



Transforming Science Teaching: Investigating the Effect of the 7Es Instructional Model on Secondary School Achievement

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Abstract

The purpose of this study was to investigate the effect of the 7Es Instructional Model on the academic achievement of secondary school students in science. A quasi-experimental pretest-posttest control group design was employed. The sample consisted of 119 students selected through random sampling from female secondary schools in Rawalpindi. The students were randomly assigned to an experimental group (60 students) and a control group (59 students). The experimental group was taught using lesson plans developed according to the 7Es Model, while the control group received instruction through traditional teaching methods. A researcher-developed Science Achievement Test (SAT) was administered as pretest and posttest to collect data on academic achievement. The validity of the test was established through expert review and item analysis, and reliability was confirmed using Cronbach’s alpha. Data were analyzed using the Wilcoxon Signed-Rank test and Mann-Whitney U test at the 0.05 level of significance. Findings revealed that students in the experimental group demonstrated significantly higher academic achievement than those in the control group ($p < 0.05$). Hence, the 7Es Instructional Model proved to be effective in improving students’ academic achievement in science.

Keywords: 7Es Instructional Model, Academic Achievement, Science Education, Secondary School Students

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Introduction

The way we live, work, and study has changed significantly in the twenty-first century. Because of the growing complexity of the world's problems, people need to be able to solve problems, think critically and be creative. Educational institutions have been asked to change their teaching methods in response to these demands in order to foster deeper learning and improve essential skills. The future of people and civilizations is greatly influenced by science education. It encourages problem-solving skills, creativity and critical thinking necessary for dealing with global issues.

However, students' performance in science subjects is inadequate in Pakistan. For the majority of students, these subjects appear abstract and challenging due to memorization of facts, methods, and the teacher-centered approach to teaching. A large number of studies have shown that insufficient teaching strategies and an excessive focus on theoretical understanding are responsible for students' substandard performance in science classes (Appiah & Beccles, 2022; Libata, Ali, & Ismail, 2021; Ndayambaje, Bikorimana, & Nsanganwimana, 2021; Gyampon et al., 2020; Jufrida et al., 2019; Majo, 2018).

The effectiveness of science education may be hampered by traditional teaching approaches, which frequently emphasize rote memorization and passive learning. In order to improve this situation, science educators aim to use more effective teaching practices to enhance positive classroom engagement and boost student learning. Henceforth, the main advancement in science education will be the investigation of methods that provide students with the chance to engage in critical thinking and reflection (Noreen, Iqbal, & Hayat, 2024). Therefore, encouraging in-depth comprehension and engagement in science subjects requires a constructivist approach that prioritizes active learning, practical experiences, and student-centered education. By active participation in the learning process, students develop individualized learning methods and gain new knowledge by drawing on their existing understanding (Balta & Sarac, 2016).

In Pakistan, like many other countries around the globe, constructivist approach is recommended by the National Curriculum (Curriculum Wing, 2009) of general science which demands active learning, inquiry based learning, cooperative learning, collaborative learning, problem-solving based learning, and experiential learning in the classroom. Instructional models that engage students actively are necessary in learning environments if students are to take an active role in teaching/learning process and apply their own efforts to acquire the knowledge.

Balta and Sarac (2016) claim that constructivist learning theory, is the source of all modern instructional models found in the literature. With the use of instructional models, teachers can carry out a range of meaningful activities that foster students' critical thinking abilities. Additionally, they provide content information, draw students attention, provide long-lasting learning, alter learners' perceptions of science and make learning process more enjoyable and productive. The instructional models are found in the literature in a number of variations, ranging from 3E to 7E. Since the 7Es Model incorporates every aspect of the constructivist instructional method, it is regarded as one of the effective and most popular models that are suggested for teaching science (Eisenkraft, 2003). It was developed by Eisenkraft (2003) as an extension of 5Es Model, with guidance of Piaget's mental functioning model. This is a seven-step model, which is used to assemble and prepare lesson plans, namely "elicit, engage, explore, explain, elaborate, evaluate, and extend". It was stressed that the first steps in the learning process should be: (1) eliciting the learners' prior knowledge; (2) engaging the learners with a distinct event to pique their interest; (3) exploring the knowledge and skills

of the learner; (4) explaining the concepts by letting the students understand it thoroughly; (5) elaborating the concepts further through questioning; (6) evaluating the learners' performance by using formative assessment; (7), extending the knowledge of the learner by assisting them in making connections between the different context of the new concept and transfer newly gained learning.

