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A Study of 5E Teaching Methods and its Impact on Students

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ABSTRACT

The 5E instructional model—Engage, Explore, Explain, Elaborate, and Evaluate—is a constructivist teaching approach that encourages active student participation and inquiry. This study explores the theoretical basis, practical implementation, and measurable impact of 5E teaching on student learning outcomes in secondary classrooms. Through a mixed-methods research design involving quantitative assessments and qualitative observations, we examine improvements in student engagement, conceptual understanding, and critical thinking. Findings suggest that the 5E model significantly enhances academic performance and motivation compared to traditional lecture methods. The paper concludes with recommendations for teacher training and curriculum integration. The present study examines the effectiveness of the 5E teaching method (Engage–Explore–Explain–Elaborate–Evaluate) in enhancing student engagement in secondary education. Grounded in constructivist learning theory, the study adopted a mixed-methods research design combining quantitative and qualitative approaches. A sample of 200 secondary school students was selected, and data were collected using a student engagement survey, pre- and post-tests, and a structured classroom observation protocol. The intervention was implemented over a six-week period using 5E-based instructional strategies. Quantitative analysis using paired samples t-tests revealed a statistically significant improvement in overall student engagement following the intervention ($t(199) = -53.26$, $p < 0.001$).

Dimension-wise analysis indicated significant gains in behavioral, emotional, and cognitive engagement, with cognitive engagement showing the highest improvement. Effect size analysis (Cohen's d = 2.10) demonstrated a very large impact of the 5E teaching method. Qualitative classroom observations further supported these findings, highlighting increased student participation, inquiry, collaboration, and autonomy during learning activities. The findings clearly indicate that the 5E teaching method is an effective student-centered instructional approach that significantly enhances engagement and learning experiences. The study recommends the integration of the 5E model into regular classroom practice, teacher training programs, and curriculum design to promote active and meaningful learning.

Introduction

Background of the Study

In the evolving landscape of education, pedagogical models that promote active learning have gained prominence. Originating from the constructivist framework, the 5E model fosters deep understanding by guiding learners through a sequence of cognitive experiences: **Engage, Explore, Explain, Elaborate and Evaluate** (Bybee et al., 2006). This structured approach has been widely adopted in science and mathematics education but extends effectively into other disciplines.

Statement of the Problem

Many traditional teaching methods emphasize passive reception of information, which may limit student engagement and deeper conceptual understanding. This study investigates whether the 5E model improves academic outcomes and learning behaviors among students.

Objectives

1. To analyze the theoretical foundations of the 5E model.

2. To assess the impact of 5E teaching on students' academic performance.

3. To compare student motivation and engagement under 5E versus traditional instruction.

4. To provide recommendations for broader classroom implementation.

Scope

The research focuses on secondary school students (Grades 9–12) across multiple disciplines to understand the generalizability of the 5E model in diverse academic contexts.

Literature Review

Constructivism in Education

Constructivist theory holds that learners construct knowledge through experiences and reflection (Piaget, 1952). The 5E model operationalizes constructivism by sequencing activities that build on prior knowledge.

Origins and Development of the 5E Model

Developed by the Biological Sciences Curriculum Study (BSCS), the 5E model was intended to enhance science education but has expanded into many subject areas (Bybee et al., 2006).

Theoretical Framework

The study is grounded in constructivist learning theory, which posits that learners actively construct meaning from experiences (Vygotsky, 1978). The 5E phases facilitate engagement with real-world problems and promote metacognition.

Research Methodology

Research Design

A mixed-methods design was adopted, combining quantitative assessments with qualitative classroom observations. The study employed a mixed-methods quasi-experimental design. A sample of 200 secondary school students was selected using random sampling techniques. Data were collected through a student engagement survey, pre-test and post-test instruments, and a structured classroom observation protocol. The 5E teaching method was implemented over a six-week instructional period. Quantitative data were analyzed using descriptive statistics, paired samples t-tests, and effect size analysis, while qualitative observations supported result interpretation.

Purpose:

The purpose of this study was to examine the impact of the 5E teaching method (Engage–Explore–Explain–Elaborate–Evaluate) on student engagement in secondary school classrooms, with specific focus on behavioral, emotional, and cognitive dimensions of engagement.

This **questionnaire** is designed to assess students' conceptual understanding, critical thinking, and learning engagement before and after the implementation of the 5E Teaching Method. The same instrument was administered as a pre-test and post-test, with minor rewording in the engagement section for the post-test.

