International Journal of
Strategic Research in Education, Technology and Humanities
p-ISSN: 2465-731X | e-ISSN: 2467-818X

IJSRETH

October, 2024

Vol. 12, No. 2

The Efficacy of 7E-Learning Instructional Strategy on Students' Achievement in Physics Practical in Lagos State

[1]**Ajayi Akintunde Oluwatosin & [2]V.F.T. Babjide**
[1&2]*Department of Science Education*
University of Lagos, Akoka

Article DOI:
10.48028/iiprds/ijsreth.v12.i2.14

Abstract

This study examined the efficacy of the 7E-Learning instructional strategy on students' achievement in practical physics, as well as the moderating role of mathematical ability. Using a quasi-experimental pretest-posttest design, the study included two experimental and two control groups, with each group taught using a different instructional method. A purposive sample of 169 senior secondary (SS2) physics students participated. The study utilized two validated instruments: the 7E instructional strategy and the WAEC Physics Practical Achievement Test (WPPAT), with reliability coefficients of 0.73 (using the score pie method) and 0.97 (using the test-retest method). Data were analyzed using both descriptive and inferential statistics. Findings revealed that students in the experimental group outperformed those in the control group. Additionally, mathematical ability did not significantly influence students' achievement in practical physics.

Keywords:
Practical, Achievement, Physics, Instructional methods

Corresponding Author:
Ajayi Akintunde Oluwatosin

Background to the Study

Practical physics plays a significant role in the development of nations worldwide. As such, the need for effective physics practical has become imperative for developing countries seeking to compete favorably with developed nations. Practical physics is an essential component of the sciences, shaping and molding the character of modern societies. Advances in technology have transformed the application of science, particularly practical physics, at the secondary school level. Practical physics sessions are crucial for reinforcing theoretical concepts and developing practical skills among students. However, traditional instructional methods for conducting physics practical's often fail to fully engage students and optimize learning outcomes. Education has shifted from teacher-centered to student-centered learning, emphasizing students' responsibility for their learning and fostering greater independence.

In response, educators have adopted innovative pedagogical approaches, such as the 7E-Learning model, which emphasizes active, inquiry-based, and experiential learning. Research shows that students exposed to the 7E-Learning approach demonstrate improved academic performance compared to those taught with conventional methods (Garcia et al., 2024). This improvement includes higher scores on assessments, better performance on standardized tests, and increased achievement in course grades. The structured nature of the 7E-Learning instructional strategy, which scaffolds learning through sequential phases, promotes deeper understanding and better retention of course material, resulting in enhanced academic outcomes.

Recent studies indicate that students report high levels of satisfaction and positive perceptions of their experiences with 7E-Learning (Lee & Gupta, 2023). Gupta and Sharma (2023) found that students experienced increased motivation and a deeper understanding of content when using the 7E-Learning model. Additionally, students felt the approach promoted a more student-centered learning environment, enabling them to take greater ownership of their education. Learners appreciated the interactive, student-centered design of the instructional strategy and the relevance of learning activities to their academic and career goals. These positive perceptions foster a supportive learning environment that contributes to both academic success and personal growth.

Practical physics plays a significant role in the development of nations across the world. Hence, the need for physics practical has become imperative for developing countries to compete favorably with developed countries. Practical physics is an important part of sciences which shapes and molds the character of modern societies. Technology in contemporary times has evolved the application of science, particularly practical physics at secondary school level. Practical physics sessions play a crucial role in reinforcing theoretical concepts and fostering practical skills among students. However, conventional instructional method of conducting physics practical often fail to fully engage students and optimize learning outcomes. The world has developed from teacher-centered learning transforming into student-centered learning that teaches students how to take responsibility for their learning and become more independent. In response, educators have turned to innovative pedagogical approaches such as the 7E-Learning model, which emphasizes active learning, inquiry-based instruction, and experiential learning.

Research findings indicate that students exposed to the 7E-Learning approach exhibit improved academic performance compared to those taught using conventional methods (Garcia et al., 2024). This includes higher scores on assessments, better performance on standardized tests, and increased achievement in course grades. The structured nature of the 7E-learning instructional strategy, which scaffolds learning through sequential phases, facilitates deeper understanding and retention of course material, leading to enhanced academic outcomes. Recent research indicates that students express high levels of satisfaction and positive perceptions regarding their experiences with 7E-Learning (Lee & Gupta, 2023). Gupta and Sharma (2023) found that students reported increased motivation and a deeper understanding of content when using this 7E-learning instructional strategy. The research also revealed that students felt the model promoted a more student-centered approach, allowing them to take greater ownership of their learning Learners appreciate the interactive and student-centered nature of the instructional design, as well as the relevance of learning activities to their academic and career goals. Positive student perceptions contribute to a supportive learning environment conducive to academic success and personal growth.

