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Enhancing the Surrounding Environment Exploration Competency for Primary School Students Through the 5E Instructional Model: An Experimental Study in Vietnam

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ABSTRACT: This study focuses on evaluating the effectiveness of the 5E instructional model (Engage - Explore - Explain - Elaborate - Evaluate) in developing the surrounding environment exploration competency for primary school students. Through a mixed-methods research approach, we conducted a pedagogical experiment on 113 third-grade students in Da Nang city with the theme "School". The initial survey indicated a significant gap: while teachers are still accustomed to one-way transmission teaching methods, students have a desire to interact and freely experience in their learning.

After the experimental process, the group of students learning under the 5E model not only achieved higher average scores, but the percentage of students reaching a "Good" competency level was also significantly higher compared to the group learning under traditional methods. Notably, the analysis of 12 specific cases (case study) helped us recognize an uneven development among the skills. The students progressed very quickly in their ability to observe and collect information, but required more time along with continuous support from the teacher to practice asking questions and critical thinking. From these results, the study affirms that the 5E model is a practical solution to overcome the limitations of the old teaching approach, helping students change their passive learning habits to confidently explore knowledge, while simultaneously providing a practical foundation to replicate this instructional method.

KEYWORDS: 5E instructional model, Experimental study, Natural and Social Sciences, Primary school students, Surrounding environment exploration competency.

1. INTRODUCTION

According to the 2018 General Education Curriculum, the shift from knowledge transmission teaching to an orientation of developing learners' qualities and competencies has become an inevitable requirement. At the primary level, the Natural and Social Sciences subject plays an important role in helping students form their initial understandings of the natural and social world and surrounding relationships. This subject highly values organizing practical experiences for students, creating opportunities for them to inquire, explore, and learn appropriate behaviors. Through this, scientific competency, especially the surrounding environment exploration competency, is gradually nurtured and developed in students.

To meet the above orientation, the application of active teaching methods is highly necessary. Among them, the 5E instructional model (Engage - Explore - Explain - Elaborate - Evaluate) is an exploration- and experience-oriented model that emphasizes the active role of the learner. This model arouses curiosity, helping students actively acquire knowledge and practice critical thinking. Applying the 5E model to the Natural and Social Sciences subject creates favorable conditions for students to practice skills in asking questions, observing, investigating, and drawing conclusions, thereby directly forming the environment exploration competency.

However, practical surveys at several primary schools show that the application of the 5E model in teaching is not yet widespread. Although many teachers are aware of this model, its level of application remains limited, largely because teachers encounter difficulties in designing learning activities that help students develop competencies. In reality, teaching primarily relies on informing students of the knowledge beforehand or having them read the textbook. This teaching approach has not met the students'

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expectations, as they prefer to interact, exchange information, practice, and freely explore knowledge. Besides, there is currently a lack of research delving into the application of the 5E model to specifically develop the surrounding environment exploration competency in this subject for Grade 3.

Stemming from the aforementioned innovation requirements and teaching realities, this article focuses on researching the organization of teaching the "School" theme in the Grade 3 Natural and Social Sciences subject using the 5E model. This is a familiar theme that helps students learn about community connection activities, school traditions, and how to maintain safety and hygiene at school. The study conducts a pedagogical experiment to evaluate the effectiveness of the 5E model in enhancing students' activeness, proactiveness, and their ability to observe and collect information. Thereby, the article contributes to providing a scientific and practical foundation for primary school teachers to continue applying this instructional method, meeting the competency development orientation.

2. THEORETICAL BACKGROUND AND ORGANIZATIONAL FRAMEWORK

2.1. Surrounding environment exploration competency in primary school students

According to the orientation of the 2018 General Education Curriculum (Ministry of Education and Training, 2018), the scientific competency of primary school students is primarily formed through the Natural and Social Sciences subject. This competency includes the ability to inquire and explore the surrounding world through activities such as observing, asking questions, conducting practical investigations, collecting data, and drawing conclusions. In the context of this subject, the surrounding environment exploration competency is constituted by three core behavioral manifestations (Ministry of Education and Training, 2018):

Component 1 (T1): Asking simple questions about certain objects, phenomena, and relationships in the natural and social surroundings.

