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IMPLEMENTING THE 7E INSTRUCTIONAL MODEL TO ENHANCE UNDERGRADUATES' ACADEMIC ACHIEVEMENT IN CHEMISTRY

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Abstract

Education plays a crucial role in shaping students' academic success and future career prospects. The quality of instructional methods significantly effects learning outcomes, particularly in science subjects where conceptual understanding is essential. This study explores the implementation of 7E instructional model to enhance student learning and academic performance. This study adopts a quasi-experimental, Pretest–Posttest non-equivalent control group research design. A non-random, purposive sampling technique was employed due to the nature of intact classes. Two comparable intact groups were selected, one is experimental group (n = 28) and the other as control group (n = 32). The experimental group was taught using the 7E Constructive Instructional Model, whereas the control group continued with traditional lecture-based instruction. This research demonstrates the effectiveness of the 7E Constructivist Instructional Model in enhancing student performance in chemistry. It is recommended that teachers should integrate the application of this strategy into their teaching and learning process. This will promote active learning and improve students' understanding of complex concepts.

Keywords: *7E Instructional Model, Academic Achievement, Chemistry.*

Introduction

Education is a planned and organized effort to provide a learning environment and method that helps students reach their full potential by developing their religious and spiritual force, self-discipline, character, intellect, moral integrity, and necessary skills. Learning is a process that is always changing and has to be improved. The field of education has goals that must be met during the learning process. Not only mastering knowledge but also mastering skills is important for learning. To get good educational results, students need to be able to use what they've learnt and apply it in real life. They need to gain both knowledge and how to use it. (Daki, 2020).

One effective approach to academic success is to integrate your existing knowledge with your current learning. This strategy is compatible with the constructivist approach, which posits that students develop their own ideas by drawing on their existing knowledge. The constructivist learning paradigm is founded on Piaget's theory of cognitive development, which posits that individuals acquire knowledge by independently resolving cognitive challenges (Marfilinda, et al., 2020).

According to Brooks and Brooks (2019), the teacher directed the students to attain scores that exceeded their average scores during each training session. The primary objective of the national curriculum in nearly every country is to help students develop a profound understanding

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of scientific concepts. Students are obligated to participate actively in the learning process in order to achieve this goal. Furthermore, it is crucial to offer students the chance to establish connections between new concepts and their existing knowledge, as well as to motivate them to apply their newly acquired knowledge to articulate their experiences (Shah & Kumar, 2019).

According to Saad et al. (2023), research researchers have been presenting several learning models that have increased students' learning skills over the course of 3E, 4E, 5E, and 7E. Einsenkraft (2003) said that teachers should use seven steps to teach students in class: elicit, engage, explore, explain, elaborate, evaluate, and extend. The 7E model builds on the old 5E model by adding more ways for people to work together, find new things, make sense of them, enhance them, and evaluate them (Kahveci & Lee, 2014). The 7E Learning Cycles stress using what you already know to help you learn or understand new things in a constructivist way. This model uses a constructivist approach to teaching and learning, which makes it a very successful way to help students actively learn new things (Rahman & Vikram, 2017).

Step 1: Elicit (Enhancing initial understanding of students)

Elicit is a part of the lecture routine when the teachers ask questions to the students about what they have already understood about the new topic. Elicit refers to the part of the lecture in which teachers pose enquiries to students regarding their prior knowledge of the forthcoming topic. The 7E learning cycle model, grounded in constructivist approach, aims to connect the elicit phase with the discovery and comprehension of new information (Balta & Sarac, 2016).

Step 2. Engagement

In the engagement phase, students participate in various activities to enhance their focus, recognize their cognitive abilities, and relate their prior knowledge to new concepts. The level of student engagement significantly influences their interest in the subject matter. Teachers instruct students to concentrate in class to enhance their learning. Students engage through demonstrations, reading, and discussions. (Aydin & Coskun, 2011).

