding instructional approach performed academically better thereby scoring high in their mean gain than those that were taught with the use of flashcard instructional approach.

Research question two: What is the difference in the mean performance scores between male and female Chemistry students' when taught unsaturated hydrocarbon using flashcard instructional approach?

Table 2: Mean and standard deviation of male and female students pretest posttest scores based on instructional approach (N=50)

Instructional Approach	Gender	N	Pretest		Posttest		Mean difference
			Mean	SD	Mean	SD	Scores
Flashcard	Male	20	5.50	3.113	11.91	1.109	6.41
	Female	30	5.13	1.592	12.10	1.185	6.97

The result in Table 2, revealed the mean performance difference scores (6.41) of male Chemistry students taught the concept of Unsaturated hydrocarbon using flashcard instructional approach is lesser than the mean performance difference score (6.97) of female Chemistry students taught the concept of Unsaturated hydrocarbon using flashcard instructional approach. This indicates that female students taught with the use of collaborative strategy performed academically better than their male counterparts. To verify if the observed mean difference is statistically significant, the data was further subjected to test of analysis using independent t-test statistics. The result is presented in table 5.

Research question three: What is the difference in the mean performance scores between male and female Chemistry students' when taught unsaturated hydrocarbon using scaffolding instructional approach?

Table 3: Mean and standard deviation of male and female students pretest posttest scores based on instructional approach (N=45)

Instructional Approach	Gender	N	Pretest		Posttest		Mean difference Scores
			Mean	SD	Mean	SD	
Scaffolding	Male	20	4.47	1.389	17.37	1.832	12.90
	Female	25	4.44	1.440	14.88	3.245	10.44

The result in Table 2 shows that the mean performance difference scores (12.90) of male Chemistry students taught the concept of Unsaturated hydrocarbon using scaffolding instructional approach is slightly greater than the mean performance difference scores (10.44) of female Chemistry students taught the concept of Unsaturated hydrocarbon using scaffolding instructional approach. This indicates that male Chemistry students taught the concept of unsaturated hydrocarbon using scaffolding instructional approach performed academically better than their female counterpart. To verify if the observed mean difference is statistically significant, the data was further subjected to test of analysis using independent t-test statistics. The result is presented in table 4.

Hypothesis one: There is no significant difference in the mean performance scores of Chemistry students taught unsaturated hydrocarbon using flashcard and scaffolding instructional approaches.

Table 4: Summary of independent t-test analysis of students' posttest scores based on teaching strategies (N=95)

Instructional Approaches	N	Mean	SD	df	t-cal	t-crit	Decision
Flashcard	50	12.80	2.115				
				101	4.96	1.96	Rejected H_{01}
Scaffolding	45	14.23	3.042				

The result in table 4 revealed that the calculated t-value of 4.96 is greater than the critical t-value of 1.96 at 0.05 level of significance and at 94 degrees of freedom. This implies that there is a significant difference in the mean achievement scores of Chemistry students taught the concept of unsaturated hydrocarbon using flashcard and scaffolding instructional approaches in favour of scaffolding instructional approach. Hence, the null hypothesis one was rejected at 0.05 level of significance and the alternative which states that there is a significant difference in the mean achievement scores of Chemistry students taught the concept of unsaturated hydrocarbon using flashcard and scaffolding instructional approaches.

Hypothesis two: There is no significant difference in the mean performance scores between male and female Chemistry students' when taught unsaturated hydrocarbon using flashcard instructional approach.

Table 5: Summary of independent t-test analysis of male and female students pretest posttest scores based on instructional approach (N=50)

Instructional Approach	Gender	N	Mean	SD	df	t-cal	t-crit	Decision
Flashcard	Male	20	11.91	1.109	48	0.94	2.01	accepted H_{03}
	Female	30	12.10	1.185				

The result in table 5 revealed that the calculated t-value of 0.94 is lesser than the critical t-value of 2.01 at 0.05 level of significance and at 49 degrees of freedom. This implies that there is no significant difference in the mean achievement scores of male and female Chemistry students taught the concept of unsaturated hydrocarbon using flashcard instructional approach. Hence, the null hypothesis two of no significant difference is accepted. Hence, there is no significant difference in the mean performance scores of male and female Chemistry students taught the concept of unsaturated hydrocarbon using flashcard instructional strategy.

Hypothesis three: There is no significant difference in the mean performance scores between male and female Chemistry students' when taught unsaturated hydrocarbon using scaffolding instructional approach.