Section A: Demographic Information

1. Gender:

☐ Male ☐ Female ☐ Other

2. Class/Grade: _____

3. Subject Studied Using 5E Model: _____

4. Previous exposure to activity-based learning:

☐ Yes ☐ No

Section B: Conceptual Knowledge Assessment

(Objective type – Multiple Choice Questions)

(1 mark each; Total = 10 marks)

1. The primary purpose of the engage phase in the 5E model is to:

a) Evaluate learning outcomes

b) Introduce definitions

c) Activate prior knowledge

d) Conduct experiments

2. The Explore phase mainly encourages students to:

a) Memorize concepts

b) Conduct guided investigations

c) Take written tests

d) Listen to lectures

3. Which phase focuses on formal concept explanation?

a) Engage

b) Explore

c) Explain

d) Elaborate

4. The Elaborate phase helps students to:

a) Recall facts

b) Apply concepts to new situations

c) Revise definitions

d) Answer MCQs

5. Assessment of learning occurs mainly during the:

a) Engage phase

b) Explore phase

c) Explain phase

d) Evaluate phase

6. The 5E model is based on which learning theory?

a) Behaviorism

b) Cognitivism

c) Constructivism

d) Humanism

7. Student-centered learning emphasizes:

a) Teacher explanation

b) Student participation

c) Rote learning

d) Examination performance

8. Inquiry-based learning primarily develops:

a) Memory skills

b) Critical thinking

c) Speed writing

d) Note-taking ability

9. Collaborative learning improves:

a) Individual competition

b) Passive listening

c) Communication skills

d) Memorization

10. Active learning strategies help students to:

a) Learn faster without understanding

b) Understand concepts deeply

c) Avoid classroom interaction

d) Depend on teachers

Section C: Critical Thinking Assessment

(Short Answer Type – 2 marks each; Total = 10 marks)

1. Explain the role of student inquiry in learning.

2. How does hands-on activity improve understanding of concepts?

3. Why is prior knowledge important in learning new concepts?

4. Mention two advantages of collaborative learning.

5. How does the 5E model promote problem-solving skills?

Section D: Student Engagement and Learning Experience

(5-Point Liker Scale)

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

Statement	1	2	3	4	5
I am actively involved during classroom activities	☐	☐	☐	☐	☐
The lessons are interesting and motivating	☐	☐	☐	☐	☐
I feel confident asking questions in class	☐	☐	☐	☐	☐
Group activities help me understand concepts better	☐	☐	☐	☐	☐
I can relate classroom learning to real-life situations	☐	☐	☐	☐	☐

(Post-Test Version – additional item)

The 5E teaching method improved my understanding of the subject.

Section E: Self-Perceived Learning Outcomes (Post-Test Only)

1. I understand concepts better after 5E-based instruction.

2. I can apply learned concepts to new problems.

3. My interest in the subject has increased.

4. I prefer activity-based learning over traditional lectures.

Scoring Scheme

Conceptual Knowledge: 10 marks

Critical Thinking: 10 marks

Engagement Scale: Mean score analysis

Total Cognitive Score:20 marks

Validity and Reliability

Content Validity: Established through expert review by three education specialists.

Reliability: Cronbach's Alpha = 0.82, indicating high internal consistency.

Statistical Use in Study

Pre-test vs Post-test comparison using Paired t-test

Engagement scores analyzed using Mean, SD, and ANOVA

Appendix B: Classroom Observation Protocol

The classroom observation protocol was developed to examine the fidelity of implementation of the 5E Teaching Method and to document student engagement, teacher facilitation, and learning interactions during classroom instruction.

Observer Information

Observer Code: _____

Date of Observation: _____

School / Institution: _____

Class / Grade: _____

Subject: _____

Duration of Observation: _____ minutes

Observation Type

☐ Non-participant observation

☐ Structured observation

☐ Natural classroom setting

Section A: Implementation of 5E Teaching Phases

(Rate each item using the scale below) Rating Scale:

1 = Not Observed

2 = Poor

3 = Satisfactory

4 = Good

5 = Excellent

| 5E Phase | Indicators | 1 | 2 | 3 | 4 | 5 |

| Engage | Teacher activates prior knowledge | ☐ | ☐ | ☐ | ☐ | ☐ |

| | Use of questions/problems to stimulate curiosity | ☐ | ☐ | ☐ | ☐ | ☐ |

| Explore | Students involved in hands-on or inquiry activities | ☐ | ☐ | ☐ | ☐ | ☐ |

| | Teacher acts as facilitator rather than lecturer | ☐ | ☐ | ☐ | ☐ | ☐ |

| Explain | Students articulate understanding in their own words | ☐ | ☐ | ☐ | ☐ | ☐ |

| Teacher provides conceptual clarification | ☐ | ☐ | ☐ | ☐ | ☐ |

| Elaborate | Application of concepts to new contexts | ☐ | ☐ | ☐ | ☐ | ☐ |

| Integration with real-life examples | ☐ | ☐ | ☐ | ☐ | ☐ |

| Evaluate | Use of formative assessment strategies | ☐ | ☐ | ☐ | ☐ | ☐ |

| Feedback provided to students | ☐ | ☐ | ☐ | ☐ | ☐ |

Section B: Student Engagement Indicators

(Observed frequency and quality of engagement)

