Improving Mathematics Achievement and Self-Efficacy in Students with Mild Intellectual Disabilities using the 7Es Learning Strategy in Inclusive Classrooms in Calabar Education Zone of Cross River State, Nigeria

Ekpenyong Effiong Ibok[1,*], Raymond Ogbebe Ogar[2], Stephen Ushie Akpa[3], Paul Agbade Olofu[4], Okoi Okorn Obeten[5], James Abua Ewa[2], Amos William Obeten[6], Chioma Precious Unamba[5], Stephen Olenye Edeh[5], Elizabeth Odije Patrick[4], Columbus Deku Bessong[4], Napoleon Osang Bessong[4], Joy Joseph Obi[7], Ubi Ubi Omini[6] and Blessing Bassey Anam[3]

[1]*Department of Mathematics and Computer Science Education, Faculty of Science Education, University of Calabar, Calabar, Cross River State, Nigeria*

[2]*Department of Special Education, Faculty of Educational Foundation Studies, University of Calabar, Calabar, Cross River State, Nigeria*

[3]*Department of Human Kinetics and Health Education, Faculty of Science Education, University of Calabar, Calabar, Cross River State, Nigeria*

[4]*Department of Continuing Education and Development Studies, Faculty of Vocational and Entrepreneurial Education, University of Calabar, Calabar, Cross River State, Nigeria*

[5]*Department Educational Management, Faculty of Educational Foundation Studies, University of Calabar, Calabar, Cross River State, Nigeria*

[6]*Department of Public Administration, Faculty of Management Sciences, University of Calabar, Calabar, Cross River State, Nigeria*

[7]*Department of Physical Science, Faculty of Science Education, University of Calabar, Calabar, Cross River State, Nigeria*

Abstract: *Aim*: The study examined the effect of the 7Es learning strategy on Mathematics achievement and self-efficacy of students with mild intellectual disabilities in an inclusive classroom in Calabar Education Zone of Cross River State, Nigeria. The study objectives were established to provide direction and focus for this research. Two research questions were formed, which were converted to two null hypotheses. A literature review was done based on the study variables, and the research gaps were also stated.

Method: The study used a 2x2 factorial design in this investigation. The design was quasi-experimental and non-randomized. The population of the study consisted of 4,031 Senior Secondary (SSII) students with mild intellectual disabilities in Calabar Education Zone of Cross River State, Nigeria, of which a sample of 200 students with mild disabilities were selected (100 students were taught using the 7Es learning strategy, while 100 were taught using the traditional approach). The data was gathered using a mathematical achievement test (MAT) and a Mathematics Self-Efficacy Rating Scale questionnaire (MSERSQ). The reliability coefficients are strong (KR-20 = 0.88, Cronbach's Alpha = 0.90) for the MAT and MSERSQ, respectively, indicating good reliability. Two research hypotheses guided the study. Descriptive statistics were used to examine the data, and Analysis of Covariance (ANCOVA) was applied to test the null hypotheses.

Results: The results of the analysis using ANCOVA indicated that students with mild intellectual disabilities who received tutoring using the 7Es learning strategy outperformed those who received tutoring using the traditional approach in terms of mathematics achievement (F-ratio = 268.399, $p < 0.050$), with a partial eta squared of 0.577 indicating a moderate effect, and self-efficacy (F-ratio = 1261.293, $p < 0.050$) with a partial eta squared of 0.865 indicating a high impact.

Conclusion: The study concluded that the high academic achievement and self-efficacy of students with mild intellectual disabilities depend on the practical application of the 7Es teaching technique by teachers in teaching Mathematics concepts.

Recommendation: Among other recommendations, the 7Es learning strategy should be adopted into the teaching and learning of Mathematics to improve mathematics achievement and self-efficacy of learners with diverse needs.

Unique Contribution: This study's key contribution was to introduce the 7Es learning strategy as an effective pedagogical tool for enhancing mathematics achievement and self-efficacy of students with diverse needs.

Keywords: 7Es learning strategy, academic achievement, mild intellectual disabilities, mathematics, self-efficacy, inclusive classroom.

*Address correspondence to this author at the Department of Mathematics and Computer Science Education, Faculty of Science Education, University of Calabar, Nigeria; E-mail: ibokekpenyong@yahoo.com

E-ISSN: 2292-2598/25

INTRODUCTION

Mathematics is a core subject that plays a crucial role in students' overall academic achievement and future career prospects. However, secondary school students with mild intellectual disabilities often face significant challenges in achieving proficiency in Mathematics, which can be attributed to a variety of factors, including ineffective teaching methods, low student engagement, and inadequate support for diverse learning needs. This situation is particularly concerning in inclusive educational settings, where the diversity of learners' abilities, including students with mild intellectual disabilities and backgrounds, requires personalized instructional approaches.

Mild intellectual disabilities (MID) are a category of intellectual disability characterized by significantly lower-than-average intellectual functioning, typically defined by an IQ score ranging from 50 to 70. Students with MID often display difficulties in adaptive functioning, which includes challenges in practical, social, and conceptual skills necessary for everyday life. These students may require support in academic settings, particularly in learning Mathematics [1, 2]. They may show strengths in specific areas while facing challenges in others, particularly in complex reasoning and problem-solving tasks. MID is typically identified during the developmental period, usually before the age of 18. The diagnostic criteria for MID are generally based on the guidelines given in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) and the International Classification of Diseases (ICD). To examine the prevalence and characteristics of MID among Nigerian students, the diagnostic criteria are assessed by a combination of standardized assessments and observational methods [2-4].

Globally, the problems surrounding the mathematics achievement of learners with mild intellectual disabilities are alarming. A significant number of students with intellectual disabilities across various countries have been confirmed to have low proficiency in mathematics, with only 30% reaching the proficient level [5]. In Nigeria, the problems related to mathematics achievement and self-efficacy are noticeable, influenced by socio-economic factors and educational practices. The National Examination Council (NECO) reported that only about 35% of students with mild learning disabilities passed mathematics in the Senior Secondary School Certificate Examination (SSCE) in recent years, indicating a significant need for effective instructional strategies [6]. The effectiveness of instructional strategies in enhancing these results has garnered considerable attention. One such approach is the 7Es learning approach, which incorporates the phases of Engagement, Exploration, Explanation, Elaboration, Evaluation, Extension, and Exit. This model has been shown to have a positive effect on students' achievement and self-efficacy, both globally and in Nigeria. The 7Es learning strategy is a comprehensive educational model designed to enhance student learning through active engagement, exploration, and application of knowledge. This model enhances critical thinking and more profound understanding in mathematics teaching and learning.