Component 2 (T2): Observing and conducting simple practical activities to explore those objects, phenomena, and relationships.

Component 3 (T3): Making remarks on external characteristics, comparing similarities and differences, as well as the changes of objects and phenomena over time through observation and practical results.

To enable students to achieve the aforementioned competency components, the teaching process needs to shift from traditional teaching methods to enhancing practical opportunities where students can directly experience and interact actively.

2.2. The 5E instructional model and its impact on science education

The 5E instructional model is built upon the philosophy of constructivism, which emphasizes that students do not passively receive knowledge but are active subjects who self-construct knowledge through experience (Bybee et al., 2006). This model creates a closed learning cycle consisting of five phases: Engage: Arousing students' curiosity and prior knowledge using real-life situations or open-ended questions. Explore: Students directly participate in investigations, observations, and practical activities to collect data. Explain: Students share what they have explored, after which the teacher provides scientific terminology to standardize the concepts. Elaborate: Encouraging students to apply their knowledge to new situations in practice. Evaluate: Occurring continuously to assess the development of students' cognition and skills.

Regarding the effectiveness of the 5E model, a recent large-scale meta-analysis by Polanin et al., (2024) on 61 experimental studies demonstrated that the 5E model yields outstanding effectiveness in improving science learning outcomes compared to traditional teaching methods (with an effect size of $g = 0.82$). Besides enhancing academic achievement, the 5E model has also been proven to be an ideal pedagogical framework for developing 21st-century skills. According to Bybee (2009), the intersection between science education and 21st-century skills is clearly manifested through the phases of the 5E model, where students are required to apply critical thinking, problem-solving abilities, and collaborative communication to construct knowledge. This foundational argument is reinforced by the experimental study of Yıldız & Ecevit (2024) on fourth-grade students, which provides strong evidence that 5E-integrated instructional activities significantly enhance core 21st-century skills such as critical thinking, creativity, and problem-solving abilities. This model not only helps primary school students acquire scientific knowledge in a more meaningful and flexibly interactive manner (Melgarejo et al., 2024), but also provides a structured inquiry framework that supports learners' active participation and reasoning competencies (Nazara et al., 2026).

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2.3. Organizational framework for teaching the Natural and Social Sciences subject using the 5E model to develop competencies

Although the effectiveness of the 5E model has been widely proven, applied research at the primary school level in Vietnam often focuses solely on developing general competencies, such as problem-solving capacity (Giang Thien Huong & Thuy Nga, 2024). To date, there remains a significant research gap due to the lack of studies delving into the application of the 5E model to specifically develop the "surrounding environment exploration competency," particularly for the Grade 3 Natural and Social Sciences subject.

Stemming from that practical reality, we propose an organizational framework for teaching that synchronizes the 5 phases of the 5E instructional model with the 3 behavioral components of the surrounding environment exploration competency:

The Engage phase stimulates Component 1 (T1): Placing students in problem-based situations tied to the familiar school environment will stimulate their cognitive needs, thereby forming their habit and ability to proactively ask questions for exploration.

The Explore phase directly cultivates Component 2 (T2): In this phase, students are empowered to engage in hands-on practice, conduct surveys, and perform field observations (e.g., surveying classroom safety, school campus). This is the core foundation that helps students know how to approach the natural world based on the collection of real-world data.

The Explain and Elaborate phases consolidate Component 3 (T3): When required to report results and participate in group discussions, students must practice their ability to compare, analyze, and make remarks. The process of applying knowledge to propose practical measures (such as maintaining hygiene and ensuring school safety) is clear evidence of transforming scientific cognition into sustainable behaviors towards the living environment.