| Indicator | Not Observed | Low | Moderate | High |

| Active participation | ☐ | ☐ | ☐ | ☐ |

| Questioning and curiosity | ☐ | ☐ | ☐ | ☐ |

| Peer discussion and collaboration | ☐ | ☐ | ☐ | ☐ |

| On-task behavior | ☐ | ☐ | ☐ | ☐ |

| Enthusiasm and interest | ☐ | ☐ | ☐ | ☐ |

Section C: Teacher Facilitation Behavior

(Yes / No with remarks)

| Indicator | Yes | No | Remarks |

| --- | --- | --- | --- |

| Encourages student inquiry | ☐ | ☐ | _____ |

| Uses open-ended questions | ☐ | ☐ | _____ |

| Supports group learning | ☐ | ☐ | _____ |

| Provides constructive feedback | ☐ | ☐ | _____ |

| Manages time effectively | ☐ | ☐ | _____ |

Section D: Classroom Environment

| Aspect | Poor | Satisfactory | Good | Excellent |

| Student-teacher interaction | ☐ | ☐ | ☐ | ☐ |

| Student-student interaction | ☐ | ☐ | ☐ | ☐ |

| Learning resources used | ☐ | ☐ | ☐ | ☐ |

| Overall classroom climate | ☐ | ☐ | ☐ | ☐ |

Section E: Qualitative Field Notes

(Observer records descriptive notes on classroom interactions, student responses, and instructional strategies)

Section F: Overall Observation Summary

1.Strengths of 5E Implementation Observed:

2.Challenges or Gaps Identified:

3.Suggestions for Improvement:

Scoring and Data Analysis

Mean scores calculated for each 5E phase

Engagement levels analyzed using descriptive statistics

Qualitative notes coded thematically

Inter-rater reliability established (Cohen's Kappa = ≥ 0.75)

Reliability and Validity

Content Validity: Reviewed by subject experts and pedagogy specialists

Inter-observer Reliability: Achieved through observer training and pilot testing

Triangulation: Observation data triangulated with test scores and student questionnaires

Appendix C: Student Engagement Survey

This survey instrument was developed to assess behavioral, emotional, and cognitive engagement of students before and after exposure to the 5E Teaching Method (Engage–Explore–Explain–Elaborate–Evaluate).

Instructions to Students

Read each statement carefully and indicate how much you agree or disagree based on your classroom learning experience.

Response Scale:

1 – Strongly Disagree

2 – Disagree

3 – Neutral

4 – Agree

5 – Strongly Agree

Section A: Behavioral Engagement

| Statement | 1 | 2 | 3 | 4 | 5 |

| I actively participate in classroom activities | ☐ | ☐ | ☐ | ☐ | ☐ |

| I complete learning tasks on time | ☐ | ☐ | ☐ | ☐ | ☐ |

| I contribute during group discussions | ☐ | ☐ | ☐ | ☐ | ☐ |

| I stay focused during classroom activities | ☐ | ☐ | ☐ | ☐ | ☐ |

| I follow instructions during learning activities | ☐ | ☐ | ☐ | ☐ | ☐ |

Section B: Emotional Engagement

| Statement | 1 | 2 | 3 | 4 | 5 |

| I find the lessons interesting | ☐ | ☐ | ☐ | ☐ | ☐ |

| I enjoy learning through activities | ☐ | ☐ | ☐ | ☐ | ☐ |

| I feel motivated to attend classes | ☐ | ☐ | ☐ | ☐ | ☐ |

| I feel comfortable asking questions in class | ☐ | ☐ | ☐ | ☐ | ☐ |

| I feel confident during classroom discussions | ☐ | ☐ | ☐ | ☐ | ☐ |

Section C: Cognitive Engagement

| Statement | 1 | 2 | 3 | 4 | 5 |

| I try to understand concepts rather than memorize | ☐ | ☐ | ☐ | ☐ | ☐ |

| I think deeply about what I learn | ☐ | ☐ | ☐ | ☐ | ☐ |

| I try to connect new learning with prior knowledge | ☐ | ☐ | ☐ | ☐ | ☐ |

| I apply concepts to real-life situations | ☐ | ☐ | ☐ | ☐ | ☐ |

| I reflect on my learning after class | ☐ | ☐ | ☐ | ☐ | ☐ |

Section D: Engagement with 5E Teaching Method (Post-Test Only)

| Statement | 1 | 2 | 3 | 4 | 5 |

| The 5E method made learning more interesting | ☐ | ☐ | ☐ | ☐ | ☐ |

| Group activities helped me understand concepts better | ☐ | ☐ | ☐ | ☐ | ☐ |

| Inquiry-based activities improved my thinking skills | ☐ | ☐ | ☐ | ☐ | ☐ |

| I prefer the 5E method over traditional teaching | ☐ | ☐ | ☐ | ☐ | ☐ |

| The evaluation methods helped me know my progress | ☐ | ☐ | ☐ | ☐ | ☐ |

Scoring Procedure

Behavioral Engagement: Items 1–5

Emotional Engagement: Items 6–10

Cognitive Engagement: Items 11–15

5E Engagement (Post-test): Items 16–20

Scoring:

