The Effects of 5E Inquiry-Based Instruction on Academic Achievement and Analytical Thinking in Grade 4 Economics

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Abstract

In the context of 21st-century education, developing analytical thinking in economics is essential, and inquiry-based instructional approaches such as the 5E model may support both conceptual understanding and higher-order reasoning. The purposes of this study were to (1) examine the effectiveness of 5E inquiry-based learning management plans based on the 80/80 efficiency criterion, (2) compare students' academic achievement after instruction with the 80 percent criterion, and (3) compare students' analytical thinking before and after instruction. The participants were 10 Grade 4 students selected through cluster random sampling from a primary school in Yasothon Province, Thailand. The instruments included 12 5E inquiry-based learning management plans, a 20-item academic achievement test, and a 20-item analytical thinking test. The data were analyzed using mean, standard deviation, percentage, E1/E2 efficiency, and the Wilcoxon Signed-Ranks Test. The results indicated that the instructional plans achieved an efficiency of 86.02/87.50, students' academic achievement significantly exceeded the 80 percent criterion ($p < .05$), and analytical thinking scores significantly improved after the intervention ($p < .05$). These findings contribute empirical evidence supporting the application of the 5E inquiry-based model in primary-level economics to enhance both academic achievement and analytical thinking.

Keywords: 5E inquiry-based learning, economics education, elementary education, consumer education, higher-order thinking

1. Introduction

In the increasingly complex learning circumstance of the 21st century, the cognitive skills to process information critically and effectively become necessary for learners (Conklin, 2011; Miterianifa et al., 2021; Rahayu & Alsulami, 2024). The rapid expansion of digital media, social networking platforms, and network technologies has made information more accessible than ever before (Zou et al., 2025). However, accessibility does not guarantee understanding. Students are frequently exposed to vast amounts of data, opinions, and misinformation, which can lead to confusion rather than knowledge construction. For this reason, analytical thinking has become a central focus of contemporary education systems worldwide (Art-in, 2014; Reddy & Lakshmi, 2024). It enables learners to examine information systematically, distinguish between facts and assumptions, evaluate evidence, and construct reasoned conclusions (Wijaya et al., 2023). As a result, many national curricula now emphasize analytical thinking as a core competency essential for academic success and responsible citizenship in a digital society.

Analytical thinking is particularly essential in the study of economics, a subject that requires students to interpret relationships, evaluate alternatives, and make reasoned decisions (Baghaei Lakeh & Ghaffarzadegan, 2015). Economic concepts such as price determination, demand and supply, resource allocation, and market systems are not merely factual knowledge; they require learners to analyze cause–effect relationships and understand underlying mechanisms (Williams & Khalo, 2023). Without the ability to think analytically, students may memorize definitions without grasping how economic principles operate in real-life contexts. Developing strong analytical skills therefore enables learners to interpret everyday economic phenomena, make informed financial decisions, and understand how individual choices influence broader economic systems. In this way, analytical thinking strengthens both conceptual

understanding and practical application in economics education.

Despite the recognized importance of analytical thinking in economics education, classroom practices often especially in the Thai context remain dominated by teacher-centered instruction (David, 2018; Prachagool & Nuangchalerm, 2021, Suyaprom & Manmee, 2018; Unicef, 2014). In many contexts, economics is taught primarily through lectures, textbook explanations, and routine exercises that emphasize content coverage rather than conceptual exploration. Such non-experiential approaches position students as passive recipients of information, limiting opportunities to question assumptions, analyze relationships, or construct meaning independently. Given the inherent complexity of economic concepts—particularly those involving dynamic systems such as supply, demand, and price mechanisms—simply listening to explanations and completing structured exercises may be insufficient for deep understanding. When instruction does not engage students in inquiry, discussion, and problem-solving, their ability to transfer knowledge to real-world contexts may remain underdeveloped. Therefore, economics education may require instructional approaches that allow learners to actively practice analytical thinking while simultaneously constructing knowledge through meaningful engagement.

In response to these instructional limitations, the 5E inquiry-based learning model offers a structured yet student-centered framework designed to promote active engagement and conceptual understanding. The 5E model—comprising Engage, Explore, Explain, Elaborate, and Evaluate—was developed on constructivist principles that emphasize learners' active role in constructing knowledge through experience and reflection (Bybee, 2009; Duran & Duran, 2004; Polanin et al., 2024). According to Bybee (2009), 5E was introduced with the principle of allowing learners to investigate problems, generate ideas, test assumptions, and refine their understanding through guided inquiry rather than passive reception of information. From this perspective, learning is not viewed as the transmission of facts but as a process of cognitive development shaped by interaction, questioning, and reasoning.

