Effect of 7E and 9E Teaching Strategies on Students' Academic Achievement in Chemistry in Oron Local Government Area

[1]Edet, Benedict C., [2]Umanah, Felicia I. and [3]Udofia, Sabbath E.
[1,2,3]Department of Science Education
Akwa Ibom State University, Mkpat Enin, Nigeria

Abstract

This study investigated the effects of 7E and 9E teaching strategies on students' academic achievement in Chemistry in Oron Local Government Area. A quasi-experimental research design was adopted for the study. The population of the study consisted of 1663 students of Senior Secondary School One (SS1) 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 Achievement Test (CAT). 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 Acid, Base and pH using 9E teaching strategy achieved academically better than students taught using 7E teaching strategy. The finding also showed no significant difference in the mean achievement scores between male and female students taught the concept of Acid, Base and pH using 7E and 9E teaching strategies. Based on the study's findings, it was concluded that the 9E teaching strategy enhanced students' academic achievement in Chemistry than the 7E teaching strategy in Oron Local Government Area. It is recommended among others that Science educators should prioritize the 9E model in teaching complex concepts, as it has been proven to enhance student understanding and achievement.

Keywords: 7E, 9E, teaching, academic achievement and gender

Introduction

Chemistry is the study of matter, its composition, properties, and the various changes that matter undergoes, providing the foundational knowledge necessary to understand the world at the molecular level. Chemistry often referred to as the central science, serves as a bridge connecting various scientific disciplines, including physics, biology, and environmental science. Its foundational principles underpin technological advancements and industrial innovations, making it an indispensable field in contemporary society (Umanah & Sunday, 2022). Chemistry plays a crucial role in addressing global challenges such as sustainable energy production, healthcare advancements, and environmental conservation. For instance, breakthroughs in chemistry have led to the development of solar cells, bio-fuels, and energy storage systems that are pivotal in the transition to renewable energy (Sunday et al., 2025; Umanah, 2024). Similarly, advancements in medicinal chemistry have resulted in the creation of life-saving drugs and vaccines, while environmental chemistry has provided innovative solutions for pollution control and waste management. By fostering scientific literacy, chemistry education equips individuals

with the problem-solving skills necessary for tackling pressing issues like climate change, pollution control, and pharmaceutical development (Umanah, et al., 2024).

Despite its significance, chemistry is often perceived as a challenging subject by students, leading to widespread difficulties in learning and engagement. One of the primary challenges is the abstract nature of many chemical concepts (Umanah & Sunday, 2022). Topics such as atomic structure, molecular bonding, reaction mechanisms, acid, base, pH, and thermodynamics require students to visualize phenomena that cannot be directly observed, making them difficult to grasp. Additionally, the mathematical rigor involved in solving chemical problems, such as stoichiometry, thermodynamics, and kinetics requiring strong analytical and computational skills often overwhelms students who struggle with quantitative reasoning (Udofia & Sambo 2017; Umanah & Sunday, 2022; Oyalchirome & Akpan, 2024).

Many students find the mathematical aspects of Chemistry intimidating, which contributes to anxiety and low confidence levels in the subject. Compounding these challenges is a general lack of interest in the subject, frequently attributed to the perception that chemistry is irrelevant to everyday life due to ineffective teaching methods that fail to connect theoretical knowledge and real-world applications (Udofia & Christopher 2017). Udofia (2024) stressed that, the problem of students' academic achievement in Chemistry is not with the subject as it was considered before, but a lack of interest resulting mostly from teaching methods used. These difficulties contribute to the persistent poor achievement of students in chemistry examinations, as evidenced by recent reports such as the West African Examinations Council (WAEC) Chief Examiners' Report (WAEC, 2024). 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), and challenges in performing mathematical computations. These shortcomings directly contribute to students' underperformance in chemistry, ultimately affecting their overall academic achievement.