Step 3. Exploration

In the exploration phase, students collaborate or engage independently without guidance or oversight from the teacher. Students interact with an object, do experiments, conduct research, and gather data to derive preliminary conclusions. The role of a teacher is to facilitate or create the atmosphere for learning. At this stage, students acquire knowledge by direct engagement with the material, while teachers assist in shaping their concepts and misunderstandings regarding the topic. (Yaman & Karasah, 2018).

Step 4. Explanation

Teachers motivate learners to comprehend concepts and meanings in their own terminology. The concepts that students acquire during the exploration phase are neither complete nor polished. The teacher assists the students in refining and completing that concept. The explanation concluded with pertinent examples illustrating the concepts. The teacher now elucidates the formal definitions that the students have researched. (Khaeruman & Saleh, 2016).

Step 5. Elaboration

The capacity to apply acquired knowledge in a novel setting is a defining characteristic of the elaboration phase. This phase of the instructional model challenges and enhances students' conceptual comprehension while providing additional opportunities for them to practice requisite skills and behaviours. Here learners are encouraged to share their understanding in a new situation and they may be boosted to raise the questions and rationale to investigate more. (Cetin-Dindar & Geban , 2017)

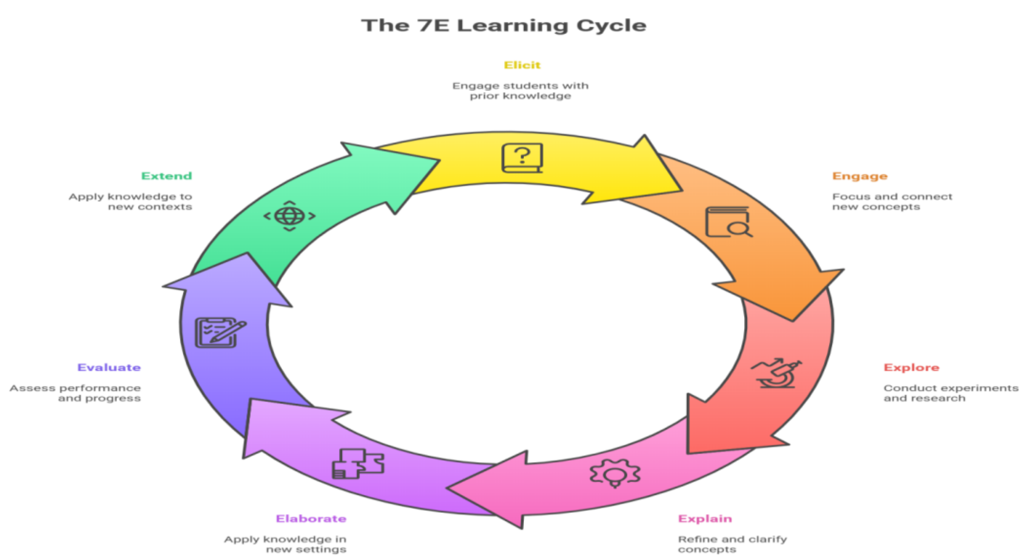
Step 6. Evaluation

In the evaluation phase, the teacher assesses the students' performance regarding the behavioural objectives. In this stage, a teacher uses numerous approaches to assess students, both formally and informally. Teachers accurately assess students' talents, capabilities, and knowledge levels. Teachers assess students' current performance in relation to their previous achievements. The 7Es constructivist method is one example of an innovative way to teach that might help students do better in class. According to situation evaluation is exercised to judge the learning level of learners. (Lay & Cahndrasegaran, 2016).

Step 7.Extend

The final step, extend, focusses on applying the knowledge acquired through inquiry, analysis, and elucidation. Investigating alternative methods for data acquisition and the application of concepts in novel contexts. This helps students in comprehending the relationship between their acquired knowledge and unstudied material. (Saad et al., 2023).

The learning cycle model employed in science education matches the scientific method, particularly in the examination of phenomena occurring on the Earth's surface.. This approach enhances students' inquiry skills and deepens their understanding of scientific concepts through practical research and experimentation (Lasaiba, 2023).



