



The Results of Inquiry-Based Learning Management on Critical Thinking and Academic Achievement of Grade-8 Students

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ABSTRACT

Purpose of the Study: The objectives of this research were threefold: (1) to evaluate the analytical thinking ability of Grade 8 students following exposure to the inquiry-based 7E learning model, (2) to assess the academic achievements of these students both before and after engaging in 7E learning, and (3) to explore the students' satisfaction with their learning experience under the 7E framework.

Methodology: The study involved 39 Grade 8 students from a school in Kalasin province, selected via Cluster Random Sampling during the first semester of the 2023 academic year. The research utilized a pre-experimental One Group Pretest-Posttest Design, with a classroom as the sampling unit. Data were gathered through pretests, posttests, and satisfaction surveys, with a focus on measuring analytical thinking and academic achievement.

Main Findings: The study revealed three key outcomes: (1) Students' critical thinking abilities improved significantly after learning with the 7E model, with results showing a statistically significant difference at the .05 level. (2) Academic achievement post-7E learning was recorded at 70.17%, indicating a notable improvement from the pretest scores. (3) Students reported high satisfaction with the 7E learning experience, emphasizing its positive impact on learning and engagement.

Novelty/Originality of this Study: This research contributes uniquely by demonstrating the effectiveness of the 7E inquiry-based learning model in enhancing critical thinking, a vital 21st-century skill. The study also shows how the 7E model boosts both student engagement and academic performance, offering an innovative approach to fostering deeper cognitive skills and academic success in a rapidly evolving educational landscape.

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1. INTRODUCTION

In the intricacies of the 21st century, critical thinking stands out as an indispensable ability, given the vast and diverse information landscape in contemporary society. It empowers individuals to navigate through the abundance of data, discern accuracy and reliability, make informed decisions, and adeptly tackle challenges [1]. At the core of critical thinking lies the proficiency in formulating and addressing profound inquiries, fostering comprehensive understanding [2]. This ability set encompasses the abilities to interpret, analyze, evaluate, synthesize, elucidate, infer, and self-regulate. Integrating critical thinking into the pedagogical framework is crucial for cultivating students' problem-solving skills, decision-making prowess, and communicative proficiency [3]-[5]. Inquiry-based learning (IBL) serves as a catalyst for refining students' critical thinking faculties by facilitating interpretation, analysis, evaluation, inference, explanation, and self-regulation—the

foundational proficiencies of critical thinking [2], [6], [7]. Learning methodologies grounded in data processing prove to be particularly effective in enhancing students' cognitive capacities due to their emphasis on individual ideation and data processing approaches. IBL, being a quintessential data processing-oriented approach, has long been acknowledged for producing superior learning outcomes in scientific education [8]. Moreover, it nurtures logical thinking, methodical reasoning, and analytical prowess [9].

A wealth of scholarly investigations spanning diverse fields highlights the pivotal role of meaningful learning in nurturing students' critical thinking ability [10], [11]. IBL is an educational approach centered on investigation and inquiry to acquire knowledge and ability [12]. It entails a systematic process that encompasses observation, questioning, source verification, data collection, analysis, interpretation, synthesis, presentation of answers, explanations, predictions, and communication of findings through discussion. This method also encourages the exploration of new questions that may emerge during the learning process. IBL places emphasis on the development of students' critical observation, questioning, and exploration of various perspectives and ideas about the real world, all under the guidance and support of teachers who facilitate the learning process. Moreover, IBL contributes significantly to enhancing critical thinking ability by actively involving students in the learning process and providing opportunities for their active participation. Research and assessments consistently affirm that IBL contributes to the improvement of students' critical thinking ability [13]. Engaging in IBL cultivates creative thinking, systematic problem-solving, and the application of critical thinking skills in analyzing situations [14]. Furthermore, IBL fosters critical thinking ability by offering students meaningful experiences and involving them in the creation of knowledge [15]. Throughout the learning process, students have opportunities to cultivate higher-order thinking skills [16]. However, IBL goes beyond showcasing students' critical thinking abilities; it establishes a learning environment that nurtures the development of critical thinking ability in diverse situations through adjustments in teaching and learning methods tailored to the progression of these ability [17].