Table 6: Summary of independent t-test analysis of male and female students pretest posttest scores based on instructional approach (N=45)

Instructional Approach	Gender	N	Mean	SD	df	t-cal	t-crit	Decision
Scaffolding	Male	20	17.37	1.832	51	0.87	2.01	Accept H_{02}
	Female	25	14.88	3.245				

The result in table 6 revealed that the calculated t-value of 0.87 is lesser than the critical t-value of 2.01 at 0.05 level of significance and at 44 degrees of freedom. This implies that there is no significant difference in the mean achievement scores of male and female Chemistry students taught the concept of unsaturated hydrocarbon using scaffolding instructional approach. Hence, the null hypothesis three of no significant difference is accepted. This result shows that male and Chemistry students taught the concept of unsaturated hydrocarbon using scaffolding instructional strategy performed academic better and at the same pace. The result shows that the strategy was gender friendly.

Discussion of Findings

This study examined the effects of flashcard and scaffolding instructional approaches on students' academic performance in Chemistry in Oron Local Government Area. The findings of this study revealed that the academic performance of students taught concept of unsaturated hydrocarbon in Chemistry using scaffolding instructional approach was significantly enhanced than their counterparts taught using flashcard instructional

approach. This was evident as students taught using the scaffolding instructional approach achieved a higher mean gain score compared to those taught using the flashcard instructional approach, with the independent samples t-test showing $t(94) = 4.96$, $p < .05$. This finding suggests that the structured phases of the scaffolding instruction might better facilitate conceptual understanding of complex topics such as unsaturated hydrocarbon. The design of the scaffolding instruction encourages active learning and continuous assessment, which can help students integrate new knowledge more effectively into their existing schema. The result of this finding aligns with the studies of Omoniyi (2017) who observed that scaffolding instructional approach had a significant positive effect in promoting students' conceptual understanding when compared with the effect of lecture method of instruction. The result also is in agreement with the findings of Awodun (2019), Chukwuagu (2016), and Bansal (2017) whose studies revealed that student taught using scaffolding instructional approach had a better academic performance than their counterpart taught using conventional approach.

The findings of this study also revealed that both male and female students performed similarly. This indicates that the flashcard and scaffolding instructional approaches operates as a gender-neutral instructional method, promoting equal learning opportunities across genders. Such an outcome is particularly important in contexts where educational equity is a central concern. This implies that there is no need for separation of male and female students during the use of the teaching strategies since both strategies were gender friendly. This was in line with Umanah and Sunday (2022), Akpan, et al., (2025) who found no statistically significant difference in the mean performance scores between male and female students in chemistry. The result of the study is in support of the research of Umar and Samuel (2023) whose findings indicated that there is no significant difference in the academic achievement of male and female students. Also, Ani, Obodo, Ikwueze, and Festus (2021) have noted similar patterns, suggesting that well-designed constructivist approaches can bridge performance gaps between male and female learners.

Overall, the study contributes compelling evidence that the scaffolding instructional approach has a more pronounced effect on academic performance in Chemistry, particularly on the topic of unsaturated hydrocarbon, than the flashcard instructional approach. Both approaches, however, are effective in creating gender-inclusive learning environments. These insights are vital for educators and curriculum developers as they seek to implement strategies that not only improve student outcomes but also promote fairness and inclusivity in science education.

Conclusion

It is evident from the findings of this study that the use of scaffolding instructional approach is more effective in facilitating and enhancing students' academic performance in Chemistry than flashcard instructional approach. By implication, this affirmed that instructional approaches are also a determinant of students' academic performance in chemistry. It is also evident from the findings of this study that no gender disparity exists in the performance of male and female chemistry students taught using flashcard and scaffolding approaches. Thus, flashcard and scaffolding are significantly very useful strategies for meaningful learning and enhances academic performance of students regardless of their gender.

Recommendations

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

1. Teachers should use scaffolding instruction in teaching of unsaturated hydrocarbon, and other concepts in chemistry instead of using the traditional method as this approach will help them to achieve the stated objectives of the lesson and subsequently enhance students' academic performance in chemistry.
2. Scaffolding approach should be enriched more with other teaching approaches as it will also help the students in a way that would enable them learn concepts in chemistry effectively and diagnose learning difficulties in various ways.
3. Educational planners should include scaffolding instructional approach into the curriculum in order to bring about effective teaching and learning of chemistry concepts.
4. There is need for government, ministry of education and other professional bodies to organize conferences, seminars and workshops to educate teachers on effective use of innovative instructional approaches.

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