Literature Review

Lestari and Wahyudin (2020) acknowledge the utilization of a 7E strategy to engage and motivate students in their academic pursuits. Rahmy et al. (2019) investigated the impact of the 7E model and direct instruction on maths learners' achievement. According to their findings, there was a statistically significant difference in performance between students in the two groups who were taught directly and using the 7E learning approach.

Istuningsihb et al. (2018) investigated an e-module that used the 7E teaching paradigm as a pedagogical intervention for high school students. The research proved that the use of a scientific approach to studying and the combination of an e-module based on the 7E paradigm of instruction led to an increase in results.

Saleh et al. (2018) investigated the effectiveness of utilizing hypnotism based on the 7E instructional model as the framework of increasing the mathematical problem-solving skills of children and, therefore, their academic achievements. Using the quasi-experimental design, the findings showed that students that have learned mathematical problem-solving with the 7E learning model that has been followed in the hypnoteaching methodology demonstrated a significant improvement in their performance compared to students who had been taught the same in a conventional way.

The study by Fitmur (2018) demonstrated that the 7E learning model contributes to enhancing scientific literacy among younger learners. The quasi-experiment was conducted in a single-group pre-test-post-test research design, and the two assessment scores confirmed the evidential improvement, which implies that the 7E learning model can help elementary-level learners access better the understanding of a scientific subject matter.

A meta-analysis conducted by Balta and Sarac (2016) examined the impact of the 7E teaching approach on learning in science subject. The study's findings indicated that the 7E educational model enhanced children's academic performance. The 7E learning instructional model has been considered an effective approach for use in science classes. Teachers ought to be motivated to implement this approach in their instruction.

Student Academic Achievement in Chemistry

Academic achievement is a broad phrase that includes both quantitative (grades, marks, and GPA) and qualitative (mental growth and development) factors. There are numerous things that affect it, like how motivated students are to study, how much assistance they get from school and teachers, and how easy it is for them to find learning materials and environments (Anwar et al., 2024). Grades or marks based on a set of standards or criteria are usually used to show academic performance (Guterman, 2020). These grades or marks show that the student has met their learning goals.

Chemistry is one of the natural disciplines that helps us understand a lot about the things we use every day, such food, drinks, clothes, medicines, cars, and many other things. Therefore, it can't be isolated from our daily lives and nature (Rusmansyah et al., 2019). So, it is important to learn and understand chemistry in order to understand the things that shape our lives. Also, getting a better understanding of chemistry principles not only helps students learn more about science, but it also ties what they learn in class to the real world.

Teachers have to do their part to make all of this hype come true. Because good teaching is linked to new ways of teaching and learning, good communication skills, good relationships with students, good classroom management abilities, and ongoing professional growth. All of these things are directly linked to better educational performance, which is shown by better student learning outcomes. In several worldwide studies, it has also been proven that the efficacy of teachers is linked to the academic achievement of their students. Some of the things that are known to help students do better in chemistry are good teaching, good communication, and a good relationship between professors and students (Akram & Kamran, 2025).