Within economics education, such an approach is particularly relevant. During the Engage and Explore phases, students encounter real-life economic situations that stimulate curiosity and activate prior knowledge. Through explanation and elaboration, they analyze relationships, interpret evidence, and connect abstract concepts to practical contexts. This structured inquiry process requires students to examine cause–effect relationships, justify conclusions, and evaluate alternatives—core components of analytical thinking. Therefore, the 5E inquiry-based learning model holds strong theoretical potential to enhance both analytical thinking skills and meaningful understanding of economic concepts.

Recent empirical studies consistently demonstrate the positive impact of inquiry-based and 5E instructional approaches on students' analytical and critical thinking skills across disciplines. In the context of economics education, Astina et al. (2025) reported that inquiry-based learning significantly improved eleventh-grade students' critical thinking compared to traditional instruction, with substantial differences between experimental and control groups. Similarly, Sasanti et al. (2024) found that implementing 5E inquiry-based learning enhanced sixth-grade students' analytical thinking, particularly after iterative instructional refinement through classroom action research. Udonsathian and Worapun (2024) further demonstrated that integrating the 5E model with questioning techniques such as 5W1H strengthened students' analytical reasoning by encouraging systematic inquiry and reflective questioning. Although these studies were conducted primarily in science contexts, their findings converge on the conclusion that structured inquiry cycles promote higher-order thinking by engaging students in problem analysis, evidence evaluation, and conceptual reconstruction. Collectively, the literature suggests that the 5E framework provides a cognitive structure that supports analytical skill development beyond mere content acquisition.

Beyond its influence on analytical thinking, the 5E model has also been shown to enhance learning achievement in social studies and related disciplines. Öteleş (2024) reported that the implementation of the 5E learning cycle in social studies significantly improved students' academic performance and generated positive learner perceptions. Hassan et al. (2024) similarly found that applying the 5Es instructional model at the secondary level contributed to improved learning outcomes and greater student engagement. In science education, Owens and Sadler (2024) illustrated how framing socio-scientific issues through a 5E lens supports both disciplinary understanding and socio-scientific reasoning, reinforcing the model's versatility across content areas. Although direct investigations of the 5E model in primary-level economics remain limited, related inquiry-based research in geography (Yulianti, 2024) demonstrates that experiential and inquiry-oriented instruction facilitates deeper conceptual understanding in complex social science subjects. Taken together, these findings indicate that the 5E instructional model holds substantial promise for enhancing both analytical thinking and academic achievement in social science domains, including economics, where conceptual reasoning and real-world application are central to meaningful learning.

Although prior research has demonstrated the effectiveness of inquiry-based and 5E instructional approaches in

enhancing analytical thinking and academic achievement across science and social studies contexts, several limitations remain evident. First, much of the existing literature focuses on secondary-level students, with relatively limited attention to primary-level economics education. Second, while inquiry-based learning has been widely examined, fewer studies have specifically investigated the structured 5E model within elementary economics classrooms. Third, empirical evidence integrating both academic achievement and analytical thinking outcomes within the same instructional framework remains comparatively scarce, particularly in local primary education settings. Given the conceptual complexity of economics and the developmental needs of younger learners, further investigation is necessary to determine whether the 5E inquiry-based learning approach can effectively support both cognitive skill development and content mastery at the elementary level.

Therefore, this study aimed to: (1) examine the effectiveness of lesson plans developed using the 5E inquiry-based learning approach in Grade 4 economics based on the 80/80 criterion; (2) compare students' academic achievement after receiving 5E inquiry-based instruction with the established 80 percent criterion; and (3) compare students' analytical thinking before and after participating in the 5E inquiry-based learning activities.

2. Methodology

2.1 Research Design

This study employed a one-group pretest–posttest design to examine the effects of 5E inquiry-based instruction on Grade 4 students' academic achievement and analytical thinking in economics. Students were assessed prior to the intervention (pretest), participated in 12 hours of 5E inquiry-based learning activities, and were then assessed again using the same instruments (posttest). The effectiveness of the instructional plans was evaluated using the E1/E2 efficiency criterion (80/80). Students' post-instruction academic achievement was compared with the predetermined 80 percent performance criterion, and analytical thinking was compared between pretest and posttest scores.