A decline in chemistry achievement discourages students from pursuing science-related careers, thereby reducing the number of professionals in fields critical to national development, such as medicine, engineering, and environmental science. The gap in academic achievement in chemistry is particularly pronounced among secondary school students, many of whom enter higher education with inadequate foundational knowledge. This persistent underachievement raises concerns about the effectiveness of current instructional methods and their impact on student's ability to succeed in STEM fields (Akpan, 2022). Research indicates that students' achievement in Chemistry is influenced by multiple factors, including instructional quality, access to learning resources, and individual motivation (Sibomana, et al., 2021). Unfortunately, the instructional methods used by Chemistry teachers have been explored by various researchers (Akpan, Umanah & Udofia, 2025; Umanah & Udo, 2015; Ibezim, 2018; Umanah & Etiubon, 2022). According to Akpan and Akpan (2017) and Umanah and Etiubon (2022), the effectiveness of instructional strategies and methods employed by teachers plays a crucial role in determining students' achievement. Goar, et al., (2021) emphasized that modern teaching and learning have evolved beyond

traditional approaches where teachers simply deliver information to passive learners without encouraging active participation.

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; Akpan, 2022). 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. Chemistry is abstract in nature, which requires integrating mathematical reasoning with conceptual understanding, presents further challenges (Binder, et al. 2019; Umanah & Sunday, 2022). Without appropriate instructional support, students struggle to establish meaningful connections between theoretical concepts and practical applications, further exacerbating their difficulties in mastering the subject. Also, the absence of interactive and hands-on learning experiences further reduces student interest, making chemistry appear overly complex and disengaging. Addressing these challenges requires a shift toward innovative, student-centered teaching strategies such as 7E and 9E teaching strategies, which promote active learning, critical thinking, and knowledge application (Umanah & Akpan, 2024). The question then arises: Will students taught using 7E teaching strategy achieve better academic outcomes than those taught using 9E model teaching strategy? Conversely, do students taught using 9E teaching strategy model achieve better academically than those taught using 7E model teaching strategy?

The 7E teaching strategy serves as an educational framework comprising seven sequential steps utilized by educators and their students in the classroom. Its objective is to empower students to autonomously construct their scientific knowledge acquisition. The 7E teaching strategy is a comprehensive strategy that accommodates various methods, such as cooperative learning, group work, lectures, laboratory investigations and direct instruction (UmoAbasi, Akpan & Babayemi, 2024). It empowers students to delve into their beliefs, facilitating the construction of fresh knowledge by dismantling misconceptions and clarifying their thought processes. The 7Es strategy consists of seven phases (Elicitation, engagement, exploration, explaining, elaboration, evaluation & extension) that emphasize deduction and building concepts on the basis of previous knowledge; provides the learners 'growth and success (UmoAbasi, Akpan & Babayemi, 2024). It enhances students' grasp of scientific concepts by integrating past and present knowledge, enabling them to apply this understanding to new situations. It contributes to improved science subject achievement scores through enhanced transfer of learning.

The initial step in this strategy, eliciting prior knowledge, serves to gauge students' comprehension levels and dispel any misconceptions, laying the groundwork for acquiring fresh knowledge. Techniques like using cartoons, posing questions, and incomplete mind maps facilitate this process, fostering knowledge transfer and allowing students to showcase their ideas and creativity (Adesoji & Idika, 2015). In the engagement phase, teachers aim to cultivate students' interest in a concept through various activities and multimedia resources (Udofia, Akpan, Babayemi & Jonah, 2024)). Brainstorming and think-pair-share techniques stimulate inquiry, prompting students to question their existing understanding. During exploration, students are encouraged to think freely and actively

engage in activities, facilitated by the teacher, such as hypothesis development, evidence collection, and data interpretation. Probing questions and puzzles further encourage critical thinking and concept development. In the explanation phase, both educators and students play active roles, with teachers guiding students' understanding and introducing scientific terminology. Students express their comprehension, provide explanations, and seek clarification, fostering deeper understanding (Adesoji & Idika, 2015). During elaboration, students apply their knowledge through practical activities, focusing on practical skills and application in new contexts. Teachers facilitate alternative explanations and evidence-based conclusions, promoting transfer of learning. Evaluation assesses students' understanding through various methods, including open-ended questions and concept mapping. The extension phase encourages application of learned concepts in unfamiliar situations, aiding in long-term retention.

Akpan, Umanah and Udofia, (2025) in their study of comparative effect of learning cycle models on students' achievement in chemistry found out that students taught through 7E learning model scored higher in posttest as compared to students exposed to 3E and 5E learning models. Juliana, et al., (2021) found that there was a statistically significant difference between the mean scores of those taught using 7E strategies and those taught using conventional method. The study concluded that 7E teaching strategy has the potential of improving students' academic achievement. Similar studies conducted by other researchers are in agreement with these findings. Research conducted by Balta and Sarac (2016) found that 7E strategy had enhanced educational effects in science teaching. Students instructed using 7E strategy performed better than students instructed through conventional methods.