The 7E-Learning instructional strategy is a teaching approach used to enhance student engagement, motivation, and performance across various disciplines. Recent studies have consistently shown that the implementation of the 7E-Learning instructional strategy leads to improved academic performance among students (Smith et al., 2023). This improvement is reflected in higher scores on standardized assessments, better grades in coursework, and increased retention of learned material compared to traditional teaching methods. Additionally, the use of the 7E-Learning model has resulted in greater student engagement and active participation in classroom activities (Jones & Smith, 2023). By incorporating interactive elements such as group discussions, hands-on experiments, and multimedia resources, educators can create dynamic learning environments that capture students' interest and motivate them to actively engage in the learning process.

Furthermore, through the integration of interactive activities, hands-on experiments, and collaborative projects, educators foster an environment where students are encouraged to actively engage with course material and contribute to class discussions. Students appreciate the interactive nature of the instructional design, the relevance of learning activities to real-world contexts, and the opportunities for peer collaboration and reflection.

In the context of physics education, studies have shown that there is a gap in the literature regarding the specific impact of the 7E-Learning strategy on achievement of students in practical physics. In light of this, the present study examines the efficacy of the 7E-Learning instructional strategy on students' achievements in practical physics, as well as the moderating effects of mathematical ability on the dependent measure.

Theoretical Framework

Lev Vygotsky, a Russian psychologist, is the proponent of the Sociocultural Theory of learning, which emphasizes the fundamental role that social interaction, culture, and language play in the cognitive development of learners. Central to Vygotsky's theory are concepts such as the Zone of Proximal Development (ZPD), scaffolding, cultural tools, and the role of language in learning. Vygotsky's theory posits that cognitive development is not merely an individual process but occurs through interactions within a social context. Learning, according to Vygotsky, is deeply social and is facilitated by guided participation in activities that are just beyond the learner's current abilities. This is the essence of the Zone of Proximal Development (ZPD), which refers to the range of tasks that learners can perform with the help of a more knowledgeable other (such as a teacher, peer, or technological tool).

The scaffolding concept, which is closely related to ZPD, refers to the temporary support provided to students while they are engaging in a task that is slightly beyond their current level of competence. This support is gradually withdrawn as learners gain independence and mastery. Furthermore, Vygotsky highlights the role of cultural tools (including language, symbols, and technology) in shaping cognitive processes. Language, for Vygotsky, is a critical tool that mediates learning and helps individuals internalize knowledge and understanding. In the context of education, Vygotsky's theory suggests that learning is most effective when students engage in activities that promote collaborative learning and are supported by appropriate scaffolding. These interactions are mediated by cultural tools and language, which enhance students' ability to make sense of the world around them.

The 7E-Learning Instructional Strategy Elicit, Engage, Explore, Explain, Elaborate, Evaluate and Extend) is an inquiry-based instructional strategy that encourages active participation, collaboration, and the use of technology in learning. Vygotsky's Sociocultural Theory aligns closely with the principles of the 7E-learning instructional strategy, particularly focus on active learning, collaborative engagement, and the use of cultural tools.

1. **Engage and Collaborative Learning**: The initial phase of the 7E strategy, Elicit and Engage, is aimed at sparking students' curiosity and motivating them to learn by connecting prior knowledge with new concepts. Vygotsky's theory emphasizes the importance of social interaction in learning. In the context of the 7E-Learning Instructional Strategy, students can engage with peers and teachers in discussions that help activate their prior knowledge and stimulate new ways of thinking.
2. **Explore, Explain, and Scaffolding**: During the Explore and Explain phases of the 7E-leaning instructional strategy, students experiment, test hypotheses, and engage in activities that require them to apply theoretical knowledge to practical tasks. Vygotsky's scaffolding concept is directly applicable to this phase. Teachers can provide temporary support by guiding students through the experimental process, offering hints, or posing questions that help students refine their thinking. As students gain more confidence, the level of support can be gradually reduced,

allowing students to develop greater independence in their problem-solving skills.