Impact of Instructional Method Upon Students Achievements

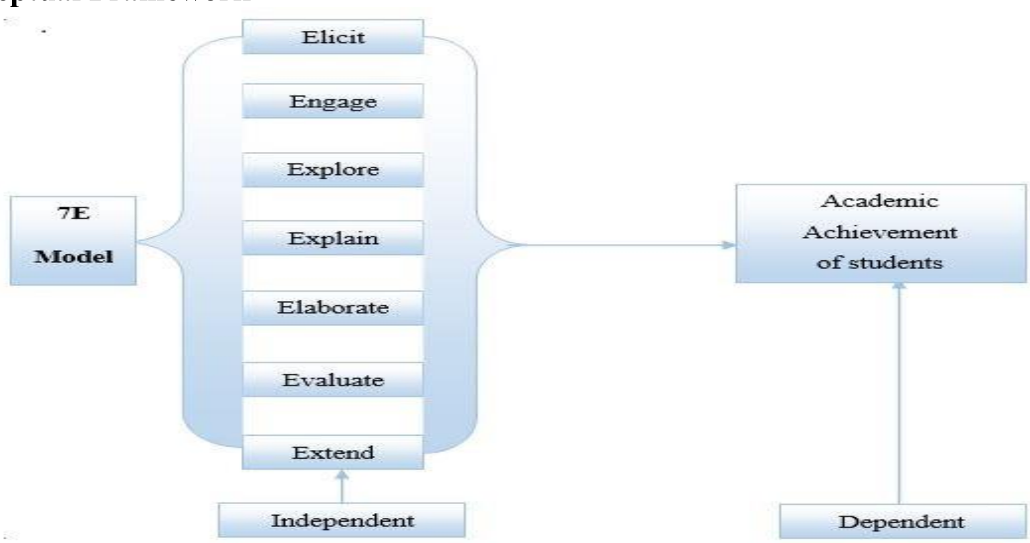
Many factors can influence successful student achievement, but classroom instruction and instructional methods are the most important. It's vital to note that not all students study in the same way or at the same pace. Students are like leaves on a tree: no two are exactly the same. Each student has a distinct learning style, just as a leaf has a variety of colors, shapes, and sizes. Classroom instruction, or teaching method, is the most critical factor influencing student accomplishment. Teaching is a continuous process that entails instilling desirable changes in students via the use of appropriate techniques. According to Farrington et al. (2012), different instructional approaches are necessary for different grade levels of students, hence educators must employ the right teaching strategies. The writers went on to say that quality and appropriateness would undoubtedly improve a student's academic performance. According to Ezenwafor and Molokwu (2015), the instructional approach is the most important factor in improving academic attainment.

Theoretical framework

Constructivism helps you build your own knowledge and figure out what is true, based on your own experiences as a learner. Students add to what they already know to build their circle of knowledge. Everyone tries to make their learning different, and constructivism theory made it feasible. In a constructivist classroom, the teacher's job is to help the students do different activities and learn. Teachers need to know about both modern teaching methods and learning theory (Sigelman & Rider, 2012).

Students who learn through constructivism do better than students who learn in a traditional way. The way constructivist teachers teach helps students remember, grasp, and use concepts in multiple situations. Students in regular classrooms acquire concepts that are only relevant for a short period and are easy to forget. A constructivist classroom helps students understand concepts in a logical fashion and encourages them to make sense of what they read. The constructivist method helps teachers get their students interested in the learning process (Franzoni & Assar, 2009).

Conceptual Framework



Significance of the Study

This study holds profound significance for university students by providing empirical evidence for instructional approaches that can enhance their academic achievement and learning experiences. The investigation of the 7E constructive instructional model's effectiveness will directly benefit students through improved pedagogical practices that promote active engagement, critical thinking development, and deeper conceptual understanding of academic content. For teachers, the study provides a useful method to make their teaching more effective by actively involving students in learning rather than just giving lectures. It helps teachers create lessons that improve student participation and performance. For administrators, the study offers guidance on how to support teachers with training and resources that can improve overall teaching quality. Curriculum developers can benefit by using the findings to design science lessons that follow modern teaching methods and meet the needs of today's learners. Finally, for policymakers, this study gives valuable information that can be used to make better decisions about educational practices, teaching standards, and policies to improve science education at the university level.

Research Objectives

The objective of the study was to:

1. Examine the effect of 7E instructional model on students' academic achievement in chemistry at undergraduate level.

Research Hypotheses

Based on the above objectives, this study sought to answer the following null hypotheses:

1. There is no significant mean difference between pretest scores of control and experiment group on academic achievement of students in chemistry.
2. There is no significant mean difference between posttest scores of control and experiment group on academic achievement of students in chemistry.
3. There is no significant mean difference between pre and posttest scores of control group on academic achievement of students in chemistry.
4. There is no significant mean difference between pre and posttest scores of experimental group on academic achievement of students in chemistry.