The applications of the 7Es learning strategy for students with mild learning disabilities extend to inclusive classrooms, where diverse learning needs must be addressed. By enhancing collaborative learning and peer interaction, the 7Es learning strategy can encourage an inclusive classroom environment that accommodates various learning styles and abilities. Niyi *et al*. [7] opined that the 7Es learning approach encourages differentiated teaching, enabling teachers to apply their teaching methods to meet the needs of all students, including those with learning disabilities. In classroom teaching and learning, traditional methods often fail to engage students effectively, leading to decreased motivation and lower mathematics achievement among learners with mild intellectual disabilities [8].

Here’s a detailed description of each component of the 7E learning strategy:

1. Engagement: This phase creates an association between learners' prior knowledge and the new content. Here, learners are engaged through activities that arouse their interest and motivate them to learn, such as demonstrations, questions, or real-life scenarios that relate to the upcoming lesson.

2. Exploration: In this phase, learners examine concepts through hands-on exercises, collaborative learning, inquiry, and exploration. This permits learners to recognize how these activities can enhance their own understanding through group work, experiments, and simulations that enhance problem-solving and inquiry.

3. Explanation: This phase provides a medium for students to share findings and receive feedback

through class discussions, presentations, and teacher-led explanations that reinforce key concepts. The learners articulate their understanding, often with the teacher facilitating discussions to clarify ideas and terminology.

4. Elaboration: This phase enables learners to apply their knowledge to new situations, deepening their understanding, encouraging critical thinking, and making connections to real-world situations through problem-solving tasks, case studies, or projects that require the application of learned concepts.

5. Evaluation: This phase offers feedback on learning development and identifies areas for improvement through peer evaluations, quizzes, and self-assessments. Assessment occurs throughout the learning process, enabling both students and teachers to measure progress thoughtfully.

6. Extension: This is the phase that promotes additional exploration of the topic outside the classroom, applying concepts to broader contexts or further investigations. It motivates learners to pursue knowledge individually and apply learning in new contexts through additional reading materials, research projects, or community-based activities related to the subject matter.

7. Exit: This phase comprises assessing students' prior knowledge and misconceptions to tailor the learning experience. It reinforces key concepts and assesses overall understanding. The approaches used include exit tickets, reflective journals, or discussions that summarize what was learned and how it can be applied.

This instructional strategy promotes active learning, encouraging students with mild intellectual disabilities to take possession of their learning processes. The 7Es framework aims to boost students' understanding and retention of mathematical concepts, subsequently influencing their academic achievement and self-efficacy [9]. In contrast, the 7Es strategy promotes a more interactive classroom environment, where students are stimulated to collaborate, explore, and reflect on their learning experiences. This active collaboration is essential, as it not only aids in mastering mathematical content but also boosts learners' confidence in their abilities to handle complex problems.

The 7Es learning strategy not only aims to enhance academic achievement but also promotes students' positive self-efficacy. Self-efficacy plays a vital role in students' academic motivation and perseverance. The 7Es learning strategy has been shown to improve self-efficacy among secondary school students. Niyi *et al*. [7] revealed that students who participated in learning using the 7Es learning approach reported increased confidence in their mathematical abilities. This enhancement in self-efficacy is associated with the strategy's focus on collaborative learning and peer support, which encourages students to take ownership of their learning journey.

The strategy not only promotes engagement and problem-solving skills but also fosters positive attitudes and accommodates diverse learning styles. The engagement component of the 7Es strategy significantly enhances students' motivation and interest in mathematics [10], promotes hands-on activities that foster a more profound understanding [11], allows students to articulate their experiences [12], permits students to apply their knowledge to new situations, and promotes self-assessment and reflection [13]. It links mathematical concepts to real-world scenarios and helps in activating prior knowledge, which is vital for new learning [14]. A study conducted by Boadu and Boateng [15] revealed that teachers who implemented the 7Es strategy effectively were able to meet individual student needs, resulting in improved mathematics performance across varied ability levels. A study conducted by Khan, *et al*. [16] shows that students who experienced the 7Es strategy showed better long-term retention of mathematical concepts compared to those who were taught through traditional methods. This suggests that the approach not only improves immediate achievement but also supports enduring understanding.

This study aims to fill this gap by exploring how the 7Es learning strategy impacts students' achievement and confidence in their mathematical abilities. Most of the work conducted has concentrated on either mathematics achievement or self-efficacy, but this study focuses on both concepts to address the gaps in the literature. Current literature suggests that interactive and student-centered teaching methods, such as the 7Es strategy, may promote a more profound understanding and improve academic outcomes; however, empirical evidence remains limited, particularly regarding diverse learning needs. To address this, this research is designed to examine whether the application of the 7Es learning strategy

can improve academic achievement and self-efficacy in mathematics among students with diverse needs.

LITERATURE REVIEW

7Es Learning Strategy Promotes Mathematical Achievement

Recent research works have consistently confirmed that the effective use of the 7Es learning strategy enhances mathematics achievement.

Hussain *et al*. [17] investigated the effect of the 7E learning model compared to traditional learning methods. The study employed a pretest-posttest control group design, involving sixty 10th-grade mathematics students from Government High School Bhakral in Rawalpindi. Students in the experimental group were taught using the 7E model, while those in the control group received instruction through traditional methods. A Mathematics Achievement Test was the primary instrument for data collection. Data were gathered through pretests and posttests, and three hypotheses were tested using t-tests and ANOVA. The independent samples t-test indicated a significant difference in mean scores between the two groups, demonstrating that the 7E model was more effective than traditional teaching methods.

Asanre *et al*. [18] examined the effects of the 7E instructional model on the academic achievement of senior secondary school students in Ijebu Ode, Ogun State, Nigeria. The study utilized a quasi-experimental design with pretests and posttests, involving eighty students from two senior secondary schools. Three hypotheses were tested at a significance level of 0.05. A validated Mathematics Achievement Test (MAT) with a reliability index of 0.82 was developed for the research. The results indicated that the 7E instructional model significantly enhanced the mathematics achievement of students in Ijebu Ode, suggesting its integration into secondary school teaching practices.