3. **Cultural Tools and Technology Integration**: The Elaborate and Extend phases of the 7E learning instructional strategy encourage students to apply their knowledge in new and diverse contexts, often in their environment. Vygotsky's emphasis on cultural tools and technology in cognitive development is highly relevant here. In physics practical's, tools like lab equipment, calculators, and simulations are vital for both gathering data and interpreting results. These tools are not just aids in performing tasks but are instrumental in shaping how students understand scientific concepts. By integrating technology and scientific instruments into the learning process, teachers can create learning environments that align with Vygotsky's view that cognitive tools mediate the learning process.
4. **Language and Communication in Science**: Vygotsky stressed that language plays a pivotal role in the cognitive development of students. In the 7E-learning instructional strategy, students are encouraged to explain their understanding and engage in scientific discourse with peers and teachers. This use of language as a tool for communicating scientific concepts allows students to internalize their learning and develop more sophisticated understanding. As students articulate their observations, hypotheses, and conclusions during the practical sessions, they engage in a process of meaning-making that is central to Vygotsky's sociocultural view of learning.
5. **Evaluation and Collaborative Reflection**: The Evaluate phase of the 7E strategy involves self-assessment and feedback from peers and teachers, providing an opportunity for reflection and further development. Vygotsky's theory underscores the value of collaborative learning during reflective activities. Students can discuss their findings with peers, ask questions, and receive constructive feedback, which promotes deeper understanding and cognitive development.

In a diverse classroom with varying levels of student ability, it may be challenging for teachers to tailor their support to each student's needs. This is particularly relevant in a practical physics setting, where tasks can be complex and individualized support is needed. Vygotsky's theory advocates for learning that is rooted in the cultural context of the learner. However, the integration of culturally relevant tools and examples may not always be feasible in diverse classrooms, especially if students come from varied cultural backgrounds. In the case of physics practical's, not all students may have the same cultural reference points for the experiments or real-world applications discussed in class. The theory supports the notion that students learn best when they are actively engaged in discussions, problem-solving, and collaborative activities. This aligns with the 7E framework's goal of fostering active student engagement in practical physics tasks.

Vygotsky's Sociocultural Theory provides a robust theoretical foundation for understanding the efficacy of the 7E-Learning Instructional Strategy in enhancing students' achievement in physics practicals. By emphasizing collaboration, scaffolding, the use of cultural tools, and the role of language in learning, Vygotsky's framework supports the active, student-centered approach promoted by the 7E-learning instructional strategy. Vygotsky's theory remains a valuable tool for designing and delivering effective instructional strategies that foster meaningful learning experiences in physics.

Empirical Evidence

Empirical studies investigating the effects of the 7E-Learning instructional strategy on achievement in physics practical. A study by BouJaoude and Barakat (2019) found a significant positive correlation between engagement in practical activities and academic achievement in physics among high school students. Research findings indicate that students exposed to the 7E-Learning instructional strategy demonstrate higher levels of conceptual understanding, problem-solving abilities, and practical skills compared to those taught using conventional methods. Moreover, students report greater engagement, motivation, and satisfaction with the learning process when immersed in the 7E-Learning environment.

The Research Objectives and Questions

Based on the above literature review, the study was planned to systematically identify the efficacy of the 7E-learning instructional strategy on students' achievement in practical physics in Lagos State. To achieve these

Objectives, the following questions were formulated to guide the study:

Research Question 1:

What is the main effect of treatments on students' achievement in practical Physics in Lagos?

Research Question 2:

What is the main effect of students' mathematics ability skill on students' achievement in practical Physics in Lagos State?

To answer the research questions, the following null and alternative hypotheses were formulated to investigate the efficacy of the 7E-learning instructional strategy on students' achievement in practical physics in Lagos State.

Ho_1: There is no significant main effect of treatments on students' achievement in practical Physics in Lagos State

H_{o2}: There is no significant impact in students' mathematics ability skills on students' achievement in practical Physics in Lagos State,

Methodology

For the study, the quasi-experimental, pretest-posttest experimental and control group design was used. There were two experimental groups. (7E-learning instructional strategy) and two control groups (conventional method of conducting physics practical.