RESEARCH METHODOLOGY

This study adopts a quasi-experimental, Pretest–Posttest non-equivalent control group research design. The participants for this study comprised of undergraduate students enrolled in science education programs at higher education institutions in Lahore, Pakistan. Two comparable intact groups from similar academic settings were selected: one served as the experimental group (n = 28), and the other as the control group (n = 32). The experimental group was taught using the 7E Instructional model, whereas the control group continued with traditional lecture method.

Test development

The researcher developed the Chemistry Achievement Test (CAT) by constructing table of specification. Three levels of Bloom's taxonomy (knowledge, comprehension and application) were taken into consideration while constructing the tests. Pre- and post-test results were achievement scores and students were tested on content knowledge. There were 30 items in chemistry achievement test. By reviewing the items with supervisor and subject matter experts in accordance with the course objectives specified in the syllabus, the validity of the instrument was ensured.

Intervention Procedure

The research was conducted at the undergraduate students studying in the first semester. The experimental group was taught using the 7E Instructional model and control group with traditional lecture method. Pretests were conducted for both groups before the intervention began to gather baseline data. The pretest results confirmed the initial equivalence established through randomization, as there were no score differences between the control and experimental groups. The researcher subsequently develops a pre-test that contains the fundamental concepts of the course. The validity and reliability of this pretest were verified, and subsequently, pretests were administered to both groups. The two groups were guided through two separate methodologies over the course of eight weeks. A post-test was conducted for both the control and experimental groups following the conclusion of the treatment. The reliability of the test was checked using Cronbach's Alpha, which was 0.84, showing good reliability for research purposes. This reliability score shows that all test questions measure chemistry knowledge in the same way.

The final version of the Chemistry Achievement Test (CAT) was given to both groups (experimental group and control group) separately before starting the teaching intervention. The examination was administered under identical settings to ensure equitable outcomes. The test had multiple-choice questions to check students' basic knowledge and understanding of chemistry concepts. The pre-test results from both groups were carefully conducted and saved for later analysis. Consequently, the experimental group received instruction through the 7E teaching method, whereas the control group was instructed using conventional teaching methods. At the end, the same test was given again to both groups under the same conditions to see if there were any changes in their chemistry knowledge. All post-test results were collected and organized for analysis. The pre-test and post-test results were then analyzed statistically using SPSS software. The average scores between the experimental and control groups were compared using independent sample t-tests both before and after the test. Paired sample t-tests were used to determine if each group's scores had changed from pre-test to post-test. These statistical tests helped the researcher find out whether the 7E teaching method was effective in improving students' chemistry achievement and ensured the comparison between groups was valid.

Data Analysis and Results

Table 1

Independent sample t-test for comparison of pre-test scores of students' academic achievement in chemistry between the control group and the experimental group.

Group in pre test	N	Mean	SD	*df*	t	Sig.
Control group	32	12.13	3.11	58	0.24	.089
Experimental group	28	11.91	3.72			

Table 1 shows control group (N = 32) had a mean score of 12.13 (SD = 3.11), while the experimental group (N = 28) had a slightly lower mean score of 11.91 (SD = 3.72). The t-value is 0.246 and significance value (p) of .089. This indicates that the difference in pre-test scores between the two groups is not statistically significant.