Numerous research have been carried out throughout the world to investigate how the 7Es instructional model affects learning. Numerous academic publications have reported on its impacts on learning (Rogayan, 2022). The literature review indicates that the 7E instructional model can improve retention ability of the students (Abdullahi et al., 2021; Adam, Lameed & Ayodele, 2022); boost academic achievement (Noreen, Iqbal, & Hayat, 2024; Cherono et al., 2021; Gyampon et al., 2020; Sarac & Tarhan, 2017); foster conceptual understanding of science (Ibrahim et al., 2022; Wodaj & Belay, 2021); develop science process skills (Hartini, Abyati & Salam, 2020); improve students' curiosity and critical thinking abilities (Abdullahi et al., 2021); and enable the students to actively engage in learning activities.

According to a study by Noreen, Iqbal, and Hayat (2024) examining the effect of the 7Es Instructional Model on students' performance in science at the elementary school level, the 7Es Model is superior to the traditional lecture style of instruction. Students taught using the 7E instructional strategy outperformed those in the control group on the posttest. In a similar vein, Mekonnen (2024) studied whether the performance of students in biology was affected by combining computer-assisted instruction with the 7Es instructional model. The results demonstrated that students who received instruction using the 7Es model performed better in posttest than the students who were taught by traditional method. Libata and Ali (2022) claim that because the 7Es model was created to allow students the opportunity to explore ideas, using it in scientific instruction boosts students' success and conceptual attainment more effectively. Science teachers will engage students in activities distinct from traditional teaching when they apply the 7Es Model. As a result, research in the literature shows that pupils learn differently from those in a traditional classroom.

Additionally, the 7Es model raises students' efficacy in science (Errabo et al., 2021) and improves students' performance (Cajayon & Benavides, 2022; San Miguel, 2021; Errabo et al., 2021 & Tecson et al., 2021). This implies that the method may be applied to enhance students' performance in scientific classes and raise their academic status. Students' engagement and academic success may rise when engaging instructional techniques like the 7Es model are used (Rogayan, Padrique, & Costales, 2021).

In a similar spirit, Abdullahi et al. (2021) ascertained whether traditional teaching approaches are superior to the 7Es instructional model. Students taught utilizing the 7Es instructional model performed better than the students who were taught by traditional techniques. Furthermore, 80% of the information taught through the 7Es model was recalled, compared to 10% recalled through traditional methods. A study on the effects of the 7Es model on learners' performance and attitudes in biology by Cherono (2021) found that students' academic performance is enhanced by the 7Es model, which also enables active participation in learning and idea sharing.

The model yields better student achievement in biology than the teacher-centered method, according to Abdullahi, Asniza, and Muzirah (2021), who studied the effect of the 7Es model on the achievement and retention of students in biology in public secondary schools. Villacrusis and Beloy (2021) found that the 7Es model enhanced students' performance and retention of environmental science knowledge. The research suggested that educators apply

the 7Es approach to other scientific courses, such as Physics, Chemistry, and Biology, in addition to environmental science teachings.

Based on the results of the study conducted by San Miguel (2021), it was concluded that there is a significant difference between the academic achievement of students who received traditional instruction and those who received the instruction by 7Es model. When the 7Es inquiry-based method is employed instead of the standard technique, the students perform better. Studies have demonstrated, according to Libata, Ali, and Ismail (2021), that the instructional model is a useful tool for teaching ideas and has a beneficial influence on certain teaching materials. Additionally, it improves students' performance, can gradually raise their level of awareness, helps them develop or strengthen positive attitudes toward their classes, and gives them access to science, experimentation, and practical thinking (Gök, 2014; Balta & Sarac, 2016; Turgut, Colak, & Salar, 2017; Vick, 2018). Because the 7Es Model was created to allow students the opportunity to explore ideas, applying it to scientific instruction boosts students' performance and conceptual attainment more effectively.