On the other hand, 9E learning cycle model has **elicit, engage, explore, explain, elaborate, evaluate, extend, echo, and e-search**. All these nine stages help the teacher to improve student learning.

Elicit 1: At this stage, the teacher determines the comprehensive prior knowledge about the topic under discussion.

Engage 2: The teacher uses relevant material or simple experimental activities to capture the attention of the learners and raise questions in their minds.

Explore 3: During this stage, learners are encouraged to work with objects and materials, understand how materials work, and talk with each other and with their teacher.

Explain 4: Learners are introduced to models, laws and theories. The teacher guides learners to organize information, find patterns, compare, and identify problems. After all the learners have gained an understanding of the desired concept and expressed it, they can also raise the scientific concepts related to this concept.

Elaborate 5: Learners are given an opportunity to apply their knowledge in new fields and areas.

Evaluate 6: This stage creates an opportunity for learners to measure their perceptions and skills, and for teachers to evaluate the progress of students in achieving educational goals.

Extend 7: At this stage, learners are guided to relate and apply the new concept to different contexts.

Echo 8: In this stage, which is known as the practice or repetition stage, the learners are strengthening the key learning objectives, and they have arisen across in the exploring and explaining stage. The teacher's job is to verify that the pupil has learned the concepts being taught and afterward give the essential recommendations or encouragement, as preferred. The information obtained even during the echo step is subsequently used further

throughout the elaboration phase. Depending on the needs and interests, several levels of technology engagement may be used.

E-Search 9: At this stage, learners are guided to apply the new concept in the context of IT and the network, such as computers, internet, multimedia CDs, electronic publications and virtual newsletters, etc. (Basri., & Asari, 2019).

The teaching and learning model observe the learning pattern of students learning, which is based on what they are able to learn naturally. Different learning models are presented by research scholars, which improved students' learning skills over a period from 3E, 4E, 5E, 7E, and the recent 9E presented by Kaur & Gakhar (2018). This study will explore 7E and 9E learning models and how it will impact on students' learning of chemistry contents irrespective of their gender.

Gender is a socially attributed characteristic that distinguishes between feminine and masculine traits (Kachel, Steffens & Niedlich, 2016). It's a socio-cultural concept dictating the varied roles and responsibilities of individuals based on societal norms. This suggests that gender determines one's societal role (Ogbanje, 2014). Numerous studies have highlighted the impact of gender on students' achievement in Chemistry and other scientific disciplines. Ekpo, Utibe and Udofia (2024); Uloko and Usman (2018), and Vale (2019) noted gender disparities in their various studies. However, conflicting reports exist. Umanah & Akpan (2024), Oyalchirome & Akpan, 2024, Abasi (2018) found no significant difference in the achievement scores of male and female students taught using 7E and 9E learning cycle model. Consequently, researchers emphasize the need to explore gender's potential effects on students' academic performance in Chemistry, given the lack of clarity in previous researches. Therefore, this study also aims to investigate how gender influences students' academic achievement in Chemistry when exposed to 7E and 9E teaching strategies.

Statement of the Problem

The indispensability of Chemistry in the development of our society has been universally acknowledged, although the output of its teaching and learning is still not encouraging. Literature is replete with evidence that teachers' use of ineffective method in Chemistry teaching has contributed to poor students' achievement in Chemistry both in internal and external examinations. Conventional method of teaching which militate against students' participation and engagement in the learning process and results in their poor achievement is still commonly used by Chemistry teachers in Nigeria. There are various innovative and effective teaching methods and strategies advocated for effective teaching of chemistry. Thus, there is need therefore to search for a better method that will demystify Chemistry and improve students' academic performance. This is to ensure that students perform very well in what they are expected to learn in a given lesson for resultant performance in their examinations. This prompted the quest for innovative teaching strategies. Hence, the present study is therefore designed to determine the effects of 7E and 9E teaching strategies on students' academic achievement in Chemistry.