In summary, the integration of the 5E model into the Natural and Social Sciences subject not only meets the requirements for innovating teaching methods but also creates a scientific, clear pathway that helps Grade 3 students gradually construct and comprehensively develop their environment exploration competency.

3. RESEARCH METHODOLOGY

3.1. Research design and sample

The study is designed based on a combination of theoretical research methods and practical research methods (including: survey investigation, observation, expert consultation, and pedagogical experiment). The research was conducted from September 2025 to January 2026 in Da Nang city, Vietnam. Sampling was conducted in two stages:

Current status survey phase: We randomly surveyed 34 teachers teaching the Natural and Social Sciences subject and 113 third-grade students at three primary schools (Nguyen Trai, Tran Cao Van Primary and Secondary School, and Le Van Tam) to evaluate the practical application of the 5E model and current teaching methods.

Pedagogical experiment phase: The experimental sample was selected at 2 schools: Nguyen Trai Primary School and Tran Cao Van Primary and Secondary School. The third grade was divided into two groups:

Experimental Group (EG): Consisting of 56 students (Class 3/1 of Nguyen Trai school with 30 students; Class 3A of Tran Cao Van school with 26 students).

Control Group (CG): Consisting of 57 students (Class 3/2 of Nguyen Trai school with 31 students; Class 3B of Tran Cao Van school with 26 students).

Besides, for an in-depth qualitative evaluation, we randomly selected 12 students in the experimental group (6 students from each school representing 3 levels of academic performance: Well completed, Completed, and Not completed) to record in detail the behavioral changes through each lesson.

To ensure the objectivity of the experiment, we conducted a pre-test. The results showed that the average scores of group EG1 (7.03) and CG1 (7.10) differed by 0.07 points; group EG2 (7.04) and CG2 (7.00) differed by 0.04 points. This difference is insignificant, allowing us to determine that the initial academic performance of the two experimental and control groups was completely equivalent.

3.2. Experimental process

The experiment was implemented in the Grade 3 Natural and Social Sciences subject with the theme "School" (Vu Van Hung, 2022a, 2022b). This theme includes 3 lessons lasting for 7 periods (Lesson 5: Community connection activities; Lesson 6: Our school's traditions; Lesson 7: Maintaining safety and hygiene at school).

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In the Control group, the teacher organized teaching using conventional methods (primarily lecturing, questioning, and requiring students to read conclusions and memorize the textbook) without using the 5E model.

In the Experimental group, the teaching process was organized entirely according to the 5E exploration model based on the foundation of constructivism (Bybee et al., 2006). This process guided students through 5 continuous phases: (1) Warm-up/Engage to create cognitive conflict; (2) Explore through observation, practical activities, and field investigation; (3) Explain the results; (4) Apply/Elaborate to practical situations; and (5) Evaluate. In this model, students freely inquire and construct knowledge, while the teacher only plays the role of an advisor, observer, and supporter.

3.3. Measurement and assessment tools

To measure the level of development of the surrounding environment exploration competency, we used a combination of the following tools, closely adhering to the requirements of the 2018 General Education Curriculum (Ministry of Education and Training, 2018) and the specific objectives of each lesson guided in the teacher's manual (Vu Van Hung, 2022b):

Competency assessment rubric: The surrounding environment exploration competency was concretized by us into 3 core criteria: Asking questions (T1); Observing and practicing (T2); Making remarks, comparing, and evaluating (T3). Each criterion was divided into 3 levels of progressive manifestation (M1: Recognizing, M2: Connecting/Organizing, M3: Applying).

Qualitative assessment tools: Using a system of worksheets (such as information collection sheets, survey sheets) and observation sheets (for teachers). The observation sheets were designed corresponding to each phase of the 5E model to promptly record the level of behavioral manifestations of the 12 students in the monitored group.