The 7Es Model is significantly effective than the traditional lecture method, according to a study by Marfilinda et al. (2020) that looked at the effect of the 7Es instructional model on students' achievement in basic science. The students in the 7Es instructional model group performed better than their counterparts in the lecture method group. According to prior research, using the 7Es Instructional Model can enhance students' learning outcomes and general scientific skills, as reported by Fatimah and Anggrisia (2019). Vick (2018) showed that students' performance in inquiry lab-based questions in the Advanced Placement test was positively affected by the use of the 7E model inquiry labs in physics.

Adak (2017) reports that research has been done on constructivist education and the impact of the 7E model on student learning. Additional benefits of the 7Es model include improving student achievement, raising awareness over time, enabling students to develop or strengthen positive attitudes toward their courses, and giving them access to science, experimentation, and practical thinking (Turgut, Colak, & Salar, 2017). Students' performance and conceptual attainment are increased more effectively when the 7Es model is used to science teaching since it is designed to allow students to freely explore concepts. Teachers will utilize a practice distinct from a traditional teaching method when they implement the 7E instructional model. As a result, literature shows that students learn differently than what they would in a traditional classroom (Balta & Sarac, 2016). The 7Es instructional model clearly has a positive effect on students' achievement, as demonstrated by the results of a meta-analysis of its efficacy in science teaching carried out by Balta and Sarac (2016). The meta-analysis included 35 different effect sizes from 24 experimental studies, which included 2918 students. Three of the effect sizes had negative effects, while the remaining thirty-two had positive effects. To fully capitalize on the educational advantages, more complex 7Es intervention designs are suggested by the discrepancy between the impact sizes and durations.

A considerable body of research has demonstrated the positive effects of the 7Es Instructional Model on students' learning outcomes across different educational contexts (Rogayan, 2022). International studies have consistently reported that the 7Es framework enhances conceptual understanding, motivation, and academic achievement in science subjects. However, most of these studies have been conducted in elementary or tertiary education, with limited attention towards its effect at secondary school level where foundational scientific reasoning is developed. Within Pakistan, empirical investigations remain scarce and often lack rigorous experimental designs, validated instruments, and systematic analysis of instructional fidelity. Moreover, the effect of the 7Es Model on students'

achievement in science, particularly at secondary level has not been comprehensively examined using reliable and contextually validated tools. Addressing these limitations, the present study investigates the effect of the 7Es Instructional Model on the academic achievement of secondary school students in science, thereby contributing empirical evidence to strengthen research-based instructional practices in the Pakistani context. This study also provide guidance for teachers, school administrators, and policymakers to improve science education outcomes.

This study has the following objectives: 1. to find the academic achievement of the secondary school students taught through 7Es instructional model and traditional method; 2. to investigate the effect of 7Es instructional model on academic achievement of secondary school students.

Theoretical Framework

Constrcutive theory served as the foundation of this study emphasizing that the learners actively construct knowledge through experience, reflection, and social interaction. It integrates cognitive constructivism (Piaget, 1970) and social constructivism (Vygotsky, 1978) to form a coherent framework for understanding how students learn individually and collaboratively. Constructivism promotes meaningful learning by activating previous knowledge and encouraging students to connect new information with existing experiences (Cherono, 2021; Altun & Yucel-Toy, 2015).

Piaget's cognitive constructivism sees learning as an active process, where learners develop new concepts based on prior understanding. Through assimilation and accommodation, they reorganize cognitive structures to make sense of new experiences. The 7Es instructional model aligns with these principles by guiding learners through stages—from explore to elaborate—that reflect Piaget's processes of adaptation. Vygotsky's social constructivism emphasizes the role of Zone of Proximal Development (ZPD) and social interaction, where learning occurs through teacher scaffolding and peer collaboration (Vick, 2018). The engage and elaborate phases of the 7Es model embody these ideas, fostering shared understanding through dialogue and cooperative learning.