Iqbal *et al*. [19] investigated the effects of the 7E approach on students' academic achievement across various educational contexts. The research employed a quasi-experimental design and focused on 10th-grade physics students in public high schools in the Sargodha district. A multi-stage sampling strategy was used to select students, resulting in the formation of two experimental groups and two control groups. The Achievement Test in Physics (ATP) was administered as a pretest and posttest, with reliability assessed using Cronbach's Alpha. Data analysis involved independent samples t-tests and ANOVA. The findings revealed that the 7E model, which includes stages such as Elicit, Engage, Explore, Explain, Elaborate, Evaluate, and Extend, significantly promotes active learning and student-centered instruction.

Khashan [20] examined the effectiveness of the 7E Learning Cycle approach in teaching mathematics, focusing on immediate and delayed achievement as well as retention among Preparatory Year students at King Saud University (KSU) in Saudi Arabia. The study involved 73 students divided into two groups: one with 35 students taught using the 7E Learning Cycle and another with 38 students receiving traditional instruction. Analysis of the students' scores through ANCOVA revealed that the 7E Learning Cycle was more effective than conventional methods in promoting both immediate and delayed understanding of mathematical concepts. Additionally, paired-samples t-test results indicated that the 7E Learning Cycle positively influenced retention among the students, whereas the traditional approach did not yield similar benefits.

Riski *et al*. [21] examined mathematics achievement disparities between elementary students with intellectual disabilities (IDs) in inclusive classrooms versus those in special schools (SLB). The study assessed mathematics achievement at both the beginning and end of the academic year in two groups: 44 students in inclusive settings and 56 in special schools. The results revealed that students with IDs in inclusive environments, where instructional strategies were employed, experienced slightly greater improvements in mathematics over nine months compared to their peers in special schools. Notably, a higher concentration of students with very low mathematics skills was found in special schools, where progress was minimal. In contrast, students with some numeracy skills were more common in inclusive classes. A sample of 44 students was used for regression analysis to control for differences in age, IQ, and prior achievement, revealing a positive effect of inclusive settings on learning gains. These findings suggest that inclusive education fosters a more supportive and stimulating environment for the academic achievement of students with IDs.

Yang *et al*. [22] examined the use of tablet PCs to enhance students' mathematical communication skills. Students were encouraged to create mathematical resources, including representations, solutions, and explanations for word problems, and to engage in

reciprocal tutoring with classmates to foster mathematical communication throughout the semester. This approach is similar to the 7E model because it was developed to support peer tutoring activities and the creation of math resources. A sample of 51 students was used. The control group received traditional one-on-one self-learning resources, while the experimental group participated in computer-supported reciprocal peer tutoring using the same resources. The results indicated that the experimental group outperformed the control group. Additionally, an analysis of the students' math creations revealed that their representations and explanations became more precise and more accurate following the learning activities.

Abiodun *et al*. [23] examined the effect of the 7E learning model (Elicit, Engage, Explore, Explain, Elaborate, Evaluate, and Extend) on the mathematics achievement of senior secondary school students. The quasi-experimental study involved a sample of students selected through purposive sampling techniques. Mathematics achievement tests and observation checklists were the main instruments used for data collection, with analysis performed using mean, standard deviation, and t-tests at a significance level of 0.05. The findings showed that students taught using the 7E model achieved significantly higher scores than those taught through conventional methods.

7Es Learning Strategy and Mathematics Self-efficacy

Aside from enhancing mathematics achievement, other research studies have supported the efficacy of the 7Es Learning Strategy in improving learners' self-efficacy in mathematics.

The literature indicates a strong link between the utilization of the 7 Es learning approach and enhanced self-efficacy among diverse learners. Tudu [24] investigated the effect of STEM-7E inquiry-based learning (STEM-7E IBL) on the self-efficacy of secondary school students in science subjects. The quasi-experimental study compared 80 senior secondary biology students (48 males and 32 females) taught using STEM-7E IBL with those taught using conventional approaches. The results indicated that STEM-7E IBL significantly enhanced students' self-efficacy in problem-solving abilities, experimental skills, and knowledge retention compared to traditional teaching methods.

Mekonnen *et al*. [25] conducted a study on the effects of the 7E learning cycle model, with computer animation, and conventional teaching methods on students' conceptual understanding, misconceptions, and self-efficacy in biology. This quasi-experimental study utilized validated instruments to examine various outcomes. The findings revealed that the group taught with the 7E learning cycle model achieved better conceptual understanding and higher self-efficacy. In contrast, the enriched 7E group showed the most significant reduction in misconceptions.

Saputri *et al*. [26] conducted a study to describe an e-LKPD based on the 7E learning cycle, focusing on its validity, practicality, and effectiveness in enhancing complex problem-solving (CPS) and student self-efficacy (SE). The study adopted a Design and Development Research (DDR) methodology, which included analysis, design, development, and evaluation phases. A trial test was conducted with three experts, ascertaining its validity in terms of media, design, content, and construction. The practicality of the e-LKPD was then assessed through evaluations of learning implementation and student feedback, which indicated that the experimental group outperformed the control group in terms of students' CPS and SE.

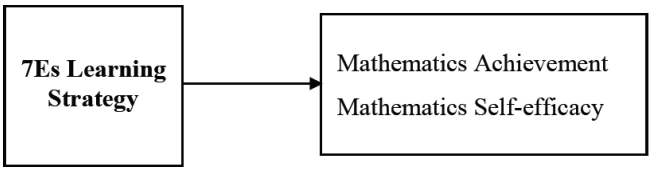

Figure 1: Conceptual model of 7Es learning strategy, Mathematics achievement, and Self-efficacy.

The information gathered from a review of the literature about the study's variables was used to develop a conceptual model that illustrates the impact of the 7Es learning strategy on math achievement and self-efficacy. Additionally, the direction of the predictive effect of all the components of the 7Es learning strategy in terms of the phases of Engagement, Exploration, Explanation, Elaboration, Evaluation, Extension, and Exit individually or collectively statistically significant influences both students' self-efficacy and mathematical achievement.

Gap in Research

While there is a growing body of literature on inclusive education, there is a notable gap in research specifically on the 7Es learning strategy (Engage, Explore, Explain, Elaborate, Evaluate, Extend, and Exit) within inclusive classrooms, particularly in the context of mathematics education for students with mild intellectual disabilities in Nigeria. There is a lack of comprehensive research that examines self-efficacy in

mathematics among students in inclusive settings. Most existing reviews focus on academic achievement without adequately addressing how experiential learning impacts students' confidence and self-belief in their mathematical abilities. Most studies carried out are cross-sectional, providing a picture of the situation rather than a longitudinal perspective. There is a need for research that tracks the long-term effects of inclusive education practices, particularly the 7Es strategy, on students' mathematics achievement and self-efficacy.