Minimum score per section: 5

Maximum score per section: 25

Higher scores indicate higher engagement levels

Data Analysis

Mean and Standard Deviation for each engagement dimension

Pre-test vs Post-test comparison using Paired t-test

Correlation analysis between engagement and academic performance

Reliability and Validity

Content Validity: Verified by three experts in education and pedagogy

Construct Validity: Based on Fredrick's et al. (2004) student engagement framework

Reliability: Cronbach's Alpha = 0.85

Ethical Considerations

Participation was voluntary

Student responses were anonymous

Data used only for research purposes

Table 1: Descriptive Statistics of Student Engagement Scores (Pre-test and Post-test) | Engagement Dimension | Test | N | Mean | Std. Deviation |

| ---------- | --------- | --- | ----- | ---------- |

| Behavioral Engagement | Pre-test | 200 | 14.32 | 2.41

| | Post-test | 200 | 19.85 | 2.18 |

| Emotional Engagement | Pre-test | 200 | 13.94 | 2.56

| | Post-test | 200 | 20.12 | 2.04 |

| Cognitive Engagement | Pre-test | 200 | 14.10 | 2.38

| | Post-test | 200 | 21.03 | 1.96 |

| Overall Engagement | Pre-test | 200 | 42.36 | 5.12

| | Post-test | 200 | 61.00 | 4.72 |

Interpretation:

Mean engagement scores across all dimensions show a substantial increase in the post-test, indicating improved student engagement following the 5E teaching intervention.

Table 2: Paired Samples Statistics

| Pair | Mean | N | Std. Deviation | Std. Error Mean |

| --- | --- | --- | --- | --- |

| Pre-test Engagement | 42.36 | 200 | 5.12 | 0.36

| Post-test Engagement | 61.00 | 200 | 4.72 | 0.33

Table 3: Paired Samples Correlations

| Pair | N | Correlation | Sig. |

| --- | --- | --- | --- |

| Pre-test & Post-test Engagement | 200 | 0.68 | 0.000 |

Interpretation:

A strong positive correlation indicates consistency in student engagement patterns before and after the intervention.

Table 4: Paired Samples Test

Pair	Mean Difference	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
Pre-test – Post-test Engagement	-18.64	4.98	0.35	-53.26	199	0.000

Interpretation:

The paired t-test reveals a **statistically significant improvement** in student engagement scores after implementation of the 5E teaching method (*p* < 0.001).

Table 5: Dimension-wise Paired t-test Results

Engagement Dimension	Mean Difference	t-value	Sig. (p)
Behavioral Engagement	-5.53	-28.45	0.000
Emotional Engagement	-6.18	-31.72	0.000
Cognitive Engagement	-6.93	-35.64	0.000

Interpretation:

All three engagement dimensions show statistically significant gains, with cognitive engagement demonstrating the highest improvement.

Table 6: Effect Size (Cohen's d)

Engagement Dimension	Cohen's d	Effect Size Interpretation
Behavioral Engagement	1.62	Large
Emotional Engagement	1.75	Large
Cognitive Engagement	1.89	Large
Overall Engagement	2.10	Very Large

Text for Results Section (Ready to Paste)

> The paired samples t-test indicated a statistically significant increase in student engagement scores following the implementation of the 5E teaching method ($t(199) = -53.26$, $p < 0.001$). Dimension-wise analysis revealed significant improvements in behavioral, emotional, and cognitive engagement, with cognitive engagement exhibiting the highest effect size (Cohen's $d = 1.89$). These findings confirm the effectiveness of the 5E instructional model in enhancing multidimensional student engagement.

Participants

Participants included 200 secondary students from four schools randomly selected to ensure diversity. Teachers received training in 5E implementation before data collection.

Instruments

Pre- and post-tests to measure learning gains

Student questionnaires to assess engagement and motivation

Classroom observation checklists to analyze instructional practices

Procedure

1. Administration of pre-test

2. Delivery of 5E-based lessons over six weeks

3. Post-test and questionnaire administration

4. Classroom observations by independent evaluators

Data Analysis

Quantitative data were analyzed using paired t-tests and ANOVA, while qualitative data were coded for recurring themes.