By structuring learning into seven constructivist stages, the 7Es model operationalizes these theories, promoting curiosity, hands-on exploration, reflection, and real-world application. This study applied the model to secondary science teaching, empirically testing its effectiveness in enhancing academic achievement and advancing constructivist classroom practice.

Methodology

Research Design

This study used a quasi-experimental design, specifically the Pretest–Posttest Control Group Design (Fraenkel, Wallen & Hyun, 2018), to examine the effect of the 7Es instructional model on students' academic achievement. In this design, both experimental and control groups are tested before (pretest) and after (posttest) the intervention to determine the effect of the treatment.

Random assignment was not possible because of the school's existing class structure; therefore, intact classes were assigned to experimental and control groups. The experimental group received instruction through the 7Es model (Elicit, Engage, Explore, Explain, Elaborate, Evaluate, Extend), while the control group was taught using the traditional method. To assess baseline knowledge, a pretest was administered to both groups, followed by the teaching intervention. After completing the intervention, a posttest was conducted to measure changes in academic achievement.



Experimental Group	O_{X_1}	X	O_{X_2}
Control Group	O_{C_1}	C	O_{C_2}

Figure 1: Research Design

Notes: O_{X_1} = pretest of Experimental Group; O_{C_1} = pretest of Control Group; X = intervention (teaching through 7Es Instructional Model); O_{X_2} = posttest of Experimental Group; O_{C_2} = posttest of Control Group; C = no intervention (teaching through Traditional Teaching Method - Lecture method)

This design enabled a comparison of learning gains between the two groups, thereby determining the effect of the 7Es instructional approach on students' academic performance.

Population and Sampling

The target population comprised all arts students enrolled in 172 female secondary schools of District Rawalpindi during the 2025-2026 academic year, while the accessible population included arts students from 45 female secondary schools of Tehsil Rawalpindi. A two-stage random sampling technique was employed (Fraenkel, Wallen, & Hyun, 2018). In the first stage, a school was randomly selected from a list of institutions with high enrollment in arts groups (so that the formation of control and experimental group would be possible), obtained from the School Information System (Secondary Education Department, Government of Punjab, 2025) website. In the second stage, two ninth-grade arts sections from the selected school were randomly chosen and assigned to experimental and control groups. The experimental group consisted of 60 students, and the control group included 59 students, making a total sample of 119 participants.

Instrument for Research

Achievement Test

The achievement test was developed by the researcher using the *General Science* textbook prescribed by the School Education Department, in accordance with the official syllabus. A table of specifications guided the development of items aligned with the relevant SLOs and Bloom's Taxonomy levels. The test included multiple-choice questions, short-questions and long question, following the paper pattern of the Board of Intermediate and Secondary Education (BISE). Content was drawn from Units 3 and 4 of the textbook to assess students' understanding of the targeted subject matter.

Since the medium of instruction in most public schools is Urdu, the test was translated into Urdu to ensure clarity and accessibility for all students. The same instrument was used as both pretest and posttest to measure academic achievement before and after the intervention. To establish validity, the test underwent expert review and item analysis to assess content accuracy and item performance. Reliability was confirmed through Cronbach's alpha, which yielded a high internal consistency coefficient ($\alpha = 0.882$), indicating that the instrument was both valid and reliable for assessing students' achievement in general science.

Intervention

The intervention comprised 14 lesson plans developed by the researcher using the 7Es Instructional Model. These lessons were designed from Units 3 and 4 of the *General Science* textbook, selected according to the Grade 9 syllabus outlined by the School Education Department. Each lesson followed the 7Es sequence in alignment with the relevant Student Learning Outcomes (SLOs).

Intervention Plan

The instructional intervention was implemented over eight weeks, consisting of 40 sessions (five 40-minute sessions per week). To ensure instructional consistency, the researcher personally conducted all sessions. Two independent observers attended all 14 lessons and used

a structured fidelity checklist to verify adherence to the 7Es model. The checklist was validated by two experts in science education and educational psychology. Inter-rater reliability showed high agreement (Cohen’s $\kappa = .89$ for the experimental group and $\kappa = .91$ for the control group), indicating consistent implementation across sessions.