Mathematics ability is a moderator variable in this study). The control group was taught with the conventional method while the two experimental groups were taught with the 7E-learning instructional strategy. Purposive sampling was used to select a sample of 169 Senior Secondary 2 (SS2) students for the study. Two instruments namely: the WAEC Physics Practical Achievement Test (WPPAT) and Mathematics Ability Test (MAT) were developed for the study. The WPPAT was constructed by this researcher through selection from WAEC past questions to measure the performance of students in practical physics. The MAT was constructed by the researchers to measure the students' mathematical ability skills. It contained 30 theory mathematics questions selected from WAEC past questions based on the mathematical concepts and skills required in the practical activities. The WPPAT and MAT were administered as pre-tests to both the experimental and control groups. The students in the control and experimental groups were then exposed to practical physics for three weeks. After each group was taught with the specified instructional method, the WPPAT and MAT were administered to them as post-tests, their responses were graded and their scores were obtained. The students' scores in the MAT during the pre-test were used to categorize them into high and low Mathematics abilities. Based on the data obtained, the research questions were answered using descriptive statistics such as Percentages and Mean scores while the Analysis of Covariance was used to test the hypotheses.

Intervention Procedural Steps Taken for Experimental Group

For the general orientation and administration of the first two instruments, the Physics Practical Achievement Test (WPPAT) and Mathematics Ability Skill Test (MAST), to obtain pretest scores, the research assistant utilized the prepared 7E-learning instructional aid developed by the researcher. This aid included the lesson topics, objectives, entry behavior, and the activities to be carried out in class by both the teacher, raters and students.

The steps involved in the administration of the intervention of the 7e-learning instructional strategy for the experimental group include.

Phase One; Elicit

The first phase of the 7E-Learning strategy focuses on activating students' prior knowledge and eliciting their initial thoughts and ideas about the topic for the experiment. This phase is crucial for connecting new information to what students already know or believe. The students identify all apparatus and state their uses, connecting prior knowledge with the recent image, allowing them to recall concepts from their theory class e.g., what is the source of an electric circuit? In an experiment to determine the potential difference of an electrical wire.

Phase Two; Engage

The Engage phase is designed to capture students' attention and spark their interest in the lesson. In this phase, teachers often introduce an intriguing problem in the experiment that will provokes thought and invites exploration. The goal is to ensure that students are mentally prepared to delve into the experiment, and actively engaging with the material and collaborating with peers to enhance their understanding. Students will be asked the following questions to encourage discussion and focus on the subject matter:

1. Identify all apparatus on your workbench and their uses.
2. Where do you usually see the materials and instruments on your work bench?

Phase Three; Explore

During the Explore phase, students perform the experiment, they follow instructions, observe phenomena, work collaboratively, and ask questions. Each group selects a leader and a recorder to collect data during the laboratory activities.

Phase Four; Explain

Once students have had the opportunity to explore the topic, the Explain phase provides a time for them to articulate their findings from the practical activities and present their discoveries to the class. Students engage in a peer-to-peer verbal review and clarification of all activities performed. This collaborative discussion helps to validate the results recorded in each group's table of values.

Phase Five; Elaborate

The Elaborate phase encourages students to extend their understanding by applying the practical experience to draw well-founded, verifiable, and reliable conclusions from their experimental activities. This stage allows students to deepen their understanding of the various concepts involved in the experiments and apply them to different contexts in physics. Specifically, students will explore and identify the following phenomena e.g. the propagation of light through a small hole in the Ray Box.

Phase Six; Evaluate

This process assesses whether students have acquired the necessary knowledge and skills, as well as whether their thinking or behavior has changed. At the end of the laboratory practical activities, students reflect on their understanding through various assessment techniques in each phase.

Phase Seven; Extend

The final phase of the 7E-Learning strategy focuses on extending students' learning beyond the classroom. In this phase, students are encouraged to think about how the knowledge and skills they have acquired in the experiment can be applied in real-world situations or in future learning. The teacher may provide opportunities for students to engage in projects, internships, or community-based activities that allow them to apply what they have learned in meaningful ways. This phase encourages lifelong learning and helps students see the relevance of their education in broader contexts.

Procedure for the Control Group

In this method, instruction is delivered through conventional teaching method, complemented by students conducting experiments in the laboratory. The necessary apparatus for these experiments is presented to the students. The procedures involved include:

1. Instruction and Apparatus Display
2. Student Engagement with Instructions and Apparatus:
3. After setting up the experiment, students are given a set of questions related to the experiment.