2.2 Participants

The population consisted of 131 Grade 4 students enrolled in 11 classrooms within the Nong Naen–Phon Ngam Educational Quality Development Network under Yasothon Primary Educational Service Area Office 2 during the second semester of the 2025 academic year. The sample comprised 10 Grade 4 students from one classroom at Ban Khok Si School, Kut Chum District, Yasothon Province. The participants were selected using cluster random sampling, with the school serving as the sampling unit. All students in the selected classroom participated in the study.

2.3 Research Instruments

2.3.1 5E Inquiry-Based Learning Management Plans

The 5E inquiry-based learning management plans were developed to enhance Grade 4 students' academic achievement and analytical thinking in economics, specifically in the unit "Understanding Goods and Services." The lesson plans were grounded in constructivist learning principles, which emphasize active knowledge construction through engagement, exploration, explanation, elaboration, and evaluation. The instructional design aimed to provide students with opportunities to investigate economic concepts through inquiry-based activities rather than passive content reception.

A total of 12 lesson plans, each lasting one hour, were developed, resulting in 12 instructional hours. The content covered six subtopics: (1) meaning of goods and services, (2) principles of selecting goods and services, (3) factors influencing purchasing decisions, (4) consumer protection, (5) basic consumer rights, and (6) criteria for decision-making in purchasing goods and services.

As an example, in one lesson on factors influencing purchasing decisions, students were first engaged through real-life scenarios involving product advertisements. During the exploration phase, students worked in small groups to analyze situations related to price, quality, and necessity. In the explanation stage, students discussed their reasoning and connected their findings to formal economic concepts. During elaboration, they applied these principles to new purchasing scenarios, comparing alternatives and justifying their decisions. Finally, in the evaluation stage, students completed a short formative assessment and reflected on the criteria they used in making decisions. These activities were designed to encourage systematic analysis, comparison, and reasoned judgment.

The lesson plans were reviewed and validated by five experts in curriculum and instruction and social studies education. Content validity was examined using the Index of Item–Objective Congruence (IOC), and revisions were made based on expert feedback to ensure alignment with learning objectives, clarity of instructional procedures, and

appropriateness for Grade 4 learners.

2.3.2 Academic Achievement Test

The academic achievement test was developed to measure students' understanding of economic concepts in the unit "Understanding Goods and Services" after receiving 5E inquiry-based instruction. The test aimed to assess knowledge and application related to consumer behavior, purchasing decisions, consumer rights, and product evaluation. The instrument consisted of 20 multiple-choice items with four response options, selected from an initial pool of 30 items developed according to a table of specifications aligned with learning objectives and cognitive levels. The items were constructed based on the Basic Education Core Curriculum and relevant social studies content standards for Grade 4. Content validity was evaluated by five experts using the Index of Item–Objective Congruence (IOC). All items were found to have acceptable content validity (IOC $\geq$ 0.50). The test was piloted with students outside the sample group to analyze item quality. The selected items demonstrated appropriate levels of difficulty and discrimination according to established criteria. The reliability of the final 20-item test was determined using the Lovett method.

2.3.3 Analytical Thinking Test

The analytical thinking test was developed to assess students' ability to analyze economic situations, examine relationships among variables, and apply decision-making principles in consumer contexts. The test was constructed based on Bloom's analytical thinking framework, covering three dimensions: analysis of importance, analysis of relationships, and analysis of principles. The instrument consisted of 20 multiple-choice items with four response options, selected from an initial pool of 30 items. A table of specifications was used to ensure alignment between test items and the defined dimensions of analytical thinking. Content validity was examined by five experts using the Index of Item–Objective Congruence (IOC), and all items met the acceptable criterion (IOC $\geq$ 0.50). The test was piloted with students outside the sample group to determine item difficulty and discrimination. Items meeting the established criteria were retained. The reliability of the final version was calculated using the Kuder–Richardson (KR-20) method.