Purpose of the Study

The main purpose of this study is to determine the effects of 7E and 9E teaching strategies on students' academic achievement in Chemistry in Oron Local Government Area. Specifically, the study sought to;

1. Determine the difference in the mean achievement scores of Chemistry students taught the concept of Acid, Base and pH using 7E and 9E teaching strategies.
2. Determine the difference in the mean achievement scores of male and female Chemistry students when taught the concept of Acid, Base and pH using 7E teaching strategy.
3. Determine the difference in the mean achievement scores of male and female Chemistry students when taught the concept of Acid, Base and pH using 9E teaching strategy.

Research Questions

The following research questions guided the study:

1. What difference exists in the mean achievement scores of Chemistry students taught the concept of Acid, Base and pH using 7E and 9E teaching strategies?
2. What difference exists in the mean achievement scores of male and female Chemistry students when taught the concept of Acid, Base and pH using 7E teaching strategy?
3. What difference exists in the mean achievement scores of male and female Chemistry students when taught the concept of Acid, Base and pH using 9E teaching strategy?

Hypotheses

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

1. There is no significant difference in the mean achievement scores of Chemistry students taught the concept of Acid, Base and pH using 7E and 9E teaching strategies.
2. There is no significant difference in the mean achievement scores of male and female Chemistry students when taught the concept of Acid, Base and pH using 7E teaching strategy.
3. There is no significant difference in the mean achievement scores of male and female Chemistry students when taught the concept of Acid, Base and pH using 9E teaching strategy.

Methods

This study employed quasi-experimental pretest-posttest design. The study was carried out in Oron Local Government Area of Akwa Ibom State, Nigeria. The population of the study consisted of 1663 Senior Secondary School One (SS1) students in the four public secondary schools in Oron Local Government Area. Simple random sampling technique was used in selecting the two (2) secondary schools out of 5 public secondary schools in the study area. A sample of 95 Chemistry students from two public secondary schools was used for the study. One intact class was assigned to experimental group 1 and the other intact class to experimental group 2. Chemistry Achievement Test (CAT) was used as an instrument for data collection. The CAT contained 20 multiple choices question having options from A to D, based on the concepts of Acid, Base and pH. The instrument was validated by one chemistry lecturer and one from 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. The chemistry teachers 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 7E teaching

strategy while experimental group II lesson package was based on 9E strategy. Pretest was administered to students in the two groups before treatment started. Students in experimental group I were taught the concept of Acid, Base and pH using 7E teaching strategy, while students in experimental group II were taught using 9E teaching strategy. The treatment lasted for three weeks after which a reshuffled CAT was 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 .05 level significance.

Results

Research question one: What difference exists in the mean achievement scores of Chemistry students taught the concept of Acid, Base and pH using 7E and 9E teaching strategies?

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

Teaching strategies	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	Scores
7E Teaching strategy	50	4.76	1.954	12.80	2.115	8.04
9E Teaching strategy	45	4.40	1.398	14.23	3.042	9.83

The result in Table 1 above revealed that the achievement mean gain scores (9.83) of Chemistry students taught the concept of Acid, Base and pH using 9E teaching strategy is greater than the mean achievement gain scores (8.04) of those taught using 7E teaching strategy. This indicates that students taught with the use of 9E teaching strategy performed academically better thereby scoring high in their mean gain than those that were taught with the use of 7E teaching strategy.

Research question two: What difference exist in the mean achievement scores of male and female Chemistry students taught the concept of Acid, Base and pH using 7E teaching strategy?

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

Teaching strategy	Gender	N	Pretest		Posttest		Mean Gain
			Mean	SD	Mean	SD	scores
7E Teaching Strategy	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 gain scores (6.41) of male Chemistry students taught the concept of Acid, Base and pH using 7E teaching strategy is lesser than the mean performance gain score (6.97) of female Chemistry students taught the concept of Acid, Base and pH using 7E teaching strategy. 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 difference exist in the mean achievement scores of male and female Chemistry students taught the concept of Acid, Base and pH using 9E teaching strategy?

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

Teaching strategy	Gender	N	Pretest		Posttest		Mean Gain
			Mean	SD	Mean	SD	Scores
9E Teaching Strategy	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 3 shows that the mean performance gain scores (12.90) of male Chemistry students taught the concept of Acid, Base and pH using 9E teaching strategy is slightly greater than the mean performance gain scores (43.79) of female Chemistry students taught the concept of Acid, Base and pH using 9E teaching strategy. This indicates that male and female students Chemistry students taught the concept of Acid, Base and pH using 9E teaching strategy performed academically better and nearly at the same pace. 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 6.