Quantitative assessment tools: Using 1 pre-test and 3 post-tests administered immediately after each lesson. The tests included essay and multiple-choice questions graded on a 10-point scale, with the same grading criteria between the experimental and control classes to measure the students' ability to remember, understand, and apply knowledge.

3.4. Data analysis methods

The collected data were processed using mathematical statistics methods. For the tests, we calculated the mean score, percentage (%), created frequency distribution tables, and used visual charts to compare the learning outcomes between the Experimental group and the Control group. For the qualitative data of the 12 individually monitored students, the behavioral manifestations on the observation sheets were encoded into scores (Level 1 = 1.0; Level 2 = 2.0; Level 3 = 3.0) and represented in the form of line charts. This approach helped us clearly and visually illustrate the competency growth trajectory of each individual throughout the experimental process.

4. RESEARCH RESULTS

4.1. Current status of awareness and learning needs prior to the experiment

The results of the initial survey on 34 teachers and 113 third-grade students at three primary schools showed a notable limitation between practical teaching methods and students' needs. On the teachers' side, up to 88.2% clearly recognized the importance of developing the surrounding environment exploration competency. However, 64.7% of teachers admitted they encountered major difficulties in designing practical learning activities. Therefore, the primary method remains requiring students to read conclusions in the textbook (Vu Van Hung, 2022a) (49.6%) or teachers informing them of the knowledge beforehand (54.0%). The application of the 5E model is still very limited, with 44.1% of teachers "knowing but rarely applying" it.

Conversely, 65.5% of students reported being "very interested" in this subject. They expressed a desire to learn through highly interactive methods such as: group discussion (40.7%), using visual aids (39.8%), and applying knowledge to explain real-life situations (31.9%). This disparity indicates that introducing a student-centered, exploration-focused learning model like 5E (Bybee et al., 2006) into the Natural and Social Sciences subject is an urgent need.

4.2. Impact of the 5E model on learning outcomes

To ensure objectivity, we conducted a pre-test. The results showed that the mean scores of the Experimental group (EG) and Control group (CG) at Nguyen Trai Primary School (EG1: 7.03; CG1: 7.10) and Tran Cao Van Primary and Secondary School (EG2: 7.04; CG2: 7.00) had an insignificant difference (0.04 - 0.07), affirming that the initial academic performance of the two groups was equivalent.

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After conducting the experiment on 3 lessons under the "School" theme, the results of the post-tests showed a clear superiority of the Experimental group compared to the Control group:
At Nguyen Trai Primary School: The mean scores for lessons 5, 6, and 7 of the EG were 6.83, 7.27, and 7.37, respectively (higher than the CG's 6.45, 6.52, and 6.55).
At Tran Cao Van Primary and Secondary School: The mean scores of the EG were 6.69, 7.23, and 7.46, respectively (higher than the CG's 6.19, 6.50, and 6.62).

Table 1. Mean scores of post-tests for the Experimental and Control groups

Test	Nguyen Trai Primary School (Class EG1, n=30)	Nguyen Trai Primary School (Class CG1, n=31)	Tran Cao Van Primary and Secondary School (Class EG2, n=26)	Tran Cao Van Primary and Secondary School (Class CG2, n=26)
Lesson 5	6.83	6.45	6.69	6.19
Lesson 6	7.27	6.52	7.23	6.50
Lesson 7	7.37	6.55	7.46	6.62

This increase in achievement is entirely consistent with the conclusions from a large-scale meta-analysis by Polanin et al., (2024), affirming that the 5E model significantly improves science learning outcomes compared to traditional methods. Besides the scores, the overall achievement level of the surrounding environment exploration competency after the experiment also reflected a positive transformation (Table 1).