Statement of the Problem

The low achievement in mathematics of students, including those with mild intellectual disabilities, in both the West African Examination Council (WAEC) and Senior School Certificate Examinations (SSCE) has drawn attention from educators, the government, and even commercial and public sector stakeholders in recent years. Despite the critical importance of mathematics in secondary education, many students with mild intellectual disabilities continue to struggle with academic achievement and self-efficacy in this subject. Traditional teaching methods often fail to engage students, resulting in a lack of motivation and understanding of mathematical concepts. This issue is predominantly pronounced among students with diverse learning needs, who may need more personalized instructional approaches to thrive in an inclusive educational environment. In light of this, it becomes necessary to understand how effectively this strategy can enhance both academic achievement and self-efficacy among secondary school students, particularly in inclusive settings.

Purpose of the Study

The primary purpose of the study is to examine the effect of the 7Es learning strategy on Mathematics achievement and self-efficacy of students with mild learning disabilities. In particular, the study attempted to:

1. Examine the effect of the 7Es instructional strategy on the achievement of students with mild intellectual disabilities in mathematics.

2. Examine the effect of the 7Es instructional strategy on self-efficacy in Mathematics of students with mild intellectual disabilities.

Research Questions

The following research questions were posed to guide the study:

i) What are the differences between the mean achievement score in Mathematics of students with mild intellectual disabilities when taught with the 7Es learning strategy and those taught with lecture methods?

ii) What are the differences between the mean self-efficacy score of students with mild intellectual disabilities in Mathematics when taught with the 7Es learning strategy and those taught with lecture methods?

Statement of Hypotheses

The following hypotheses guided the study:

1. There is no significant difference between the mean achievement scores in Mathematics of students with mild intellectual disabilities when taught using the 7Es learning strategy and those taught

2. using the lecture method.

Methodology

A 2x2 factorial design was used in this investigation. The design was quasi-experimental and non-randomized. The group type was pretest-posttest control. Because it included a control group and permitted the modification of the independent variable to determine the causal relationship between events, the researchers chose this design. A control group was incorporated**,** and a treatment was administered as part of the intervention. MID diagnosis was based on teacher assessment.

The following is this design's structural representation:

O1 x O2 (E)

O1 x O2 (C)

where O1 represents the pretest results of the experimental and control groups, and O2 represents the experimental and control groups' posttest results.

4,031 Senior Secondary (SSII) students with mild intellectual disabilities from Cross River State, Nigeria's Calabar Education Zone, made up the population. Proportionate stratified random selection and judgmental sampling were used to choose respondents (students) from the population. In stage 1, two Local Government Areas (Calabar South and Calabar

Municipality) were selected using the stratified random sampling method (one for the experimental group [Calabar Municipality] and the other for the control [Calabar South]). In stage 2, students were chosen using judgmental sampling. Judgmental sampling, also known as purposive sampling, is a non-probability sampling technique that enables researchers to select students with MID based on criteria relevant to the study. The Brief Problem Monitor – Teacher Form for Ages 6-18 was used to assess students' emotional and behavioral problems with three scales: internalizing, externalizing, and attention. The researchers also used school records, teacher mathematics assessment scores, and a teacher nomination checklist.

The sample for the study consisted of 200 Senior Secondary School students with mild intellectual disabilities, 100 in each group. Out of 100 students, there were 57 girls and 43 boys in the experimental group and 59 females and 41 males in the control group.

Instrumentation

The "Mathematics Achievement Test" (MAT) and the Mathematics Self-Efficacy Rating Scale Questionnaire (MSERSQ) were constructed by the researchers as a means of gathering data for the pretest and posttest. Except for the serial arrangement, this MAT was identical in both tests. To gauge students' confidence and belief in their ability to learn, the MSERSQ was composed of 20 items that were developed using a five-point Likert scale of Strongly Agree (SA), Agree (A), Undecided (UD), Disagree (D), and Strongly Disagree (SD). The fifty (50) multiple-choice objective test items that were chosen from the previous WAEC examination, based on the SS2 scheme of work, limited to geometry concepts, were scored dichotomously (Correct options - 1 Mark each, Incorrect options - 0 Marks each) and were used to measure students' academic achievement. Before instruction started, the students in the schools took the MAT and MSERSQ pretests. It was employed both in conjunction with and independently of the 7Es teaching approach. For four weeks, the instruction was conducted. Following this period, the same set of students took the MSERSQ and MAT posttests to gauge their level of learning. Four experts from the Faculty of Education—two from test and measurement and two from mathematics education—validated the instrument's questions by assessing their face validity in light of the different levels of the cognitive domains they were designed to determine. To ensure that subtopics of greater importance received more questions, content validity was ensured. Adequate items were employed for the study after items deemed unsuitable were eliminated.

Reliability

To assess the instrument's reliability, fifty SSII Mathematics students from a class at a school located approximately 16 kilometers from the experimental school and 25 kilometers from the control were given the MAT and MSERSQ. This particular school was selected because it was deemed to be similar in all aspects to the students in the main study. The reliability coefficients are strong (KR-20 = 0.88, Cronbach's Alpha = 0.90), indicating good reliability.

Procedure for Data Collection

It was carried out during the first term of the 2024–2025 school year. Both the lecture method group and the 7Es model group underwent this for a total of four weeks. During this twenty-two-day timeframe, activities that may compromise internal authenticity were avoided. Before the study's implementation, permission was obtained from all participants, teachers, and school administrators. Every ethical rule guiding the conduct of the study was followed. Each week, the experimental class received 40 minutes of instruction using the 7Es instructional technique. Similarly, the control group received instruction for 40 minutes, but in the form of lectures. The pretest was given before instruction began to determine their level of understanding before the treatment. Following the conclusion of instruction, the posttest was given to both the experimental and control groups. The posttest item**s** were altered to create the impression that the test items differed from the pretest to prevent pupils from being test-wise. Descriptive statistics were used to address the research questions, and the study formulated and evaluated two hypotheses. Analysis of covariance (ANCOVA) was used to analyze the data.