Data Analysis and Presentation of Results

Demographic Data

Table 1: Group Distribution of Respondents

Group	Frequency	Percent
Experiment	095	56.2
Control	074	43.8
Total	169	100.0

Table 1 shows the total number of students involved in this study. For the experimental group ninety-five (95) students representing 56.20% were involved, for the control group seventy-four (74) students representing 43.80% were involved in this study.

Research Question 1: What is the main effect of treatments on students' achievement in practical Physics in Lagos?

Table 2: Main Effect of Treatments on students' Academic Achievement in practical Physics in Lagos State

		Pre – Test		Post – Test		
Treatment	N	Mean	Std. Deviation	Mean	Std. Deviation	Mean Gain
Control	74	6.64	1.94	12.12	1.41	5.48
Experimental	95	7.32	1.64	21.70	6.64	14.38

Table 2 indicates that students under the experimental groups had a higher post-test mean score (21.70) and mean gain (14.38) than students in the control group (Normal convectional teaching method; 12.12 (posttest mean score), 5.48 (mean gain). Specifically, the treatment had a positive effect on students' achievement in practical Physics in Lagos State.

Research Question 2: What is the main effect of students' mathematics ability skill on students' achievement in practical Physics in Lagos State?

Table 3: Descriptive Statistics of Achievement Gain by Mathematics Ability Skill

		Pre – Test		Post – Test		
Ability	N	Mean	Std. Deviation	Mean	Std. Deviation	Mean Gain
High	116	7.16	1.71	14.06	4.86	6.09
Low	53	6.52	2.04	17.35	6.99	10.83

Table 3 indicates that students under the high student's ability level had a higher post-test mean score (14.06) and mean gain (6.09) than students in the low students' ability group; 17.35 (post-test mean score), 10.83 (mean gain). Specifically, the treatment had a positive effect on students' mathematics ability skills in practical Physics in Lagos State. Students who score less than 40 are grouped as low while those who score above 40 are classified as high based on the Lagos state evaluation system in schools.

Hypothesis

The following research hypotheses were formulated and will be tested at a 0.05 level of significance.

Ho1: There is no significant main effect of treatments on students' achievement in practical Physics in Lagos State

Table 4: Summary of Analysis of Covariance of Achievement in Practical Physics Scores by Treatment, Mathematical Ability

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Et*a Squared
Corrected Model	4019.454[a]	8	502.432	25.036	.000	.556
Intercept	2950.285	1	2950.285	147.012	.000	.479
Covariate	.009	1	.009	.000	.983	.000
Treatment	2495.595	1	2495.595	124.355	.000*	.437
Mathematics Ability	1.756	1	1.756	.087	.768	.001
Error	3210.925	160	20.068			
Total	52207.000	169				
Corrected Total	7230.379	168				

a. R Squared = .556 (Adjusted R Squared = .534)

b. * = p is significant at .05

The result in the table above showed that there was a significant main impact of treatments on students' achievement in practical Physics after controlling for the effect of pre-test scores $F_{(1,160)} = 124.335$; $p = 0.000$. Since $p < 0.05$, it follows that the main effect of treatments on students' achievement in practical Physics is statistically significant.

Table 5: Pairwise Comparisons of Practical Physics Achievement (Post Hoc)

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
CONTROL	EXPERIMENTAL	-9.704*	.870	.000	-11.423	-7.986
EXPERIMENTAL	CONTROL	9.704*	.870	.000	7.986	11.423

The mean difference is significant at the .05 level.

The table shows the results of the statistical analysis of post hoc test on the achievement scores based on treatment. The values derived indicate that the mean scores of the post-test scores of the students were significantly higher than each other with the mean of the experimental group as the highest followed by the Team assisted individualization group and lastly, the control group with a mean difference of 9.704, SD=0.870; p<0.05 which is statistically significant. The result reveals the fact that the experimental methods are significantly better than the control (Lecture method).