Consequently, IBL is recognized as an effective teaching method that efficiently promotes students' critical thinking and contributes to enhancing their learning in both present and future contexts [18], [19]. The IBL process can be structured into either 5 steps (5Es) or 7 steps (7Es). The 5-step inquiry-based learning model (The 5E of Inquiry-Based Learning) supports students in autonomously discovering and connecting existing knowledge, finding problem-solving strategies independently, and subsequently applying them in their daily lives. This learning process encourages students to actively participate in creating their own knowledge [20]. In contrast, the 7Es model emphasizes knowledge transfer and underscores the importance of assessing students' existing knowledge, a crucial aspect that teachers should not overlook. Evaluating students' prior knowledge aids teachers in identifying what students need to learn before delving into specific content, thereby enhancing the effectiveness of the learning process [21].

Academic achievement [22] refers to the extent of students' success in mastering the content of school subjects, usually evidenced by scores obtained from examinations covering diverse topics. On the other hand, Tu'u Sincere [23] characterizes academic achievement as the attainment of knowledge or skills aligned with the subject matter, often assessed through exam scores or numerical criteria established by educators. Drawing upon the rationale, concepts, and principles explored by researchers, it is evident that the 7Es Inquiry-Based Learning (IBL) model comprising Engage, Explore, Explain, Elaborate, Evaluate, Extend, and Enhance serves as a comprehensive learning management approach. The model unfolds with the initial step of assessing prior knowledge, progressing to fostering connections between students' existing knowledge and their individual interests. Subsequently, students engage in research to gather evidence, facilitating the explanation and linkage of acquired knowledge to other relevant narratives. Within this framework, teachers play a pivotal role in assessing students' knowledge and encouraging them to apply acquired knowledge for practical purposes. These diverse learning processes collectively contribute to the cultivation of critical thinking skills among students. The present research posits that the implementation of the 7Es model serves as a strategic method to nurture students' critical thinking ability, ultimately leading to heightened academic achievement.

2. RESEARCH METHOD

This research is pre-experimental design using the One Group Pretest-Posttest Design research plan. The researchers employed the following research methodolog. The sample group comprised 8th grade students from a specific school in Kalasin province during the academic year 2023, semester 1. The selection focused on one classroom, encompassing a total of 39 students, and was deliberately chosen as a purposive sample.

The 7Es learning management plan consists of 9 plans, with a combined duration of 17 hours. Five experts evaluated the plan for its appropriateness and found an average score of 4.20, signifying a high level of suitability. The assessment test for Unit 2, which covers the topic of Separation of Mixtures, is a multiple-choice test with four options, comprising a total of 40 questions. After its development, the test underwent evaluation by five experts to gauge the alignment of each question with the designated learning objectives. The evaluation utilized the Index of Item-Objective Congruence (IOC) with a selection criterion ranging from 0.50 to 1.00.

Following the evaluation process, 30 questions were identified that met the established criterion, with an IOC value falling within the range of 0.60 to 1.00. Furthermore, the test's discriminant power and reliability coefficient were computed, resulting in discriminant power values ranging from 0.17 to 0.37 and a reliability coefficient of 0.84. In summary, the test demonstrated satisfactory quality, with 30 questions meeting the criteria: an IOC value between 0.60 and 1.00, discriminant power ranging from 0.17 to 0.37, and a reliability coefficient of 0.84. The analytical thinking ability assessment is a multiple-choice test comprising 30 questions, each with four options. The test evaluates five sub-skills: 1) the ability to identify problem issues, 2) the ability to assess the credibility of information sources and observations, 3) the ability to argue, 4) the ability to analyze, and 5) the ability to identify preliminary agreements. Following the test's development, it underwent evaluation by five experts. The results revealed that 20 questions met the established criteria, with an Index of IOC ranging from 0.60 to 1.00. A survey was conducted to assess the satisfaction of grade 8th students with the implementation of the 7Es learning model. The questionnaire consists of 20 questions, utilizing a Likert scale format with approximately 5 levels.