Ethical Information

Data were collected from the respondents through their voluntary participation, with anonymity ensured, after obtaining informed consent from the heads or principals of the schools, as well as support from class teachers. All information collected was treated confidentially and was used only for this research, and the results were communicated accordingly.

RESULTS

Answer to research questions.

Research Question One

What are the differences in the mean achievement scores in mathematics between students with learning disabilities when taught using the 7Es learning strategy and those taught using lecture methods? Table **1** shows the answer to this research question using descriptive statistics.

The results shown in Table **1** reveal that the mean achievement difference score in Mathematics concepts of students with learning disabilities using the 7Es learning strategy (18.40) was higher than that of their counterparts taught by the lecture method, with a mean difference score of 10.70. By implication, students who were taught mathematical concepts utilizing the 7Es learning strategy outperformed their counterparts who were trained through the lecture method.

Research Question Two

What are the differences between the mean self–efficacy score in Mathematics of students with learning disabilities when taught with the 7Es learning strategy and those taught with lecture methods? Table **2** shows the answer to this research question using descriptive statistics.

The results presented in Table **1** reveal that the mean self-efficacy difference score for students with learning disabilities in Mathematics concepts, taught using the 7Es learning strategy (18.40), was higher than that of their counterpart**s** taught by the lecture method, with a mean difference score of 10.70. By implication, students who were taught mathematical ideas utilizing the 7Es learning technique had greater levels of self-efficacy than their counterparts who were taught using the lecture method.

Testing Research Hypotheses

Ho1: The mean achievement score in Mathematics of students with learning disabilities when taught with the 7Es learning strategy does not significantly differ from their counterparts when taught with lecture methods. The independent variable is the 7Es learning strategy, while the dependent variable is the mean mathematics achievement score of students. The results shown in Table **3** indicate that the mean achievement score in mathematics for students with learning disabilities, when taught using the 7Es learning strategy, significantly differs from that of their counterparts when taught with the lecture method, with the experimental group outperforming ($F = 268.399$; $p = 0.000$). Therefore, at the significance level of.05, the null hypothesis was rejected.

Additionally, the result displays a partial Eta squared estimate of.577, which is a measure of impact magnitude. This suggests that the 7Es learning technique was the cause of the moderate variation of 57.7% in the posttest results of the students' academic performance in mathematics. Additionally, the corrected R-squared value is 0.573, meaning that the independent variable (the 7Es learning approach)

Table 1: Mean of Pretest and Posttest Scores of the Difference between the Mean Achievement Score in Mathematics of Students with Learning Disabilities when taught with the 7Es Learning Strategy and those taught with Lecture Methods (N = 200)

Strategy	N	Pretest/Mean SD	Posttest/Mean SD	Mean difference score
7Es learning	100	18.63/2.94	37.03/4.27	18.40
Lecture method	100	17.77/2.60	28.47/3.41	10.70

Sources: Field work, 2024.

Table 2: Mean of Pretest and Posttest Scores of the Difference between the Mean Self–Efficacy Score in Mathematics of Students with Learning Disabilities when Taught with the 7Es Learning Strategy and those Taught with Lecture Methods (N = 200)

Strategy	N	Pretest/Mean SD	Posttest/Mean SD	Mean difference score
7Es learning	100	30.25/2.80	65.08/6.43	34.83
Lecture method	100	28.52/2.77	39.77/3.21	11.25

Sources: Field work, 2024.

Table 3: One-Way Analysis of Covariance (ANCOVA) of the Difference in the Mean Achievement Score in Mathematics of Students with Learning Disabilities when Taught with the 7Es Learning Strategy does not Significantly Differ from their Counterparts when Taught with Lecture Methods (N = 200)

Source	Type III Sum of Squares	Df	Mean Square	F-ratio	Sig.	Partial Eta Squared
Corrected Model	3822.897[a]	2	1911.449	134.551	0.000	0.577
Intercept	6723.315	1	6723.315	473.269	0.000	0.706
Pretest	159.217	1	159.217	11.208	0.001	0.054
Treatment	3812.907	1	3812.907	268.399	0.000	0.577
Error	2798.603	197	14.206			
Total	221134.000	200				
Corrected Total	6621.500	199				

[a]R Squared = 0.577 (Adjusted R Squared = 0.573).

explained 57.3% of the variation in the dependent variable.

Ho2: The mean self-efficacy score in Mathematics of students with learning disabilities when taught with the 7Es learning strategy does not significantly differ from their counterparts when taught with lecture methods. The independent variable is the 7Es learning strategy, while the dependent variable is self-efficacy in Mathematics. The results presented in Table **4** show that the mean achievement score of students' self-efficacy in Mathematics when taught with the 7Es learning strategy significantly differs from their counterparts when taught with lecture methods, with the experimental group outperforming (F = 1261.293; p =.000). Therefore, at the significance level of.05, the null hypothesis was rejected. Additionally, the outcome has a partial Eta squared estimate of.865, which is a measure of impact magnitude. This suggests that the treatment (7Es learning strategy) accounted for 86.5 percent, which is a high variance observed in the posttest scores of students' academic self-efficacy in Mathematics. Also, the adjusted R-squared value is 869, which means that the treatment with the 7Es learning strategy jointly accounted for 86.9% of the variance in the dependent variable.

DISCUSSIONS OF FINDINGS

The first null hypothesis, which stated that the mean achievement score in Mathematics of students with learning disabilities when taught with the 7Es learning strategy does not significantly differ from their counterparts when taught with lecture methods, was rejected. Teaching and learning may be accomplished with the help of the 7Es instructional technique. This may be a result of encouraging students to participate actively in class, which in turn increases academic success. By encouraging students to engage in inquiry and critical thinking, the 7Es educational technique helps them build their knowledge. In contrast to learning by rote memory, which vanishes in no time, information created by an individual leads to

Table 4: One-Way Analysis of Covariance (ANCOVA) of the Difference in the Mean Self-Efficacy Score in Mathematics for Students with Learning Disabilities, Comparing those Taught with the 7Es Learning Strategy to their Counterparts Taught with Lecture Methods (N = 200).