Table 2. Assessment results of the surrounding environment exploration competency of students in the experimental and control classes

Competency level	Experimental class (%)	Control class (%)
Good	38.5	18.7
Fair	42.3	31.4
Achieved	15.4	34.2
Not achieved	3.8	15.7

Data from Table 2 indicates that the percentage of students reaching the "Good" competency level in the class applying the 5E model was more than twice as high as that of the traditional class (38.5% compared to 18.7%). Simultaneously, the number of students at the "Not achieved" level in the 5E group decreased to a very low level (3.8%). The integration of purposeful exploration activities in the 5E model helped students deeply understand concepts and participate more actively in the knowledge construction process (Melgarejo et al., 2024).

4.3. The development of competency behavioral indicators (Qualitative assessment)

To further analyze how the competency was formed, we conducted a case study on 12 students representing different levels of academic performance. Data from the observation sheets were encoded into scores (Level 1 = 1.0; Level 2 = 2.0; Level 3 = 3.0), illustrating the development trajectory of the three behavioral components: Asking questions (T1), Observing and practicing (T2), and Making remarks and comparing (T3).
The monitoring results throughout the 3 lessons indicated that all 12 students had an increase in their behavioral scores, with no recorded cases of behavioral decline. Even the group of students at the "Not completed" level (such as students LBN and DNTY) demonstrated clear progress, especially in the behaviors of confidently asking questions and practicing observation.
An important finding in our study is the uneven difficulty level and development speed among the competency behaviors: The behavior of Observing and practicing to explore objects (T2) was the skill students performed best and had the fastest rate of improvement right from the very first lessons.

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Conversely, the behavior of Asking questions (T1) and especially Making remarks, critiquing, and comparing (T3) developed more slowly. This is understandable because making evaluations and remarks (Evaluating) requires higher-order cognitive processes and needs repeated guidance and reinforcement to be solidly formed (Orteza et al., 2025; Sotáková & Ganajová, 2023).
In the initial lessons (Lesson 5), students were still unfamiliar with assigning group work and confused when presenting results. However, once accustomed to the 5E cycle (in Lesson 6 and Lesson 7), students became more confident in communication, knew how to plan field surveys (such as surveying classroom and playground safety), and proactively drew conclusions based on collected evidence. This transformation affirms that the 5E model combined with practice not only enhances conceptual understanding but also promotes students' critical thinking and core communication skills (Yıldız & Ecevit, 2024).

5. DISCUSSION

This study aimed to evaluate the effectiveness of the 5E model in enhancing the surrounding environment exploration competency for primary school students. The quantitative and qualitative results obtained from the pedagogical experiment provided strong evidence to answer this objective, while simultaneously elucidating the mechanism of students' competency development when transitioning from passive learning methods to active exploration.

5.1. Impact of the 5E model on academic achievement and competency development

Results from the post-tests indicated that the mean scores of the Experimental group consistently outperformed the Control group at both primary schools (ranging from 6.69 to 7.46 compared to 6.19 to 6.62). Simultaneously, the percentage of students reaching the "Good" competency level in the class applying the 5E model (38.5%) was more than twice as high as that of the traditional class (18.7%). This increase in achievement affirms that the closed 5-phase process of the 5E model (Engage - Explore - Explain - Elaborate - Evaluate) created an effective learning environment where students constructed knowledge themselves (Bybee et al., 2006).
Our findings are entirely consistent with the large-scale meta-analysis by Polanin et al., (2024), affirming that the 5E model improves science learning outcomes significantly and with statistical significance compared to traditional teaching. Placing students in practical situations in the Explore phase and requiring them to self-construct concepts in the Explain phase helped transform knowledge into "meaningful learning", enabling them to understand deeply and retain knowledge longer (Melgarejo et al., 2024). Besides, Nazara et al. (2026) also emphasized that the 5E model, when combined with practical exploration tasks, will evenly and consistently enhance learners' scientific thinking abilities and cognitive competencies.