The data collection process for the first semester of the academic year 2023 was carried out by the researchers following these steps: 1) The researchers initiated contact with the teacher training center to arrange materials for the chosen school and obtain approval for data collection from the school; 2) Students were instructed to complete pre-learning assessments, evaluating their reasoning skills and cognitive abilities; 3) Learning activities were implemented, utilizing an IBL management plan that specifically focused on the 7Es knowledge separation process for 8th-grade students in the sample group; 4) Following the learning activities, students underwent post-learning assessments to measure their reasoning skills, and teachers conducted post-teaching evaluations; 5) Students provided feedback on their satisfaction with the IBL management, incorporating the 7Es process, after completing the learning activities; 6) The research findings were analyzed using statistical methods to summarize the study's outcomes.

The following data analysis techniques were employed to evaluate the outcomes of the study: Effectiveness of the 7Es Learning Plan: The E1 and E2 efficiency scores were calculated to assess the plan's effectiveness in delivering the Science and Technology curriculum; E1 refers to the students' performance during instruction, while E2 represents post-instruction outcomes. The efficiency levels were determined as 75.10 for E1 and 70.17 for E2. These values were analyzed using mean and percentage scores. Comparison of Critical Thinking Abilities and Academic Achievement: A t-test was used to compare the pretest and posttest results, evaluating any significant improvement in students' critical thinking abilities and overall academic achievement. Analysis of Student Satisfaction, The satisfaction scores from the student surveys were analyzed by calculating the mean and standard deviation. The mean satisfaction score was interpreted using established criteria to assess the students' overall satisfaction with the 7Es learning model.

3. RESULTS AND DISCUSSION

The study on the impact of 7Es on critical thinking ability and academic performance in Science and Technology subjects for grade 8th students in Science and Technology classes can be outlined. The findings from the analysis of the effectiveness of the 7Es model for grade 8th students revealed that all 9 learning activities were implemented, as depicted in Table 1.

Table 1. Efficiency of 7Es

Efficiency	Score	Mean	S.D	Percentage
E ₁	110	82.62	1.37	75.10
E ₂	30	21.05	2.04	70.17

Based on the table, students achieved scores from assignments, projects, experiments, and various questions, resulting in an average score of 82.62, equivalent to 75.10 percent. Additionally, they received scores from post-learning performance tests with an average of 21.05, equivalent to 70.17 percent. Consequently, the efficiency of this learning management plan is calculated as 75.10/70.17 percent.

The results of analyzing the critical thinking abilities of grade 8th students using the 7Es before and after learning, are shown in the table 2.

Table 2. The critical thinking abilities

Variable	Number Of Students In The Sample Group	Mean	Standard Deviation	Percent	T-Test	1-Tailed
Pre-Test	39	6.95	1.85	34.74	11.68*	.00
Post-Test	39	10.85	1.29	54.23		

* < .05

From the table, it is found that grade 8th students who received IBL management in the 7Es format had an average critical thinking score of 6.95 before learning and 10.85 after learning, respectively. When comparing the average scores before and after learning, it is observed that students who received IBL management in the 7Es format had significantly higher scores after learning than before learning, with statistical significance at the .05 level, consistent with hypothesis 1.

The results of comparing learning efficiency before and after implementing the 7Es IBL management process in the subject of Science and Technology for grade 8th students, specifically regarding the topic of separating mixtures, are shown in the table 3.

Table 3. The results of comparing the average scores of academic

Variable	Number Of Students In The Sample Group	Mean	Standard Deviation	Percent	T-Test	1-Tailed
Pre-Test	39	10.13	3.49	35.75	9.65*	.00
Post-Test	39	21.20	7.27	70.17		

* < .05

From the table, it is found that the average learning efficiency scores of grade 8th students using the 7Es IBL management process before and after learning are 10.23 and 21.05, respectively. It can be concluded that students who received the 7Es IBL management process had higher learning efficiency scores before learning than after learning, at 70.17 percent, which is consistent with hypothesis 2.