Source	Type III Sum of Squares	Df	Mean Square	F-ratio	Sig.	Partial Eta Squared
Corrected Model	32311.038[a]	2	16155.519	658.953	.000	.870
Intercept	7463.445	1	7463.445	304.420	.000	.607
Pretest	281.233	1	281.233	11.471	.001	.055
Treatment	30923.050	1	30923.050	1261.293	.000	.865
Error	4829.837	197	24.517			
Total	586817.000	200				
Corrected Total	37140.875	199				

[a]R Squared = 0.870 (Adjusted R Squared = 0.869).

comprehension. The findings are in agreement with the study carried out by Riski etal [21], which found that the use of the 7Es strategy was effectively able to meet individual student needs, resulting in improved mathematics performance across varied ability levels. The following findings agree with this finding (e.g., Ajayi and Babjide, [27], Iqbal *et al*. [28], Jack and Ogunleye [29], Abdulrahim [30], who reported that students exposed to the 7Es model scored significantly higher on academic achievement than those who received traditional instruction. The finding aligns with Ndagijimana and Uwimbabazi [31], who found that teacher expectations significantly influence the performance of students with mild intellectual disabilities. The finding agrees with Kamoet and Mbirithi [32], who found that teachers in urban areas provided more opportunities for collaboration and access to materials for the 7Es strategy, significantly enhancing students' achievement. The finding also agrees with Garcia-Peinado [33], who found that the emotional and physical environment of the classroom substantially influences student learning. Also, the finding is in agreement with Rahman and Chavhan [34], who found that variations in student characteristics, such as prior knowledge, motivation, and learning preferences, significantly influence students' performance.

The second null hypothesis, which stated that there is no significant difference in self-efficacy in mathematics between students with learning disabilities when taught using the 7Es learning strategy and those trained with the lecture method, was rejected. This increased self-efficacy is crucial for fostering a positive attitude towards mathematics and encouraging further engagement. The 7E instructional model offers a promising framework for enhancing learning outcomes by promoting engagement and building self-efficacy. By implementing this model effectively, educators can help students develop the necessary skills and confidence to succeed in mathematics. This finding aligns with a study conducted by Warner and Kaur [35], who found that students participating in lessons structured around the 7Es reported significantly higher levels of self-efficacy in mathematics. The finding aligns with the studies by Wodaj and Belay [36] and Samsudin *et al*. [37], which also found that the 7E instructional model positively influences students' self-efficacy. These findings are consistent with previous research conducted by Mekonnen *et al*. [25], Sulistiawati and Arifin [38], and Demelash *et al*. [39], all of which support the effectiveness of the 7E Model in enhancing students' self-efficacy in learning.

The finding aligns with Pondang *et al.* [40], who found that teacher expectations and beliefs regarding the use of the 7Es learning strategy significantly foster self-efficacy in learners. The finding is in line with Hafeez [41], who found that variations in teacher training, experience, and geographical location in the implementation of the 7Es strategy significantly influence student outcomes. The finding aligns with Davidovitch and Yavich [42], who found that the overall classroom environment, including physical layout and emotional climate, significantly influences student learning.

IMPLICATIONS OF INCLUSIVE EDUCATION

Inclusive education, when applied effectively, can lead to improved mathematics achievement for all learners. By employing experiential learning strategies, such as the 7Es, educators can create a more engaging and supportive learning environment that caters to diverse learning needs. According to Julien [43], inclusive classrooms that utilize experiential learning strategies can lead to increased self-efficacy among students. When learners actively engage in their learning through exploration and collaboration, they are more likely to develop a positive self-image regarding their mathematical abilities [8, 11, 44, 45]. For inclusive education to be successful, teachers must be adequately educated in both inclusive practices and specific strategies like the 7Es, with the techniques needed to implement these strategies effectively. The practical application of the 7Es strategy requires access to appropriate teaching materials and technologies. Many schools lack the necessary resources, which can impede the ability to create engaging and interactive learning environments. Teachers' attitudes towards inclusive education can vary significantly. Most of them feel unprepared or lack confidence in teaching students with MID, which can lead to an unwillingness to utilize new strategies, such as the 7Es.

CONCLUSION

This study examined the effect of the 7Es learning strategy on mathematics achievement and self-efficacy among secondary school students with learning disabilities. The empirical evidence gathered from recent studies indicates that the 7Es learning strategy significantly enhances mathematics achievement and self-efficacy, particularly among students with mild learning disabilities. The strategy's structured approach—encompassing elements of engagement, exploration, explanation, elaboration, evaluation, and

extension—facilitates a deeper understanding of mathematical concepts. Its interactive and student-centered nature encourages active participation, critical thinking, and collaborative learning, which are essential for developing positive self-efficacy in mathematics. The excellent academic achievement and self-efficacy of students taught using the 7Es instructional technique may have resulted from active class participation, as they applied critical thinking and inquiry skills during the sessions. Since the schools were fixed and the individuals were not transferred between them, a randomized quasi-experimental design was not employed.

Additionally, the potential effects of students' age, gender, motivation, and interest on the outcomes were not examined. Conducting longitudinal studies could provide valuable insights into the long-term effects of the 7Es strategy on students with mild intellectual disabilities (MID) across various subject areas. Expanding the study to include other disciplines may broaden the applicability of this instructional strategy, thereby contributing to more effective inclusive education practices.

RECOMMENDATIONS

The study's results may be used to inform a few recommendations.

The primary goal of the 7Es teaching technique is to improve students' learning in terms of achievement and self-efficacy in various mathematical ideas. Therefore, it should be recommended.

Second, regular seminars and workshops should be conducted by the Federal Ministry of Education, the Zonal Education Board, and school administrators, with a focus on the use of the 7Es teaching method. In addition to helping teachers improve their processes, this will make the strategy more widely used.

Thirdly, regular assessment of student performance and self-efficacy should be carried out to determine the effectiveness of the 7Es learning strategy. Feedback mechanisms help refine instructional approaches and ensure that all students benefit. Schools should provide supportive and inclusive classroom environments that encourage learners' engagement and collaboration. This includes the provision of learning resources and support for both teachers and students.

Last, but not least, educational institutions should adopt the 7Es learning strategy in mathematics curricula across all grade levels to develop the scientific minds of the next generation into more imaginative, focused, and capable problem solvers for learners with diverse needs.

LIMITATIONS

The fixed nature of schools prevented the researchers from randomly allocating the study's subjects to the experimental and control groups. Since complete classrooms were employed, they were referred to as experimental and control based on the school they attended. Second, the research only looked at one area of mathematics—geometry. Nonetheless, the goal of using the 7Es educational technique was to maintain student engagement during instruction. Before the 7Es model was used, a variety of other factors, such as motivation, attitude, family history, and seating arrangement, might have impacted students' self-esteem.