Hypothesis one: There is no significant difference in the mean achievement scores of Chemistry students taught the concept of Acid, Base and pH using 7E and 9E teaching strategies

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

Teaching strategies	N	Mean	SD	df	t-cal	t-crit	Decision
7E Teaching Strategy	50	12.80	2.115				
				101	4.96	1.96	Rejected
9E Teaching Strategy	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 .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 Acid, Base and pH using 7E and 9E teaching strategies in favour of 9E teaching strategy. 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 Acid, Base and pH using 7E and 9E teaching strategies

Hypothesis two: There is no significant difference in mean achievement scores of male and female Chemistry students taught the concept of Acid, Base and pH using 7E teaching strategy.

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

Teaching Strategy	Gender	N	Mean	SD	df	t-cal	t-crit	Decision
7E Teaching Strategy	Male	20	11.91	1.109	48	0.94	2.01	accepted H_{03}
	Female	30	12.10	1.185				

The result in table 6 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 a significant difference in the mean achievement scores of male and female Chemistry students taught the concept of Acid, Base and pH using 7E teaching strategy. Hence, the null hypothesis three 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 Acid, Base and pH using 7E teaching strategy.

Hypothesis three: There is no significant difference in the mean achievement scores of male and female Chemistry students taught the concept of Acid, Base and pH using 9E teaching strategy.

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

Teaching Strategy	Gender	N	Mean	SD	df	t-cal	t-crit	Decision
9E teaching strategy.	Male	20	17.37	1.832	51	0.87	2.01	Accept H_{02}
	Female	25	14.88	3.245				

The result in table 5 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 Acid, Base and pH using 9E teaching strategy. Hence, the null hypothesis two of no significant difference is accepted. This result shows that male and Chemistry students taught the concept of Acid, Base and pH using 9E teaching 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 7E and 9E teaching strategies on students' academic achievement in the concept of Acid, Base and pH in Chemistry. The findings of this study revealed that the academic achievement of students taught concept of Acid, Base and pH in Chemistry using 9E teaching strategy was significantly enhanced than their counterparts taught using 7E strategy. This was evident as students taught using the 9E teaching strategy achieved a higher mean gain score compared to those taught using the 7E strategy, with the independent samples t-

test showing $t(94) = 4.96$, $p < .05$. This finding suggests that the structured phases of the 9E model might better facilitate conceptual understanding of complex topics such as Acid, Base and pH. The design of the 9E model encourages active learning and continuous assessment, as well as e-research which can help students integrate new knowledge more effectively into their existing schema. The result of this finding aligns with the studies of Abdullahi, Ishak and Musa (2021) who found that students taught using 9E strategy achieved academically higher than their counterpart taught using conventional strategy. Also, the finding lends credence to Juliana, Dinah and Stella (2021) whose findings showed that the 7E learning model greatly affected academic achievement according to the random effects model.

The findings of this study also revealed that both male and female students performed similarly. This indicates that the 7E and 9E strategies operate 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 finding is in line with Umanah and Sunday (2022) 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) and Abasi (2018) 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), Akpan, et al., (2025) have noted similar patterns, suggesting that well-designed constructivist approaches can bridge performance gaps between male and female learners.

Conclusion

It is evident from the findings of this study that the use of 9E teaching strategy is more effective in facilitating and enhancing students' academic achievement in Chemistry than 7E strategy. By implication, this affirmed that teaching strategies are also a determinant of students' academic achievement in chemistry. It is also evident from the findings of this study that no gender disparity exists in the achievement of male and female chemistry students taught using 7E and 9E strategies. Thus, 7E and 9E are significantly very useful strategies for meaningful learning and enhances academic achievement of students regardless of their gender.

Recommendations

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

1. Teachers should use 9E strategy in teaching of Acid, Base and pH, and other concepts in chemistry instead of using the traditional method as this strategy will help them to achieve the stated objectives of the lesson and subsequently enhance students' academic achievement in chemistry.
2. 9E strategy should be enriched more with other teaching strategy 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 9E teaching strategy 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 learning cycle models.

References

Abasi, A. U. (2018). Teachers' instructional strategies and upper basic students' academic achievement in mathematics in Essien Udim Local Government Area of Akwa Ibom State. *International Journal of Educational Benchmark,* 9(3) 76-83.