For the control group, the same content and duration were taught using the traditional lecture method. A separate fidelity checklist ensured that teacher-centered strategies, textbook explanations, and limited student interaction were maintained, without elements of the 7Es model. To ensure validity of the lesson plans, four subject specialists and experienced teachers reviewed each plan for alignment with SLOs, Bloom’s Taxonomy, and the 7Es stages. Reliability was confirmed through independent observation of implementation using the fidelity checklist.

Procedure

To conduct the study, formal permission from the District Education Officer, Rawalpindi and the head of the selected secondary school, was obtained by the researcher in order to collect data from ninth-grade students. After approval, control and experimental group was formed from the selected schools.

Initially, a pretest (achievement test) was administered to both groups, to determine their baseline knowledge. The pretest scores were recorded for subsequent data analysis. The control group was taught by the traditional lecture method, while the experimental group received instruction by 7Es Instructional Model through researcher-developed lesson plans. The instructional content for both groups was identical and based on the prescribed syllabus.

Each group attended five sessions per week, with 40-minute duration for eight weeks. After the intervention, posttest was administered to both groups in order to assess their academic achievement. The comparison of posttest and pretest scores enabled the researcher to determine the effect of the 7Es Instructional Model on students’ academic performance in general science.

Data Analysis and Findings

Before conducting statistical analyses, the data was screened to test the normality and homogeneity of variances. The Shapiro–Wilk test was used to assess the normality of score distributions, while the Brown–Forsythe test examined the equality of variances between groups.

Table 1: Test of Normality

Variable	N	W	p-value
Pretest	119	0.899	< .001
Posttest	119	0.865	< .001

Results of the Shapiro–Wilk test revealed that both pretest ($W = 0.899, p < .001$) and posttest ($W = 0.865, p < .001$) scores significantly deviated from normality, indicating that the data was not normally distributed.

Table 2: Test of Equality of Variances

Variable	F	df ₁	df ₂	p
Posttest	7.707	1	117	.006
Pretest	22.601	1	117	< .001

The Brown–Forsythe test showed significant variance differences between groups for both pretest ($F(1,117) = 22.601, p < .001$) and posttest ($F(1,117) = 7.707, p = .006$).



Since both the assumptions of normality and homogeneity of variance were violated ($p < .05$), the use of parametric tests such as the t -test was considered inappropriate. Therefore, non-parametric statistical tests were employed for subsequent analyses to ensure the robustness and validity of results.

1. Descriptive Analysis

The descriptive statistics, including mean and standard deviation, summarized the performance of both the control and experimental groups on the pretest and posttest measures of academic achievement.

Table 3: Descriptive Statistics of Pretest and Posttest Scores

Variable	n	Mean	SD	Total (N = 119)
Pretest (Control)	59	13.51	2.046	12.70
Posttest (Control)	59	24.69	2.860	32.31
Pretest (Experimental)	60	11.90	1.053	12.70
Posttest (Experimental)	60	39.80	2.007	32.31

As shown in Table 3, the control group obtained a pretest mean score of 13.51 ($SD = 2.046$) and a posttest mean score of 24.69 ($SD = 2.860$). The experimental group obtained a pretest mean score of 11.90 ($SD = 1.053$) and a posttest mean score of 39.80 ($SD = 2.007$).

2. Inferential Analysis

Inferential statistics was conducted, including the Wilcoxon Signed-Rank Test to compare pretest and posttest scores within each group (experimental and control), and the Mann-Whitney U Test to compare posttest scores between the two groups in order to determine the effect of the instructional intervention.

Table 4: Pretest of Control and Experimental group.

Group	N	Mean	SD
Control group	59	13.51	2.046
Experimental group	60	11.90	1.053

As shown in Table 4 , it was found that pretest mean score of control group was 13.51 ($SD = 2.046$, $n = 59$) and pretest mean score of experimental group was 11.90 ($SD = 1.053$, $n = 60$). The examination of pretest scores revealed that students of control group have better scores than students of experimental group.