FUTURE IMPLICATIONS

The results of this study indicate that the 7Es instructional technique may be used in mathematics instruction to improve students' performance and sense of self-efficacy. The importance of students' critical thinking, inventiveness, and active class participation has been demonstrated by this study. It is necessary to retrain working instructors on the application of the 7Es teaching technique. When the need arises, instructors should have access to a database that contains information on how the 7Es instructional technique may be used to assist students in various areas of mathematics.

FUNDING

This study received no specific financial support from any institution.

INSTITUTIONAL REVIEW BOARD STATEMENT

The Ethical Committee of the Research and Development Committee, Ministry of Education, Cross River State, Nigeria, approved this study on April 2, 2024 (Ref. No. MOE/SEC/544/V-II/50).

TRANSPARENCY

The paper is honest, accurate, and transparent, according to the authors, who also claim that no essential parts of the inquiry have been left out and that any deviations from the intended study have been

explained. All writing ethics were adhered to in this work.

CONFLICTING INTERESTS

The writers affirm that they don't have any conflicts of interest.

CONTRIBUTIONS OF THE AUTHORS

Each author made an equal contribution to the study's concept and design. The published version of the work has been reviewed and approved by all authors.

REFERENCES

[1] Okaba AM, Ogbebe OR, Ishifundi UL. Demographic variables and academic achievement of primary five pupils with mild intellectual disability in public primary schools in Calabar Metropolis of Cross River State, Nigeria. Glob J Educ Res 2024; 23(4): 475-83. https://doi.org/10.4314/gjedr.v23i4.10

[2] Mulovhedzi SA, Thuketana NS, Luhalima TR. Understanding intellectual disabilities: An African perspective. In: Advancing education and educational leadership in a challenging world. Hershey, PA: IGI Global; 2023. p. 1-20. https://doi.org/10.4018/978-1-6684-5800-6.ch027

[3] Eburu OS, Ironbar VE, Edu GO, Atah AV, Emmanuel UD, Ogbeche OR, *et al*. A descriptive analysis of social media usage as predictors of study habits among students with intellectual disabilities in Calabar Metropolis: Implications for inclusive education. J Intellect Disabil Diagn Treat 2023; 11(4): 176-90. https://doi.org/10.6000/2292-2598.2023.11.04.2

[4] McKenzie J, Ohajunwa CO. Understanding disability in Nigeria: a commentary on Country profile: intellectual and developmental disability in Nigeria. Tizard Learn Disabil Rev 2017; 22(2): 94-8. https://doi.org/10.1108/TLDR-02-2017-0008

[5] OECD. PISA 2018 results: what students know and can do. Paris: OECD Publishing 2019.

[6] NECO. National Examination Council annual report. Minna: NECO Publications 2022.

[7] Niyi OO, Salami AJ, Alagbe SO, Awoyale O. Effect of instructional scaffolding on achievement of secondary school students in mathematics. Kontagora Int J Educ Res 2025; 2(2): 1-13.

[8] Algahtani F. Teaching students with intellectual disabilities: constructivism or behaviourism? Educ Res Rev 2017; 12(21): 1031-5. https://doi.org/10.5897/ERR2017.3366

[9] Abdullahi S, Asniza IN, Muzirah M. Effect of 7E instructional strategy on the achievement and retention of students in biology in public secondary schools in Adamawa State, Nigeria. J Turk Sci Educ 2021; 18(4): 748-64. https://doi.org/10.36681/tused.2021.101

[10] Arthur YD, Dogbe CSK, Asiedu-Addo SK. Enhancing performance in mathematics through motivation, peer-assisted learning, and teaching quality: the mediating role of student interest. Eurasia J Math Sci Technol Educ 2022; 18(2): em2072. https://doi.org/10.29333/ejmste/11509

[11] Mishra NR. The effect of constructivist 7E model of teaching algebra on academic achievement of class IX students of George High School, Bargarh, Odisha. J Maharaja Sayajirao Univ Baroda 2020; 54(2): 43-7.

[12] Bohara PS. Supporting teachers in implementing project-based learning in teaching secondary mathematics: An action research. Adv Mobile Learn Educ Res 2024; 4(2): 1122-34. https://doi.org/10.25082/AMLER.2024.02.007

[13] Habimana S, Bizimana B, Maniraho JF. Adapted Terry Borton's reflective model for 21st-century tools to observe and reflect on a 7E model-based mathematics lesson. Int J Educ Methodol 2025; 11(3): 317-33. https://doi.org/10.12973/ijem.11.3.317

[14] Bertiliya WA, Yulianti D, Perdana R. Analysis of making LKPD based on the 7E learning cycle model to empower critical and creative thinking skills. Budapest Int Res Critics Inst J 2023; 6(1): 437-44. Available from: https://bit.ly/3G7POUl

[15] Boadu SK, Boateng FO. Enhancing students' achievement in mathematics education in the 21st century through technology integration, collaborative learning, and student motivation: the mediating role of student interest. Eurasia J Math Sci Technol Educ 2024; 20(11): em2534. https://doi.org/10.29333/ejmste/15622

[16] Khan F, Khan S, Islam ZU. Effectiveness of instructions in academic achievements: an experimental study using 7E's instructional model. Glob Reg Rev 2020; 5(3): 151-65. https://doi.org/10.31703/grr.2020(V-III).17

[17] Hussain Z, Mehmood DST, Aslam Asghar PDM. Effect of 7E's model on problem-solving ability of students in mathematics at secondary level. Int Res J Educ Innov 2022; 3(1): 93-104. https://doi.org/10.53575/irjei.v3.01.9(22)93-104

[18] Asanre AA, Sondlo A, Abiodun TO, Sottin DO. Effect of 7E's instructional strategy on the academic achievement in mathematics among senior secondary school students in Ijebu Ode. J Educ Teach Train 2024; 15(2): 56-66.

[19] Iqbal M, Noreen Z, Hayat K. Impact of 7E model on students' academic achievement: a comprehensive analysis in educational settings. J Educ Soc Stud 2024; 5(1): 154-67. https://doi.org/10.52223/jess.2024.5115

[20] Khashan K. The effectiveness of using the 7E's learning cycle strategy on the immediate and delayed mathematics achievement and the longitudinal impact of learning among preparatory year students at King Saud University. J Educ Pract 2016; 7(36): 40-52.