Abasi, A. U. & Ado, I. B. (2021). Effect of problem-solving method on secondary school students' academic achievement and attitude in mathematics in Uyo Local Government Area of Akwa Ibom State. *The Journal of Mathematical Association of Nigeria,* 46(1) 342-352.

Adam, U. A., Lameed, S. & Ayodele, B. B. (2022). Attaining meaningful learning of ecological concept: A test of the efficacy of 7E learning cycle model. *International Journal of Educational Research, 5*(4), 18-29.

Adesoji, F. A., & Idika, M. I. (2015). Effects of 7E learning cycle model on secondary school students learning outcomes in chemistry. *Journal of the International Society, 19*(1), 7-19.

Akpan, Anyanime O. Atabang, Atim A. & Udofia, Sabbath E. (2025). Online learning platforms and bridging of digital knowledge gap among postgraduate students in Akwa Ibom State. *International Journal of Education Framework (IJEFA)* 5(1) 43 – 56.

Akpan, A. O., (2022). Infographics as instructional resource for teaching basic science and technology in junior secondary schools in Akwa Ibom State. *Journal of Basic Education in Nigeria. 8,* 197-218.

Akpan, A. O., Akpan, I. F. (2017). Facilitation activity strategy and pre-service teachers' achievement in basic science and technology. *Journal of Educational Research and Human Development* 4(1), 13-31.

Akpan, A. O., Umanah, F. I. & Abasi, A. U. (2025). Effect of virtual field trip and field experience strategies on performance in Air pollution among college of education students in Akwa Ibom State, Nigeria. *Zamfara International Journal of Education*, 5(3), 110-117.

Akpan, E. I., Umanah, F. I. & Udofia, S. E. (2025). Comparative effects of learning cycle models and students' academic achievement in chemistry in Uyo, Akwa Ibom State. *GAS Journal of Education and Literature (GASJEL),* 2(11) 27 – 38.

Ani, M., Obodo, A. C, Ikwueze, C. C. & Festus, I. T. (2021). Effect of gender on basic science students' academic achievement in secondary schools. *Unizik Journal of Educational Research and Policy Studies*, 9, 36-43.

Balta, N., & Sarac, H. (2016). The effect of 7E learning cycle on learning in science teaching: A metaanalysis study. *European Journal of Educational Research, 5*(2), 61-72.

Basri, H., & As'ari, A. R. (2019). Investigating Critical Thinking Skill of Junior High School in Solving Mathematical Problem. *International Journal of Instruction*, 12(3), 745-758.

Binder, T., Sandmann, A., Sures, B., Friege, G., Theyssen, H., & Schmiemann, P. (2019). Assessing prior knowledge types as predictors of academic achievement in the introductory phase of biology and physics study programmes using logistic regression. *International Journal of STEM Education, 6*(1).

Edem, S., Akpan, I. & Udofia, S. (2023). Teachers' use of multiple resources and students' academic performance in chemistry. *Inter-Disciplinary Journal of Science Education (IJ-SED),* 4(2) 176-187

Ekpo, I., Utibe, U. & Udofia, S. (2024). Demonstration and enhanced lecture teaching methods, combined with care of equipment and students' achievement in practical physics in secondary schools in Nsit- Ubium, Akwa Ibom State, Nigeria. *Journal of Centre for Distance & e-Learning* 3(1) 67 – 78.

Goar, N. S., Buwah, J. S. & Duktur, S. L. (2021). Challenges of teaching and learning entrepreneurship in business education in Nigeria. Nigerian *Journal of Business Education, 8(1), 79-85.*

Ibezim, E. V. (2018). Factors affecting chemistry students' performance in secondary schools in Mbaitolu local government area in Imo state. *International Journal of Advanced Multidisciplinary Research, 5*(5), 1-7.

Juliana, C., Dinah, S. & Stella, K. (2021). The study concluded that 7E Learning Cycle Model has the potential of improving students' academic achievement. *African Journal of Education, Science and Technology,* 6(3), 312-322.

Kachel, S. Steffens, M. C. & Niedlich, C. (2016). Traditional masculinity and femininity: validation of a new scale assessing gender roles. *Frontier in Psychology, 7,* 9-56.