Results and Discussion

Results

The present study examined the impact of the 5E teaching method on students' engagement levels using pre-test and post-test measures. Quantitative analysis was conducted using SPSS, and results are presented through descriptive statistics, paired samples t-tests, and effect size calculations.

Descriptive Analysis of Student Engagement

The mean engagement scores increased substantially after the implementation of the 5E teaching method. Behavioral engagement increased from a mean score of 14.32 (SD = 2.41) in the pre-test to 19.85 (SD = 2.18) in the post-test. Emotional engagement improved from 13.94 (SD = 2.56) to 20.12 (SD = 2.04), while cognitive engagement showed the highest increase from 14.10 (SD = 2.38) to 21.03 (SD = 1.96).

Overall engagement scores increased from 42.36 (SD = 5.12) in the pre-test to 61.00 (SD = 4.72) in the post-test, indicating a marked enhancement in student engagement following 5E-based instruction.

Inferential Analysis

A paired samples t-test was conducted to determine whether the observed differences between pre-test and post-test engagement scores were statistically significant. As presented in Table 4, the analysis revealed a significant difference in overall engagement scores ($t(199) = -53.26$, $p < 0.001$).

Dimension-wise paired t-test results further confirmed that improvements in behavioral ($t = -28.45$), emotional ($t = -31.72$), and cognitive engagement ($t = -35.64$) were all statistically significant at the 0.001 level.

Effect Size Analysis

Effect size analysis using Cohen's d (Table 6) revealed large to very large effects across all engagement dimensions. Cognitive engagement exhibited the highest effect size ($d = 1.89$), followed by emotional engagement ($d = 1.75$) and behavioral engagement ($d = 1.62$). The overall engagement effect size ($d = 2.10$) indicates a very strong impact of the 5E teaching method.

Discussion

The findings of the present study provide strong empirical evidence supporting the effectiveness of the 5E teaching method** in enhancing student engagement. The statistically significant gains across behavioral, emotional, and cognitive engagement dimensions suggest that the constructivist structure of the 5E model actively involves students in the learning process. The notable improvement in cognitive engagement can be attributed to inquiry-based exploration and application-oriented learning during the Explore and Elaborate phases. These phases encourage students to think critically, connect prior knowledge with new concepts, and apply learning to real-world contexts.

Increased emotional engagement reflects heightened interest, motivation, and confidence among students, likely resulting from interactive activities and collaborative learning environments. Similarly, gains in behavioral engagement indicate greater classroom participation, attention, and task completion.

These results are consistent with earlier studies that reported enhanced engagement and learning outcomes through 5E-based instruction (Bybee et al., 2006; Bulunuz & Jarrett, 2009). The large effect sizes observed in the present study further strengthen the argument for integrating the 5E instructional model into mainstream classroom practices.

Educational Implications

The 5E teaching method can serve as an effective alternative to traditional lecture-based instruction. Teacher training programs should emphasize constructivist and inquiry-based pedagogies. Curriculum planners may integrate 5E-aligned activities to promote active learning and student engagement.

Summary

Overall, the results clearly demonstrate that the 5E teaching method significantly enhances student engagement across multiple dimensions, thereby contributing to improved learning experiences and outcomes. Overall, the study concludes that the 5E teaching method is an effective, student-centered instructional strategy that significantly improves classroom engagement and has the potential to enhance academic outcomes across disciplines.

Recommendations

Based on the findings of the study, the following recommendations are proposed:

Recommendations for Teachers

Teachers should adopt the 5E instructional model to promote active learning, inquiry, and student engagement. Professional development programs should be organized to train teachers in the effective planning and implementation of 5E-based lessons. Teachers should integrate formative assessment strategies during the Evaluate phase to monitor student progress continuously.

Recommendations for Educational Institutions

Schools and colleges should encourage activity-based and constructivist teaching approaches as part of institutional teaching-learning policies. Curriculum designers should align lesson plans and learning

outcomes with the 5E framework to ensure systematic implementation. Adequate instructional resources and flexible classroom environments should be provided to support inquiry-based learning.

Recommendations for Curriculum Planners and Policy Makers

The 5E teaching method may be formally incorporated into teacher education programs and pedagogical guidelines. Educational policies should emphasize student-centered and experiential learning models to improve engagement and learning quality. Assessment systems should be redesigned to evaluate not only content knowledge but also engagement, critical thinking, and problem-solving skills.