Ho_2: There is no significant main effect of treatments on students' achievement in practical Physics in Lagos State

Table 6: Summary of Analysis of Covariance of Achievement in Practical Physics Scores by Treatment on Mathematical Ability skill

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Et*a Squared
Corrected Model	4019.454[a]	8	502.432	25.036	.000	.556
Intercept	2950.285	1	2950.285	147.012	.000	.479
Covariate	.009	1	.009	.000	.983	.000
Treatment	2495.595	1	2495.595	124.355	. 000*	.437
Mathematics Ability	1.756	1	1.756	.087	.768	.001
Treatment * Ability	.486	1	.486	.024	.877	.000
Error	3210.925	160	20.068			
Total	52207.000	169				
Corrected Total	7230.379	168				

a. R Squared = .556 (Adjusted R Squared = .534)
b. * = p is significant at .05

The result in the table above showed that there was a significant main effects of treatments on students' achievement in practical Physics after controlling for the effect of pre-test scores $F_{(1,160)} = 124.335$; $p = 0.000$. Since $p < 0.05$, it follows that the main effect of treatments on students' achievement in practical Physics is statistically significant.

Findings

The results of the statistical analysis indicated that students in the experimental group, who were taught using the 7E-Learning instructional strategy, outperformed students in the control group, who were taught using conventional methods. The posttest mean scores of the experimental group were significantly higher than those of the control group, suggesting that the 7E-Learning strategy had a positive effect on students' achievement in practical physics. This was further supported by the findings of ANCOVA, which showed that the differences between the two groups were statistically significant. The study also sought to determine the moderating effect of students' mathematical ability on their achievement in practical physics. However, the findings revealed that mathematical ability did not significantly influence the students' achievement in practical physics. The statistical analysis showed no significant correlation between students' mathematical background and their performance on the physics practical assessments. Furthermore, the study found no interaction effect between the treatment (7E-Learning instructional strategy) and mathematical ability on students' achievement in practical physics.

The ANCOVA results further indicated that there was no significant interaction effect between the type of instructional treatment (7E-Learning strategy) and students' mathematical ability on their performance in practical physics. This suggests that while the 7E-Learning strategy itself was effective in improving student achievement, mathematical ability did not serve as a moderating factor in this improvement. Thus, the positive effect of the 7E-Learning strategy on practical physics achievement was not contingent upon the students' mathematical proficiency. In summary, the findings of this study suggest that the 7E-Learning instructional strategy significantly enhances students' achievement in practical physics. However, mathematical ability was not found to influence students' performance in physics practical's, nor was there any interaction between the treatment and mathematical ability. These results indicate that the 7E-Learning strategy is an effective approach for improving physics achievement, regardless of students' mathematical background. Brown and Garcia (2024) found that the implementation of this model significantly enhanced student participation and interest in science subjects. By structuring lessons around the seven phases of 7E-Learning, the study highlighted how interactive, inquiry-based activities could foster deeper learning and greater enthusiasm for scientific exploration among high school students. Their findings suggest that incorporating the 7E model into science instruction can lead to improved academic outcomes and more active student involvement in the learning process.

Conclusion and Recommendations

This research concludes that practical work is a rewarding approach to teaching sciences, particularly teaching Physics in secondary schools. Also, effective use of suitable instructional methods that are student-centered and practical-oriented will enhance the performance of students in physics practical activities. This study recommends that by embracing 7e-learning instructional strategy in teaching physics practical's, educators can create dynamic and engaging learning experiences that empower students to become active participants in their own learning journey.

References

BouJaoude, S., & Barakat, H. (2019). A study on the correlation between engagements in practical activities and academic achievement in physics among high school students, *Journal of Science Education, 28*(3), 215-230.

Brown, A., & Garcia, C. (2024). Enhancing student engagement through 7E-Learning: case study in high school science classrooms, *Journal of Educational Research, 39*(2), 215-230.

Gupta, S., & Sharma, R. (2023). Student perceptions of 7E-Learning: A qualitative analysis. *Educational Technology Research and Development, 71*(4), 567-582.

Johnson, T., et al. (2023). Fostering critical thinking skills through the 7E-Learning model: A Longitudinal study, *Journal of Higher Education, 48*(3), 321-336.

Jones, L., & Lee, M. (2022). The impact of the 7E-Learning model on knowledge retention: A Meta-analysis, *Educational Psychology Review, 36*(1), 87-100.

Lee, M., & Gupta, S. (2023). Recent research on student satisfaction and perceptions of 7E-Learning. *Journal of Educational Technology, 45*(2), 123-138.

Smith, J., et al. (2023). Effects of the 7E-Learning model on academic performance: A randomized controlled trial, *Journal of Educational Psychology, 115*(2), 301-317.