Kaur & Gakhar (2018). Integration of high-tech communication practices in teaching of biology in indonesian higher education institutions. *International Journal of Education and Practice, 8(3):346-58*

Oyalchirome, A. H. & Akpan, A. O. (2024). Effect of experimentation on chemistry students' conceptualization of acid, base and salts. *Inter-Disciplinary Journal of Science Education*, 5(2), 15 -23

Sibomana, A., Karegeya, C., & Sentongo, J. (2021). Factors affecting secondary school students' academic achievements in chemistry. *International Journal of Learning Teaching and Educational Research*, *20*(12), 114–126.

Sunday, E. S., Umanah, F. I & Udofia, S. E. (2025). Enhancing students' academic achievement in chemical reactions through computer based molecular modeling and Hackathon teaching strategies. *International Journal of Research and Innovation in Social Science (IJRISS),* IX (111S) 1815 – 1824.

Udofia, S., Akpan, A., Babayemi, J. & Ekpo, I. (2025). Location, demonstration, enhanced teaching methods and students achievement in practical physics in public secondary schools in Nsit Ubium. *Journal of research in education and society* 16(2) 65 – 78.

Udofia, S., Akpan, A., Babayemi, J. & Jonah, N. (2024). Integration of ict tools and resources among secondary school science teachers during classroom lesson deliveries. *International Journal of Vocational Education, Library and Information Science* 2(1) 149 – 155.

Udofia, S. E. & Christopher, A. G. (2017): Science education benchmarks for sustainable national development. *African Journal of Educational Assessors (AJEA),* 3(1), 171 – 180.

Udofia, S. E. & Sambo, D. D. (2017): Effect of palm wine additives on fermentation of sugar and its application in determining order of reaction. *International Journal Educational Benchmark (IJEB)*, 6(1), 1-12.

Udofia, S. E. (2024). Effectiveness of vista demonstration learning strategies on students' achievement in chemistry, *Ibadan Journal of Education Studies (IJES)* 2(142), 63-71.

Uloko, E. S. & Usman, K. O. (2018) Effect of ethno mathematics teaching approach and interest on Students' achievement in locus. *Benue Journal of Research in Science and Science Education, 1*(1), 81-91.

Umanah, F. I. & Sunday, E. S. (2022). Crosswords puzzle, flashcards teaching strategies and senior secondary school students' academic performance in chemistry. *International Journal of Educational Benchmark (IJEB), 22*(2), 1-12

Umanah, F. I. & Akpan, A. O. (2024). Effects of 5E and 7E learning cycles models on students' academic achievement and retention in chemistry. *Global Journal of Academic Research Forum, 12(1), 92 -106.*

Umanah, F. I. & Etiubon, R. U. (2022). Effects of roundrobin and jigsaw cooperative strategies on chemistry students' academic achievement on hydrocarbons in senior secondary schools, Uyo, Akwa Ibom State, Nigeria. *African Journal of Educational Assessors, 9*(1) 41 - 56.

Umanah, F. I. & Udo, M. E. (2015). Making the teaching and learning of Boyle's and Charles's laws fun using heads-on, hearts-on and hands-on activities. *Science Teachers Association of Nigeria, Chemistry Panel Series, 14,* 35 - 38.

Umanah, F. I. (2024). Effects of roundrobin brainstorming and think-pair-share cooperative teaching strategies on students' academic performance in chemistry. *Ibadan Journal of Educational Studies, 21*(1&2), 1- 9.

Umanah, F. I., Arop, B. A. & Neji, H. A. (2024). Chemistry educators' awareness and utilization of green chemistry principles in tertiary institutions in Akwa Ibom State: Implications for environmental sustainability. *Journal of Science, Technology and Mathematics Pedagogy, 2*(2), 97-109.

Umar, U. S., & Samuel, R. I. (2023). Influence of Gender Stereotyping on Achievement in Basic Science among Upper Basic School Students. International Journal of Current Innovations in Advanced Research, 1(6), 14–19.

UmoAbasi, E., Akpan, I. & Babayemi, J. (2024). Effect of three-step interview strategy on performance in basic science concepts among secondary school students in Onna, Akwa Ibom State. *Zamfara International Journal of Education (ZIJE)* 4(3), 13 – 20.

Vale, C. (2019). Trend and factor concerning gender and mathematics in Australia. Retrieved from http/www.faqs.org/periodical.