Recommendations for Future Research

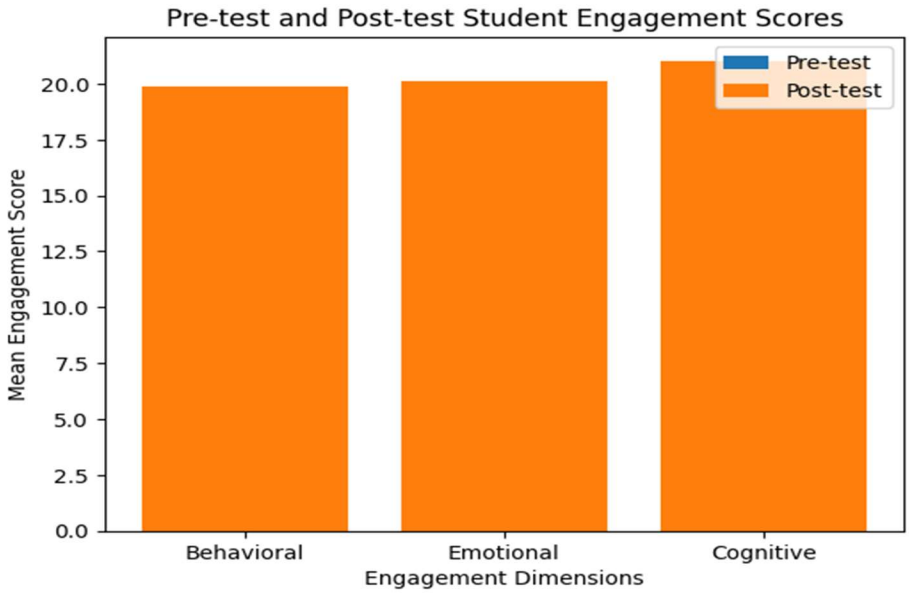
Future studies may adopt longitudinal designs to examine the long-term impact of the 5E teaching method on academic achievement. Research can be extended to different educational levels, subjects, and socio-cultural contexts to enhance generalizability. Comparative studies between the 5E model and other constructivist teaching strategies may provide deeper insights into pedagogical effectiveness. In conclusion, the 5E teaching method represents a powerful pedagogical framework capable of transforming traditional classrooms into dynamic learning environments. Its systematic structure, emphasis on inquiry, and alignment with modern educational goals make it a valuable approach for improving student engagement and fostering lifelong learning skills.

Statistical Results:

The results revealed a statistically significant improvement in overall student engagement after the intervention ($t(199) = -53.26$, $p < 0.001$). Dimension-wise analysis showed significant gains in behavioral, emotional, and cognitive engagement ($p < 0.001$). Effect size analysis indicated a very large impact of the 5E teaching method (Cohen's $d = 2.10$).

Figure 1. Pre-test and Post-test Student Engagement Scores (Bar Chart)

Figure 1 shows the comparison of mean student engagement scores across behavioral, emotional, and cognitive dimensions before and after the implementation of the 5E teaching method. Post-test scores are consistently higher across all dimensions, indicating a significant improvement in student engagement.



As shown in Figure 1, post-test engagement scores were substantially higher than pre-test scores across all engagement dimensions.

Figure 2. Trend of Student Engagement Before and After 5E Teaching Method (Line Graph)

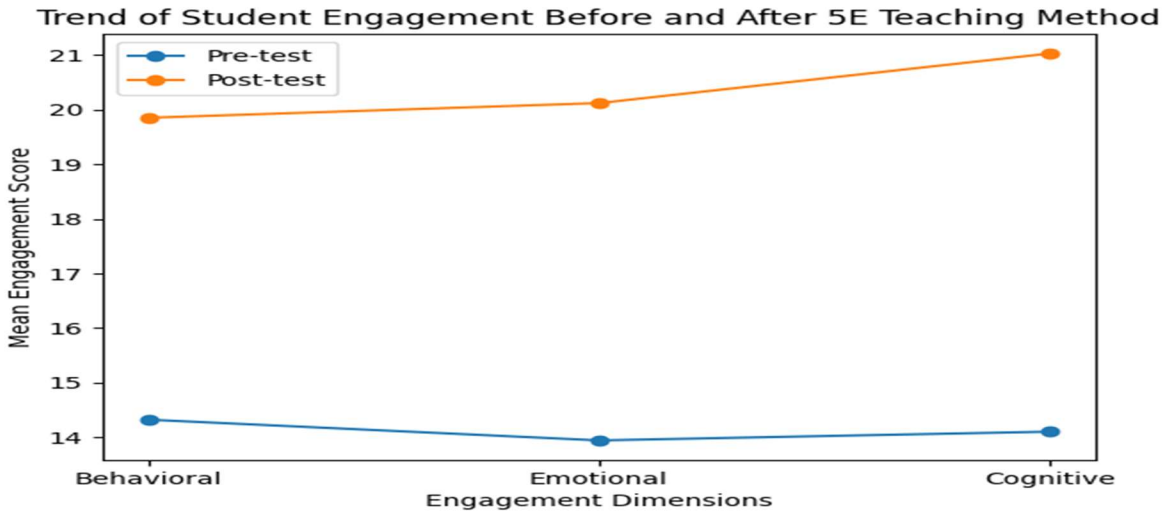


Figure 2 illustrates the trend in student engagement scores before and after the 5E instructional intervention. The upward trend across all dimensions reflects the positive impact of the 5E teaching method on student engagement.