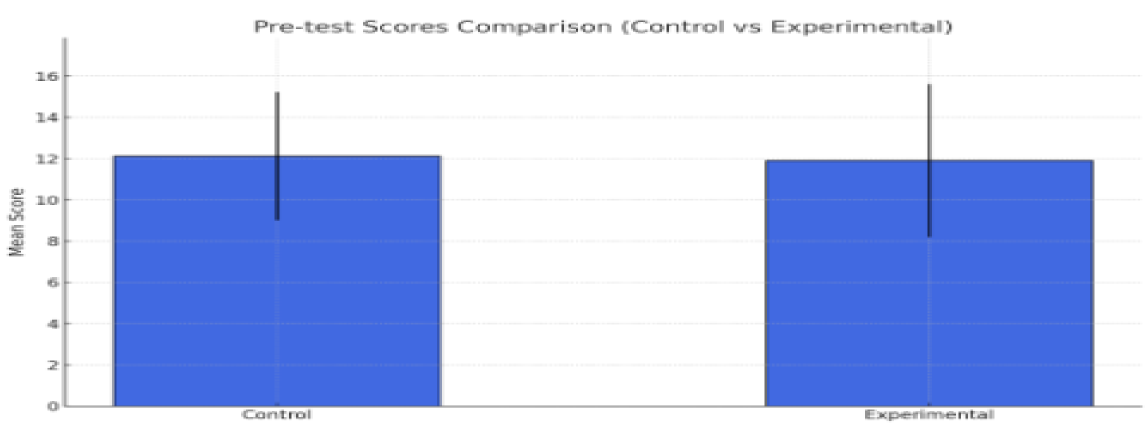


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Table 2

Independent sample t-test for comparison of post-test scores of students' academic achievement in chemistry between the control group and the experimental group.

Group in post test	N	Mean	SD	*df*	T	Sig.	Cohen's d
Control group	32	13.50	3.53	58	-8.69	.01	0.73
Experimental group	28	22.13	4.09				

Table 2 shows the control group (N = 32) achieved a mean score of 13.50 (SD = 3.53), while the experimental group (N = 28) scored significantly higher, with a mean of 22.13 (SD = 4.09). The t-value is -8.69 with and the significance level is .001. This indicates a highly significant difference between the post-test scores of the two groups. Furthermore, the effect size, represented by Cohen's d, is 0.73, which indicates a very large effect, suggesting that the 7E Constructivist Instructional Model had a strong positive impact on the academic achievement of students in the experimental group compared to the control group.

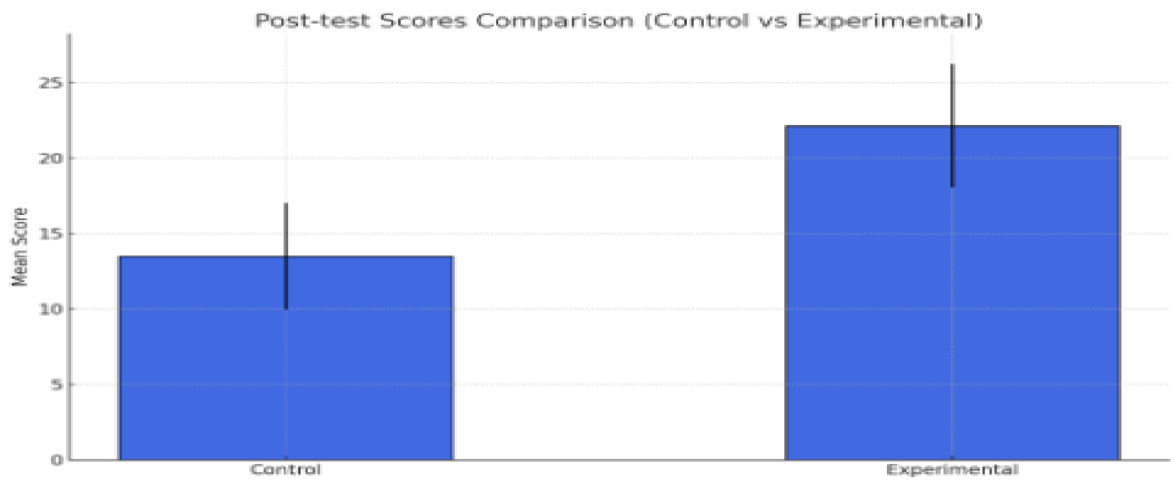


Table 3

Paired sample t-test for comparison of pre-test and post-test scores of students' academic achievement in chemistry within the control group.