5.2. The uneven development of competency behavioral components

An important contribution of this study lies in the detailed analysis of the development trajectory of the three behavioral components (T1, T2, T3) through 12 case studies. Our qualitative data indicate an uneven development: students improved the fastest in the skill of Observing and practicing to explore objects (T2), but encountered many challenges and progressed more slowly in the skill of Making remarks, comparing, and evaluating objects (T3).
The cause of this difference may be due to cognitive psychological characteristics. Observing and practicing (T2) requires students to interact physically and directly with objects (e.g., surveying the current status of waste, classroom equipment), which is highly suitable for the concrete thinking of third-grade children. Conversely, the skill of making remarks, evaluating risks, and proposing measures (T3) requires higher-order cognitive processes. This argument is reinforced by the study of Orteza et al. (2025), as the authors also discovered that within the 5E cycle, critical thinking skills related to the Evaluation of Arguments usually achieve lower scores and require more practice time compared to basic information recognition skills. Therefore, to solidly form the evaluating competency (T3), primary school students need a repeated practice process and continuous support (scaffolding) from the teacher in the Explain and Elaborate phases.

5.3. Changes in learning attitudes and overcoming limitations in teaching methods

Our initial survey results indicated a limitation: while teachers primarily teach by requiring students to read the textbook (49.6%) or informing them of the knowledge beforehand (54.0%), students desire group discussions (40.7%) and free exploration (24.8%). The 5E model experiment thoroughly resolved this disparity. In the initial lessons (Lesson 5), the majority of students were still unfamiliar and confused in group work due to their previous passive learning habits. However, when moving on to Lesson 6 and Lesson 7, students became more confident, active, and collaborated more effectively in planning field surveys and sharing results.

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This transformation demonstrates that the 5E exploratory learning environment not only develops scientific competency but also enhances the activeness, interest, and sustainable learning motivation of primary school students (Yıldız & Ecevit, 2024). Our finding is entirely consistent with the assertion of Bybee (2009), affirming that immersing students in the 5E process is essentially a direct training process for 21st-century skills, especially communication skills, teamwork, and adaptability in an interactive learning environment.

5.4. Limitations of the study

Although yielding positive results, our study still has some limitations. First, the pedagogical experiment was only conducted with a small sample size at two primary schools in Da Nang city, which may limit the generalizability of the results to regions with different socio-economic conditions. Second, the experimental period was relatively short (lasting only across 3 lessons), therefore it is not yet possible to comprehensively evaluate the students' competency retention in the long term. These limitations open directions for future studies with larger sample sizes and longer-term monitoring to affirm the sustainability of the 5E model in Vietnam.

6. CONCLUSION AND RECOMMENDATIONS

6.1. Conclusion

The study affirms the feasibility and outstanding effectiveness of applying the 5E model in teaching the "School" theme (Grade 3 Natural and Social Sciences subject). This model not only enhances quantitative academic achievement but also directly develops the surrounding environment exploration competency. Students changed their passive learning habits to proactively plan observations, conduct field surveys, and draw lessons themselves.

A notable point of the study is pointing out the uneven development of competency components at the primary school age: the skills of observing and collecting information improved very quickly, while the skills of asking questions and critical thinking required a long-term practice process and continuous support (scaffolding) from the teacher. The success of the experiment largely overcame the limitations between the teachers' old transmission methods and the students' need for interaction and free exploration.

6.2. Recommendations

From the achieved results, we propose the following recommendations:

For schools and management levels: It is necessary to create flexible mechanisms and provide maximum support in terms of space and facilities so that teachers can easily organize outdoor exploration activities, transforming the school campus into a practical "laboratory" for students.

For teachers: It is necessary to boldly change their mindset, shifting from the role of a transmitter to a designer and guide, stepping back to give students the space to take ownership. Although preparing lessons according to the 5E model requires a lot of effort, the resulting effectiveness is entirely worthwhile. Teachers also need to be more patient when cultivating higher-order skills for students.

Regarding future research orientations: It is necessary to continue expanding the application of the 5E model to other themes and grade levels at the primary education level. Simultaneously, longitudinal studies with larger sample sizes should be conducted across various socio-economic regions to firmly affirm the sustainability of this model in Vietnam.

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