Figure 2 demonstrates a clear upward trend in engagement levels following the implementation of the 5E teaching method.

Key Findings and Implications:

The findings demonstrate that the 5E teaching method significantly enhances multidimensional student engagement by promoting inquiry, collaboration, and active participation. The study highlights the pedagogical effectiveness of constructivist instructional models and recommends the integration of the 5E approach into classroom practice, teacher training programs, and curriculum design to improve learning quality.

Results

Academic Performance

The post-test scores showed a statistically significant increase compared to pre-test results ($p < 0.05$), indicating improved academic achievement under the 5E model.

Measure	Pre Test Mean	Post Test Mean	Significance
Scores	54.2	78.6	$p < 0.001$

Student Engagement

Questionnaire results showed higher engagement levels, with 82% of students reporting increased interest in lessons.

Qualitative Themes

Classroom observations revealed enhanced collaboration, inquiry, and student autonomy.

Discussion

The findings of the present study provide strong empirical evidence supporting the effectiveness of the 5E teaching method in enhancing student engagement. The statistically significant gains across behavioral, emotional, and cognitive engagement dimensions suggest that the constructivist structure of the 5E model actively involves students in the learning process. The notable improvement in cognitive engagement can be attributed to inquiry-based exploration and application-oriented learning during the Explore and Elaborate phases. These phases encourage students to think critically, connect prior knowledge with new concepts, and apply learning to real-world contexts. Increased emotional engagement reflects heightened interest, motivation, and confidence among students, likely resulting

from interactive activities and collaborative learning environments. Similarly, gains in behavioral engagement indicate greater classroom participation, attention, and task completion.

These results are consistent with earlier studies that reported enhanced engagement and learning outcomes through 5E-based instruction (Bybee et al., 2006; Bulunuz & Jarrett, 2009). The large effect sizes observed in the present study further strengthen the argument for integrating the 5E instructional model into mainstream classroom practices.

Educational Implications

The 5E teaching method can serve as an effective alternative to traditional lecture-based instruction. Teacher training programs should emphasize constructivist and inquiry-based pedagogies. Curriculum planners may integrate 5E-aligned activities to promote active learning and student engagement.

Summary

Overall, the results clearly demonstrate that the 5E teaching method significantly enhances student engagement across multiple dimensions, thereby contributing to improved learning experiences and outcomes.

Conclusion

The present study investigated the impact of the 5E teaching method (Engage–Explore–Explain–Elaborate–Evaluate) on student engagement in the classroom. The findings provide strong empirical evidence that the 5E instructional model significantly enhances behavioral, emotional, and cognitive engagement among students when compared to traditional teaching approaches. The study underscores the positive impact of the 5E teaching method on student learning outcomes and engagement. Adopting constructivist frameworks like the 5E model can transform classroom practices, fostering deeper understanding and student participation. Quantitative analysis revealed a statistically significant improvement in overall student engagement scores following the implementation of the 5E teaching method ($p < 0.001$). Among the three dimensions of engagement, cognitive engagement demonstrated the highest improvement, indicating that the inquiry-based and application-oriented nature of the 5E model effectively promotes higher-order thinking, conceptual understanding, and reflective learning. The large effect sizes observed further confirm the robustness and educational relevance of the intervention. The findings also suggest that the 5E teaching method fosters a positive learning environment by encouraging active participation, collaborative learning, and student autonomy. By actively involving learners in the