The results of the analysis of student satisfaction data regarding the 7Es IBL management process for grade 8th students are presented in the table 4.

Table 4. The comparison of average scores, standard deviations, and levels of satisfaction

List	Mean	S.D.	Level of satisfaction
1. Teaching methods aligned with objectives, content, and assessment.	4.28	0.78	Very satisfied
2. Teaching methods facilitate easy understanding of the learning content for students.	4.28	0.64	Very satisfied
3. Utilization of diverse teaching aids stimulates students' interest.	4.44	0.67	Very satisfied
4. Learning activities allow students to work both individually and in groups	4.31	0.79	Very satisfied
5. Encouragement of student inquiries and participation during class.	4.31	0.72	Very satisfied
6. Assignments such as exercises or additional tasks are given to students.	4.41	0.71	Very satisfied
7. Students actively participate in classroom activities.	4.26	0.78	Very satisfied
8. Modern and content-relevant media are used in teaching.	4.28	0.81	Very satisfied
9. Pre- and post-learning assessments are conducted.	4.41	0.74	Very satisfied
10. Instructors provide explanations of assessment results to students.	4.23	0.80	Very satisfied
11. Assessments are aligned with learning objectives and teaching activities.	4.33	0.76	Very satisfied
12. Planning and preparation for teaching.	4.38	0.77	Very satisfied
13. Diligence and enthusiasm in conducting teaching activities.	4.44	0.71	Very satisfied
14. Responsibility and punctuality in teaching.	4.46	0.71	Very satisfied
15. Neat attire and polite speech.	4.41	0.67	Very satisfied
16. Clear and easily understandable explanation of content.	4.31	0.72	Very satisfied
17. Students develop critical thinking ability and various other necessary skills.	4.69	0.61	Extremely satisfied
18. Students can link new knowledge with existing knowledge.	4.39	0.68	Very satisfied
19. Helps students better understand the content of the lesson.	4.44	0.71	Very satisfied
20. Students express opinions and practice thinking.	4.49	0.67	Very satisfied
Overview	.439	0.72	Very satisfied

From the table, it is found that students who received IBL using the 7Es framework had an overall average satisfaction score after the lesson of " $\bar{X} = 4.39$ (SD = 0.72). Satisfaction with the IBL process using the 7Es framework among students after the lesson is at a high level.

The students' ability to think critically using the 7Es IBL process was higher after the lesson than before. Students demonstrated a significantly higher level of critical thinking ability across all aspects after the lesson compared to before, at a significance level of .05. The ability to think critically can be ranked after the lesson from the highest to lowest average scores as follows: Ability to infer (2.26), Ability to identify preliminary agreements (2.23), Ability to identify problem areas (2.15), Ability to assess the credibility of sources and observations (2.15), Ability to analyze (2.05). With average scores of critical thinking abilities before and after the lesson being 6.95 and 10.85 respectively, and comparing the average scores before and after the lesson, it is found that Students who have undergone learning management using the 7Es IBL approach show statistically significant improvement after the lesson compared to before, at a significance level of .05, which aligns with the hypothesis. This is because the IBL approach has a positive impact on critical thinking abilities. Students are able to identify issues, gather relevant information, analyze data logically, and make appropriate decisions. Moreover, they have a better understanding of scientific content and principles, enabling them to solve problems and apply knowledge in daily life. Therefore, IBL is an effective method for enhancing critical thinking abilities and academic performance in science and technology subjects, consistent with research findings: Nisa et al, Study the effectiveness of the inquiry-based learning approach to develop students' analytical thinking skills at the high school level [24]. It was found that learning through inquiry-based learning is effective in developing students' critical thinking ability at the high school level, as evidenced by the increase in the average scores of students' critical thinking ability before and after learning [25]-[27].