Scores of control group	N	Mean	SD	Std. Error Mean	*df*	t	Sig.	Cohen's d
Pretest	32	12.13	3.11	0.46	31	2.98	.01	0.2
Post test	32	13.50	3.53					

Table 3 presents that the mean pre-test score was 12.13 (SD = 3.11), while the mean post-test score increased to 13.50 (SD = 3.53). The t-value is 2.98 and the p-value is .01. This indicates that the improvement in scores from pre-test to post-test within the control group is statistically significant. The effect size, as measured by Cohen's d, is 0.2, representing a small effect that indicates the control group showed some improvement in academic achievement over time.

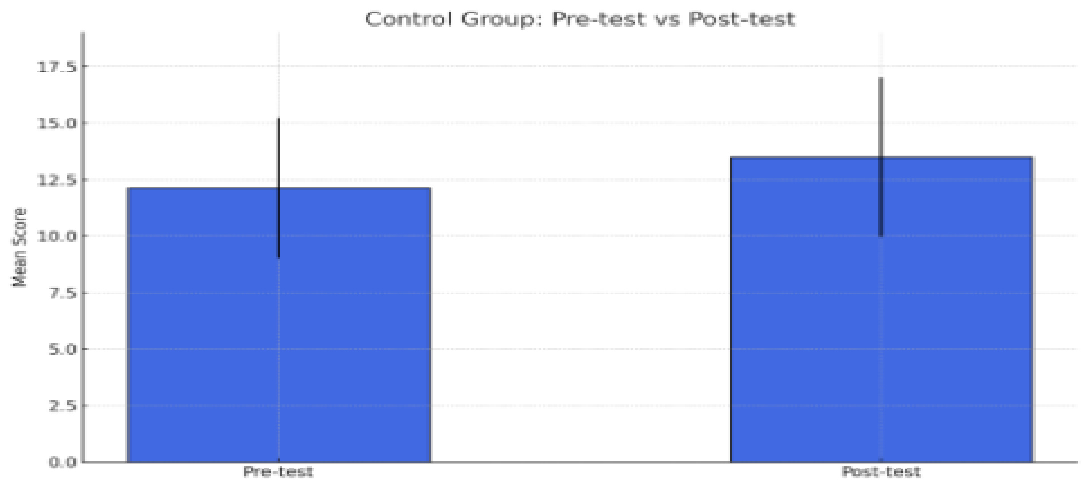
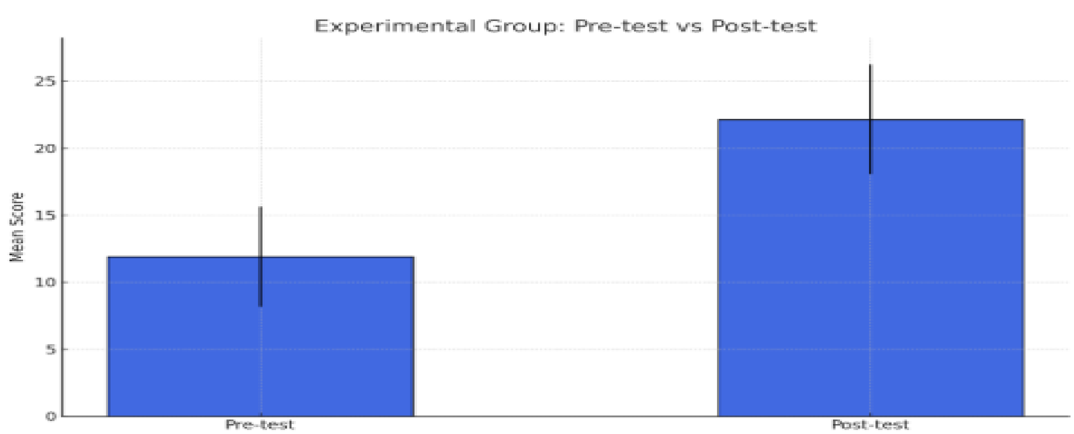


Table 4

Paired sample t-test for comparison of pre-test and post-test scores of students' academic achievement in chemistry within the experimental group.