Table 5: Difference between Pretest scores of Control and Experimental Groups

Group	N	Median	Mean Rank	U	p value	Rank-Biserial r
Control group	59	12.5	46.20	2598	$< .001$	-0.468
Experimental group	60	12.8	74.03			

A Mann-Whitney U test was conducted to difference between pretest scores of control and experimental groups. According to Table 5, there was a statistically significant difference between the pretest scores of the control and experimental groups, $\alpha = 0.01$, $U = 2598$, $r = -0.468$, $N = 119$, $p < .001$. However, the difference in actual performance was negligible, indicating that both groups were approximately equivalent at the pretest stage.

Table 6: Pretest and Posttest Scores of Experimental Group

Measure	N	Mean	SD
Pretest	60	11.90	1.053
Posttest	60	39.80	2.007

As shown in Table 6, it was found that the pretest mean score of the experimental group was 11.90 (SD = 1.053, n = 60), while the posttest mean score was 39.80 (SD = 2.007, n = 60). The examination of pretest and posttest scores revealed that students of the experimental group performed significantly better in the posttest.

Table 7; *Difference between the Pretest and Posttest Scores of Experimental Group*

Measure 1	Measure 2	W	z	p-value
Pretest	Posttest	0.000	-6.736	< .001

A Wilcoxon Signed-Rank Test was conducted to determine the difference between pretest and posttest scores of students taught through the 7Es instructional method. According to Table 7, there was a statistically significant difference between the pretest and posttest scores of students taught through the 7Es instructional method, $\alpha = 0.05$, $W = 0.000$, $z = -6.736$, $p < .001$. Therefore, students' scores significantly improved after instruction.

Table 8: *Pretest and Posttest Scores of Control Group*

Variable	N	Mean	SD
Pretest	59	13.51	2.046
Posttest	59	24.69	2.860

As shown in Table 8, it was found that the pretest mean score of the control group was 13.51 (SD = 2.046, n = 59), while the posttest mean score was 24.69 (SD = 2.860, n = 59). The examination of pretest and posttest scores revealed that students of the control group performed better in the posttest.

Table 9: *Difference between the Pretest and Posttest scores of Control group*

Measure 1	Measure 2	W	z	p-value
Pretest	Posttest	0.000	-6.680	< .001

A Wilcoxon Signed-Rank Test was conducted to determine the difference between pretest and posttest scores of students taught through the traditional method. According to Table 9, there was a statistically significant difference between the pretest and posttest scores of students taught through the traditional method, $\alpha = 0.05$, $W = 0.000$, $z = -6.680$, $p < .001$. Students in the control group showed improvement in academic achievement after instruction, though the gain was modest.

Table 10: *Posttest scores of Control and Experimental group*

Group	N	Mean	SD
Control group	59	24.69	2.860
Experimental group	60	39.80	2.007

As shown in Table 10, it was found that the posttest mean score of the control group was 24.69 (SD = 2.860, n = 59), while the posttest mean score of the experimental group was 39.80 (SD = 2.007, n = 60). The examination of posttest scores revealed that students of the experimental group scored higher than those of the control group.

Table 11: *Difference between the Posttest scores of Control and Experimental group*

Group	N	Median	Mean Rank	U	p value	Rank-Biserial r
Control group	59	26.00	30.00	0.000	< .001	1.000
Experimental group	60	36.50	89.50			

A Mann–Whitney U test was conducted to difference between posttest scores of control and experimental groups. According to Table 11, there was a statistically significant difference between the posttest scores of the control and experimental groups, $\alpha = 0.05$, $U = 0.000$, $p < .001$. Students taught through the 7Es Instructional Model outperformed those taught through the traditional method, indicating a strong difference between the groups.

Discussion and Conclusion

The present study examined the effectiveness of the 7Es Instructional Model on students' academic achievement compared to the traditional method of teaching. The data were analyzed using non-parametric tests due to the violation of normality and homogeneity assumptions. The results consistently showed that the 7Es instructional approach had a positive and statistically significant effect on students' learning outcomes.

The the between-group comparison at the pretest stage (Table 4 and Table 5) revealed that there was a statistically significant difference between the control and experimental groups prior to the intervention ($U = 2598$, $p < .001$, $r = -0.468$). However, the difference in mean scores was minimal ($M = 13.51$ for the control group and $M = 11.90$ for the experimental group), suggesting that both groups were approximately equivalent at the start of the study. This ensured that any subsequent differences in posttest performance could be attributed to the instructional intervention rather than pre-existing disparities.