2.4 Data Collection and Data Analysis

Data were collected during the second semester of the 2025 academic year. Prior to the intervention, students completed a pretest measuring academic achievement and analytical thinking. The 5E inquiry-based learning management plans were then implemented over 12 instructional hours. During instruction, formative assessments embedded in each lesson were administered to monitor learning progress. After completing all lesson plans, students completed the same academic achievement and analytical thinking tests as posttests. The effectiveness of the instructional plans was evaluated using the E1/E2 efficiency criterion (80/80). The process efficiency (E1) was calculated from the mean percentage score of students' performance on formative assessments during instruction. The product efficiency (E2) was calculated from the mean percentage score of students' posttest academic achievement. The instructional plans were considered effective if both E1 and E2 met or exceeded the 80/80 benchmark. Descriptive statistics, including mean, standard deviation, and percentage, were used to summarize student performance. Students' post-instruction academic achievement was compared with the 80 percent criterion. Differences between pretest and posttest analytical thinking scores were analyzed using the Wilcoxon Signed-Ranks Test, as the sample size was small and the data did not meet normality assumptions.

3. Results

3.1 Efficiency of the 5E Inquiry-Based Learning Management Plans (E1/E2)

The efficiency of the 5E inquiry-based learning management plans was evaluated using the 80/80 criterion. The results are presented in Table 1.

Table 1. Efficiency of the 5E Inquiry-Based Learning Management Plans (E1/E2)

Indicator	N	Full Score	Mean	S.D.	Percentage
Process Efficiency (E1)	10	324	278.70	8.37	86.02
Product Efficiency (E2)	10	20	17.50	1.08	87.50

The findings indicate that the process efficiency (E1), derived from students' performance on formative assessments administered during each lesson, was 86.02 percent. The total full score of 324 was obtained from the accumulation of scores from worksheets and post-lesson quizzes across the 12 instructional sessions. The product efficiency (E2), calculated from students' posttest academic achievement scores, was 87.50 percent. Since both values exceeded the established 80/80 benchmark, the 5E inquiry-based learning management plans were considered effective.

3.2 Academic Achievement Compared with the 80 Percent Criterion

Students' post-instruction academic achievement scores were compared with the 80 percent criterion (16 out of 20 points) using the Wilcoxon Signed-Ranks Test. The results are presented in Table 2.

Table 2. Comparison of Post-Instruction Academic Achievement with the 80 Percent Criterion

N	Full Score	M	S.D.	Z	Sig.
10	20	17.50	1.08	-2.549	.011*

*Significant at the .05 level

The mean posttest score was 17.50 out of 20, exceeding the 80 percent benchmark. The Wilcoxon Signed-Ranks Test revealed a statistically significant difference ($Z = -2.549$, $p = .011$), indicating that students' academic achievement after the implementation of the 5E inquiry-based instruction was significantly higher than the established criterion.

3.3 Comparison of Analytical Thinking Before and After Instruction

Students' analytical thinking scores before and after the intervention were compared using the Wilcoxon Signed-Ranks Test. The results are shown in Table 3.

Table 3. Comparison of Analytical Thinking Scores Before and After Instruction

Test	N	Full Score	Mean	S.D.	Z	Sig.
Pretest	10	20	10.70	1.70	-2.825	.005*
Posttest	10	20	18.10	0.74		

*Significant at the .05 level

The mean analytical thinking score increased from 10.70 (S.D. = 1.70) before instruction to 18.10 (S.D. = 0.74) after instruction. The Wilcoxon Signed-Ranks Test indicated a statistically significant improvement ($Z = -2.825$, $p = .005$). These findings suggest that the 5E inquiry-based learning approach contributed to substantial gains in students' analytical thinking abilities.

4. Discussion

The findings of this study indicate that the 5E inquiry-based learning approach effectively enhanced both academic achievement and analytical thinking among Grade 4 students in economics. The instructional efficiency exceeded the 80/80 criterion, students' post-instruction achievement surpassed the 80 percent benchmark, and analytical thinking scores significantly improved after the intervention. These outcomes can be explained by examining how each stage of the 5E learning cycle contributes to cognitive development.

The Engage stage activated prior knowledge and stimulated curiosity through real-life economic scenarios, allowing students to connect abstract concepts with familiar consumer experiences. Such activation of prior knowledge is essential in constructivist learning and supports meaningful cognitive engagement (Bybee, 2009). The Explore stage provided opportunities for students to investigate purchasing situations collaboratively, analyze alternatives, and examine cause–effect relationships. This active exploration shifts learning from passive reception to experiential inquiry, which has been shown to enhance higher-order thinking skills. Similarly, Astina et al. (2025) reported that inquiry-based learning significantly improved students' critical thinking in economics compared with traditional instruction.