[21] Riski KI, Asrorul M, Endra P, Lailil AY. The influence of inclusive education on the mathematics achievement of students with intellectual disabilities. Indones J Instr Media Model 2025; 7(1): 18-32. https://doi.org/10.32585/ijimm.v7i1.6300

[22] Yang EFY, Chang B, Cheng HNH, Chan TW. Improving pupils' mathematical communication abilities through computer-supported reciprocal peer tutoring. Educ Technol Soc 2016; 19(3): 157-69.

[23] Abiodun TO, Asanre A, Taurayi C. Impact of the elicit, engage, explore, explain, elaborate, evaluate, and extend (7E) learning model on senior secondary school students' mathematics achievement. ASEAN J Sci Eng Educ 2025; 5(2): 117-26.

[24] Tudu UGB. Effect of STEM-7E inquiry-based learning on secondary school students' self-efficacy in learning science subjects in Nigeria. Int J Humanit Soc Sci Manag 2024; 4(6): 33-44.

[25] Mekonnen ZB, Yehualaw DD, Mengistie SM, Mersha BS. The effect of 7E learning cycle enriched with computer animations on students' conceptual understanding and overcoming misconceptions. J Pedagog Res 2024; 8(2): 325-56. https://doi.org/10.33902/JPR.202425017

[26] Saputri AY, Suyatna A, Abdurrahman. Development of e-LKPD based on 7E learning cycle to stimulus students' complex problem-solving and self-efficacy. J Penelit Pendidik IPA 2024; 10(10): 7313-21. https://doi.org/10.29303/jppipa.v10i10.7506

[27] Ajayi AO, Babjide VFT. The efficacy of 7E-learning instructional strategy on students' achievement in physics practical in Lagos State. Int J Strateg Res Educ Technol Humanit 2024; 12(2): 185-97. https://doi.org/10.48028/iiprds/ijsreth.v12.i2.14

[28] Iqbal M, Noreen Z, Hayat K. Impact of 7E model on students' academic achievement: a comprehensive analysis in educational settings. J Educ Soc Stud 2024; 5(1): 154-67. https://doi.org/10.52223/jess.2024.5115

[29] Jack GU, Ogunleye DO. Improving secondary school students' academic achievement in chemistry using 7Es constructivist instructional strategy. Int J Innov Soc Sci Educ Res 2024; 12(1): 61-83.

[30] Abdulrahim BJ. Impact of the 7E teaching model on secondary school students' academic achievement in biology in Ilorin, Nigeria. FNAS J Math Sci Educ 2025; 6(2): 43-8. Available from: https://fnasjournals.com/index.php/FNAS-JMSE/article/view/687

[31] Ndagijimana JB, Uwimbabazi C. Contribution of school leaders' practices to students' academic performance in selected nine-year basic education (9YBE) schools in Rwanda. Afr Q Soc Sci Rev 2025; 2(2): 183-97. https://doi.org/10.51867/AQSSR.2.2.17

[32] Kamoet PC, Mbirithi DM. Effect of classroom environment on the academic achievement of secondary school students in Mombasa County, Kenya. Int Acad J Soc Sci Educ 2024; 2(3): 345-63. Available from: https://iajournals.org/articles/iajsse_v2_i3_345_363.pdf

[33] Garcia-Peinado R. The impact of classroom climate on emotional development in childhood. Environ Soc Psychol 2024; 9(1): 1868. https://doi.org/10.54517/esp.v9i1.1868

[34] Rahman S, Chavhan R. 7E model: An effective instructional approach for teaching learning. EPRA Int J Multidiscip Res 2022; 8(1): 339-45. https://doi.org/10.36713/epra9431

[35] Warner S, Kaur A. The perceptions of teachers and students on a 21st century mathematics instructional model. Int Electron J Math Educ 2017; 12(2): 193-215. https://doi.org/10.29333/iejme/609

[36] Wodaj H, Belay S. Effects of 7E instructional model with metacognitive scaffolding on students' conceptual understanding in biology. J Educ Sci Environ Health 2021; 7(1): 26-43. https://doi.org/10.21891/jeseh.770794

[37] Samsudin MA, Jamali SM, Md Zain AN, Ebrahim NA. The effect of STEM project-based learning on self-efficacy among high-school physics students. J Turk Sci Educ 2020; 16(1): 94-108. https://doi.org/10.36681/tused.2020.15

[38] Jaya DP, Sulistiawati, Arifin S. The impact of the 7E learning cycle model on students' capacity for understanding mathematics. AIP Conf Proc 2023; 2886: 020001. https://doi.org/10.1063/5.0154654

[39] Demelash M, Andargie D, Belachew W. Enhancing secondary school students' engagement in chemistry through 7E context-based instructional strategy supported with simulation. Pedagog Res 2024; 9(2): em0189. https://doi.org/10.29333/pr/14146

[40] Pondang KA, Madulid A, Lotilla J, Agot K, Rufil C, Cabalhin J, *et al*. The relationship between learning environment and self-efficacy among senior high school students. Int J Res Innov Soc Sci 2025; 9(2): 1819-32. https://doi.org/10.47772/IJRISS.2025.9020148

[41] Hafeez M. Impact of teacher's training on interest and academic achievements of students by multiple teaching methods. Pedagog Res 2021; 6(3): em0102. https://doi.org/10.29333/pr/11088

[42] Davidovitch N, Yavich R. Classroom climate and student self-efficacy in e-learning. Probl Educ 21st Century 2022; 80(2): 304-23. https://doi.org/10.33225/pec/22.80.304

[43] Julien G. The importance of inclusive education and correlation with self-concept among students: A conceptual literature review. J Educ Res Pract 2025; 3(2): 182-203. https://doi.org/10.70376/jerp.v3i2.367

[44] Anderson DW, Krajewski HT, Goffin RD, Jackson DN. A leadership self-efficacy taxonomy and its relation to effective leadership. Leadersh Q 2008; 19(5): 595-608. https://doi.org/10.1016/j.leaqua.2008.07.003

[45] Assi PN, Bassey EE, Atsu JU, Ibok EE, Nnaji ES, Ugbe BA, *et al*. Multi-criteria decision making for determining critical success factors in achieving top university graduation. Eur J Pure Appl Math 2024; 17(3): 1959-81. https://doi.org/10.29020/nybg.ejpam.v17i3.5149