The within-group analysis further supported the effectiveness of the 7Es model. For the experimental group (Table 6 and Table 7), a significant improvement was found between pretest and posttest academic achievement scores ($W = 0.000$, $z = -6.736$, $p < .001$), with mean scores increasing from 11.90 to 39.80. This demonstrates that students exposed to the 7Es instructional approach achieved considerable learning gains following the intervention.

Similarly, the control group (Table 8 and Table 9) also showed a statistically significant improvement between pretest and posttest scores ($W = 0.000$, $z = -6.680$, $p < .001$). However, the increase was much smaller, with mean scores rising from 13.51 to 24.69. This modest improvement may be attributed to routine exposure and reinforcement under traditional teaching methods, which tend to rely more on teacher explanation and rote learning.

Finally, the between-group comparison at the posttest stage (Table 10 and Table 11) revealed a highly significant difference in academic achievement between the experimental and control groups ($U = 0.000$, $p < .001$, $r = 1.000$). Students taught through the 7Es instructional model significantly outperformed those taught through traditional methods, confirming the superior effectiveness of the 7Es model in enhancing students' conceptual understanding and achievement levels. Overall, the findings are consistent with prior research (e.g., Noreen, Iqbal, & Hayat, 2024; Asanre, 2024; Cheronno, 2021; Libata & Ali, 2022; Marfilinda et al., 2020; Balta & Sarac, 2016) that emphasizes the effectiveness of constructivist instructional models such as the 7Es framework in improving students' academic performance. The model's emphasis on engagement, exploration, and evaluation allows learners to actively construct knowledge rather than passively receive information, thereby deepening understanding and retention.

Beyond statistical significance, the findings have pedagogical and contextual implications for science education in Pakistan. The consistent improvement in performance of students highlights the potential of the 7Es model as a alternative to the dominant teacher-centered approach prevalent in public schools. It offers a structured yet flexible method that aligns with the National Curriculum's learning outcomes and fosters inquiry-based, student-centered learning environments. Implementing such models can help shift classroom

practices from rote memorization to conceptual understanding and active exploration, critical shifts needed to improve the quality of science education nationally.

From a broader perspective, this study contributes to the ongoing discussion on instructional innovation in developing countries, where systemic barriers often hinder the adoption of modern pedagogical practices. The evidence from this study suggests that, when appropriately adapted, the 7Es Instructional Model can enhance both instructional quality and learner achievement without requiring extensive infrastructural resources.

In conclusion, this study confirms that 7Es Instructional Model significantly improves academic achievement of secondary school students in General Science. The model's sequential and interactive design enhances students' engagement, critical thinking, and conceptual mastery, leading to superior learning outcomes compared to traditional teaching methods. These findings advocate for the broader integration of the 7Es framework in science classrooms to foster deeper learning and scientific inquiry.

Recommendations

Following recommendations were made, keeping in view the results, conclusions and discussions of the study :

1. Curriculum planners should formally embed the 7Es Instructional Model in secondary school science programs. The model's sequential and inquiry-driven nature aligns with the goals of the National Curriculum by fostering critical thinking and scientific reasoning.
2. Regular professional development and training programs should be organized to familiarize teachers with 7Es-based lesson planning, inquiry facilitation, and formative assessment methods. Continuous mentoring and peer collaboration can enhance fidelity of implementation.
3. Educational publishers and curriculum units should develop teaching guides, worksheets, and assessment rubrics aligned with the 7Es model. Providing structured resources will ease the transition from traditional to constructivist teaching.
4. Policymakers should prioritize the adoption of innovative pedagogical frameworks like the 7Es through funding, monitoring, and performance-based incentives. Sustained institutional and policy-level commitment is crucial for meaningful educational transformation.
5. Future studies should explore longitudinal effects of the 7Es model on student motivation, retention, and problem-solving abilities. Comparative and mixed-method research across different subjects and educational levels would further validate the model's effectiveness.

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