Scores of experimental group	N	Mean	SD	Std. Error Mean	*df*	t	Sig.	Cohen's d
Pretest	28	11.91	3.72	0.57	27	17.93	.000	0.84
Post test	28	22.13	4.09					

Table 4 displays that the mean pre-test score was 11.91 (SD = 3.72), which significantly increased to 22.13 (SD = 4.09) in the post-test. The t-value is 17.93 with 27 degrees of freedom, and the significance level is .000, which is far below the standard alpha level of 0.05. This indicates a highly significant improvement in students' academic achievement after the intervention. The effect size, measured by Cohen's d, is 0.84, which represents an extremely large effect. This suggests that the intervention had a powerful and strong positive effect on the academic achievement of students in the experimental group.



Major Findings

The results of this study were summarized below for each hypothesis:

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1. There was no statistically significant difference in pre-test scores between the control and experimental groups indicating both groups were academically equivalent before the intervention.
2. The experimental group performed better than the control group on the post-test, marking a statistically significant difference. The results show that the 7E instructional model has a significant impact on students' academic achievement.
3. There was statistically significant improvement within the control group from pre-test to post-test with a small effect size showing limited gains through traditional instruction.
4. There was a highly significant improvement within the experimental group with an extremely large effect size confirming the strong effectiveness of the 7E instructional model in enhancing academic achievement.

CONCLUSION

Students' academic achievement was significantly improved in the experimental group compared to the control group that followed the conventional lecture method. At the beginning of the study, the pre-test scores for the experimental and control groups were identical. This indicated that the proficiency of the students in both groups was equivalent. The experimental group learned via more engaging and student-centered 7E method, while the control group received instruction through conventional lecture method. After the teaching sessions, the experimental group did much better on the post-test than the control group. The control group did make some progress, but it was not much. The experimental group results went up a lot, which shows that the 7E method helped students learn more and understand the issue better. This shows that the 7E teaching style is better than the traditional lecture method in enhancing the academic performance of undergraduate students

DISCUSSIONS

The findings of this study showed that there is a significant difference in academic achievement between students who learnt chemistry using the 7Es instructional learning approach and those who taught it the traditional way. This aligns with the findings of Johnson and Brown (2023), who also determined that 7Es instructional model, resulted in enhanced academic achievement. The pre-test comparison results between the control and experimental groups indicated no statistically significant difference in students' academic performance prior to the intervention. Similar studies in science education found no significant differences at the pre-test stage when groups were randomized randomly or spontaneously (Acar & Tuncel, 2021). The significant improvement in performance of the experimental group indicates that the model facilitates deeper study and thinking that is more scientific. Although the control group performed average on the post-test compared to the pre-test, indicating that traditional instruction does not significantly enhance student learning and active engagement. This supports our previous understanding that while traditional, lecture-based teaching methods may be somewhat beneficial, they don't necessarily foster critical thinking or long-term idea modification in students (Ali, 2020; Prince, 2004).

This research demonstrates the effectiveness of the 7E constructivist instructional model in enhancing student performance in chemistry. The model allows students in actively and significantly constructing knowledge, resulting in enhanced comprehension and improved performance (Yadav & Mishra, 2021). This study discovered a degree of change that is consistent with prior research that has demonstrated the effectiveness of the 7E model in transforming science classrooms and facilitating significant academic advancements among students (Tas & Yilmaz, 2019).

RECOMMENDATIONS

Based on the results, the following recommendations are proposed:

1. It is advised that teachers should integrate the application of this strategy into their teaching and learning process to alienate students, misconceptions about the challenges of learning chemistry in classroom.
2. The model can be integrated to other science subjects to promote inquiry based learning towards the construction of learners' meaningful experience for long-life learning.
3. Curriculum planners should include the 7E model in undergraduate chemistry courses. This will promote active learning and improve students' understanding of complex concepts.
4. Universities should organize professional development sessions on the 7E model. This will equip instructors with skills to deliver student-centered and inquiry-based lessons.
5. Educators should shift from traditional lectures to more interactive, student-focused strategies. The 7E model encourages engagement, exploration, and critical thinking.

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