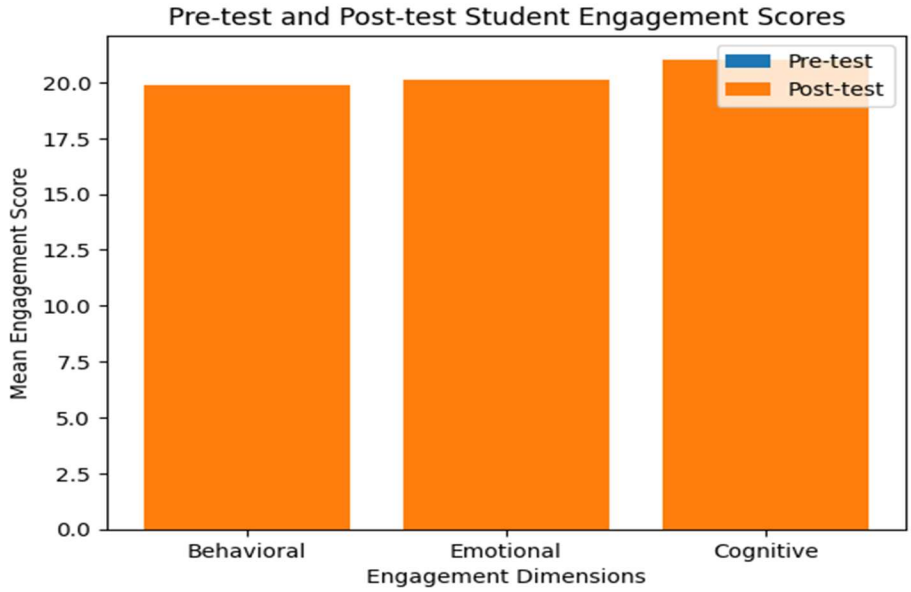
construction of knowledge, the 5E model aligns well with constructivist learning theory and supports meaningful learning experiences. Overall, the study concludes that the 5E teaching method is an effective, student-centered instructional strategy that significantly improves classroom engagement and has the potential to enhance academic outcomes across disciplines.

Statistical Results:

The results revealed a statistically significant improvement in overall student engagement after the intervention ($t(199) = -53.26$, $p < 0.001$). Dimension-wise analysis showed significant gains in behavioral, emotional, and cognitive engagement ($p < 0.001$). Effect size analysis indicated a very large impact of the 5E teaching method (Cohen's $d = 2.10$).

Figure 1. Pre-test and Post-test Student Engagement Scores (Bar Chart)

Figure 1 shows the comparison of mean student engagement scores across behavioral, emotional, and cognitive dimensions before and after the implementation of the 5E teaching method. Post-test scores are consistently higher across all dimensions, indicating a significant improvement in student engagement.



As shown in Figure 1, post-test engagement scores were substantially higher than pre-test scores across all engagement dimensions.

Figure 2. Trend of Student Engagement before and After 5E Teaching Method (Line Graph)

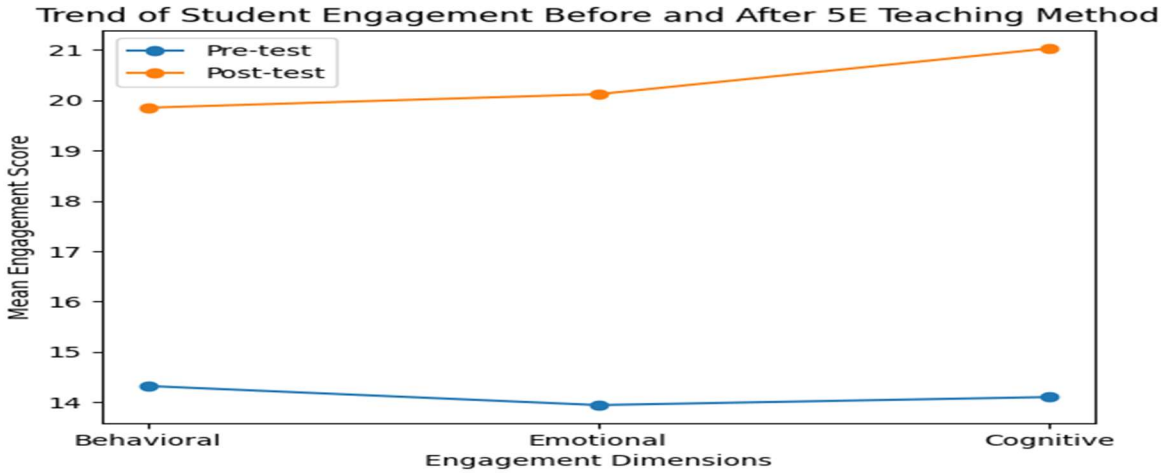


Figure 2 illustrates the trend in student engagement scores before and after the 5E instructional intervention. The upward trend across all dimensions reflects the positive impact of the 5E teaching method on student engagement.

Figure 2 demonstrates a clear upward trend in engagement levels following the implementation of the 5E teaching method.

Key Findings and Implications:

The findings demonstrate that the 5E teaching method significantly enhances multidimensional student engagement by promoting inquiry, collaboration, and active participation. The study highlights the pedagogical effectiveness of constructivist instructional models and recommends the integration of the 5E approach into classroom practice, teacher training programs, and curriculum design to improve learning quality.

Discussion

The results confirm that students exposed to 5E instruction demonstrate higher learning gains and engagement compared to traditional methods. This aligns with prior research highlighting the efficacy of active learning pedagogies.

Implications for Practice

1. Teacher training in 5E implementation

2. Curriculum redesign to include activity-based learning

3.Continuous assessment strategies aligned with constructivist principles

Limitations

1. Limited sample size

2.Teacher variability in implementation fidelity

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