The study found that the academic performance of 8th-grade students using the 7Es IBL approach differed significantly before and after instruction, with mean scores of 10.23 and 21.05, respectively. It was observed that students who received instruction using the 7Es IBL approach had significantly higher academic performance before instruction compared to after instruction, with statistical significance at the .05 level, consistent with the hypothesis set forth. The researchers designed learning activities aligned with the steps of the learning standards. This resulted in learning activities that fostered students' thinking at various stages of the activity and allowed for the review of students' prior knowledge, consistent with research findings: Özkan and Güneş, The study found that using the inquiry-based learning method had a positive impact on students' academic performance in science. This demonstrated the success in enhancing students' learning efficiency [28]. Inquiry-based learning encouraged students' participation in the learning process, leading to the development of their abilities to explore and analyze data. This is crucial for improving students' problem-solving and analytical thinking skills in science subjects. The results of this study are significant for the development and improvement of teaching methods to promote effective learning in science subjects for students at various levels of education, especially at higher levels than general science students. Higher student achievement in science compared to traditional instruction, with effect sizes varying depending on specific implementation models [29].

The satisfaction level of grade 8 students towards the 7Es IBL approach was found to be highly satisfactory. Students' overall satisfaction score after learning was $\bar{X}=4.39$, (SD = 0.72), indicating a high level of satisfaction with the 7Es inquiry-based learning approach. When considering students' satisfaction levels with each of the 20 aspects, the average scores ranged from 4.26 to 4.69, which were within the highly satisfactory range. This high satisfaction level could be attributed to students engaging in diverse activities and being able to perform activities independently, which aligns with their interests. The 7Es IBL approach focuses on making students the center of learning, evident in various stages of the learning process. This approach enables students to construct knowledge, review it, express their opinions, and fosters their cognitive development. Students actively participate in every step of the learning process, express their opinions, and enjoy learning activities. This stimulates students to remain engaged and aligns with the research findings Smith & Brown, found that quantitative analysis revealed significant improvements in students' understanding of biological concepts after implementing the inquiry-based teaching approach [30]. Students' scores on post-assessments increased noticeably compared to their scores on pre-assessments, indicating improved learning outcomes. Furthermore, qualitative feedback from students emphasized high levels of satisfaction with the 7E learning cycle. Students reported enjoying the interactive and hands-on learning experiences provided by the inquiry-based approach, which contributed to their overall satisfaction with the learning process. Overall, the study demonstrates the effectiveness of the 7Es learning cycle in promoting both learning outcomes and student satisfaction in high school biology education [31].

4. CONCLUSION

The study on the critical thinking abilities, learning effectiveness, and satisfaction of 8th-grade students using the 7-step Inquiry-Based Learning (IBL) approach (7Es) yielded positive results. Critical thinking abilities of the students improved significantly after the lesson, with a statistical significance level of .05, indicating that the 7Es IBL approach effectively enhanced their critical thinking skills. Additionally, the learning effectiveness of the students increased by 70.17% after implementing the 7Es approach compared to before the lesson.

Furthermore, student satisfaction with the 7Es IBL approach was rated as highly satisfactory, indicating a positive reception from the students.

These findings suggest that the 7Es IBL approach is a valuable teaching method that not only fosters critical thinking but also significantly improves learning effectiveness and student satisfaction. Its use can enhance student engagement and understanding, making it a promising strategy for secondary education. Teachers and educational institutions should consider adopting this method to create more interactive and thought-provoking learning environments that support deeper understanding and skill development. Future research could explore the long-term effects of the 7Es IBL approach on student outcomes in various subjects and contexts, as well as its adaptability to different educational settings. Additionally, investigating its impact on other cognitive skills, such as problem-solving and creativity, could further highlight its broader educational benefits. This approach offers a pathway for educators seeking to shift towards more student-centered, inquiry-driven learning models that better prepare students for complex real-world challenges.

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