During the Explain phase, students articulated their reasoning and connected their observations to formal economic principles. This process of verbalization strengthens conceptual clarity and promotes metacognitive awareness. The Elaborate stage further extended learning by requiring students to apply principles to new scenarios, compare variables such as price and quality, and justify decisions. Such structured application fosters analytical thinking by encouraging systematic examination of relationships and principles. These findings align with Sasanti et al. (2024) and Udonsathian and Worapun (2024), who found that integrating 5E-based inquiry activities significantly enhanced students' analytical reasoning abilities in science contexts. Although those studies were conducted in science education, the cognitive mechanisms underlying inquiry-based learning are transferable across disciplines.

Finally, the Evaluate stage enabled both formative and summative assessment, allowing students to reflect on their reasoning processes and consolidate understanding. This reflective component strengthens analytical capacity by encouraging learners to review and refine their decision-making strategies. The significant improvement observed in this study suggests that the cyclical structure of the 5E model systematically scaffolds analytical thinking through progressive cognitive engagement.

Beyond analytical thinking, the findings also demonstrate the positive impact of the 5E model on academic achievement in social science education. Previous research has documented similar effects in social studies contexts. Öteleş (2024) found that the 5E learning model significantly improved academic achievement in social studies, while Hassan et al. (2024) reported that applying the 5Es instructional model enhanced student learning outcomes at the secondary level. Furthermore, Yulianti (2024) demonstrated that inquiry-based instruction promoted deeper conceptual understanding in geography, another social science discipline characterized by complex relational reasoning. The current findings extend this body of research by providing evidence that 5E inquiry-based instruction can also strengthen learning outcomes in primary-level economics.

Economics education requires students to interpret relationships among variables, evaluate alternatives, and make reasoned decisions in real-world contexts. Traditional lecture-based approaches may not sufficiently support these cognitive demands. The present study suggests that when instruction is structured around inquiry and guided through the 5E framework, students are better positioned to develop both conceptual understanding and analytical competence. In this respect, the results support broader arguments that inquiry-based pedagogies are particularly suitable for social studies education, where reasoning, judgment, and application are central learning objectives.

Nevertheless, several limitations should be considered when interpreting the findings of this study. First, the study employed a one-group pretest–posttest design without a control group, which limits the ability to establish causal relationships between the 5E instructional approach and the observed outcomes. Second, the sample size was relatively small (N = 10) and drawn from a single classroom in a rural primary school, which may restrict the generalizability of the findings to broader educational contexts. Additionally, the use of multiple-choice tests to measure analytical thinking may not fully capture the depth and complexity of students' reasoning processes. Therefore, future research should incorporate larger and more diverse samples, include control or comparison groups, and employ a wider range of assessment methods, such as open-ended tasks or qualitative data, to provide a more comprehensive understanding of students' analytical thinking development.

5. Conclusion

This study investigated the effects of 5E inquiry-based instruction on academic achievement and analytical thinking in Grade 4 economics. Using a one-group pretest–posttest design, the intervention was implemented over 12 instructional hours and evaluated through efficiency criteria and statistical analysis. The findings revealed that the instructional plans met the 80/80 efficiency standard, students' academic achievement exceeded the 80 percent criterion, and analytical thinking significantly improved after the intervention.

These results contribute to the growing body of research supporting inquiry-based pedagogies in social science education. Specifically, this study provides empirical evidence that the 5E instructional framework can be effectively adapted for primary-level economics to promote both conceptual understanding and higher-order thinking skills. By demonstrating measurable gains in analytical thinking within an elementary context, the study extends prior research predominantly conducted in science and secondary education settings.

From a practical perspective, the findings suggest that social studies teachers may consider integrating structured inquiry cycles such as the 5E model to foster deeper engagement and reasoning in economics instruction. However, the study was limited by its small sample size and one-group research design, which may restrict the generalizability of the findings. Future research should employ experimental or quasi-experimental designs with control groups,

involve larger and more diverse samples, and examine long-term retention effects of inquiry-based instruction in social science education. Additionally, incorporating qualitative data such as classroom observations or students' written reflections could provide deeper insights into how analytical thinking develops throughout the inquiry process.

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Data sharing statement

No additional data are available.