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The Implementation of a Problem-Based Learning (PBL) Model Assisted by a Science Escape Room to Improve Critical Thinking Skills of Fifth-Grade Students

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Abstract :

In this study, the researcher utilized a Science Escape Room as a medium to implement the Problem-Based Learning (PBL) model in an IPAS (Natural and Social Sciences) lesson on ecosystem harmony, aiming to enhance students' critical thinking skills. The study employed a Classroom Action Research (CAR) approach consisting of two cycles, with each cycle comprising the stages of "look," "think," and "act." Twenty-six fifth-grade students from SDN Tingkir Lor 02 Salatiga participated in the study. Students' critical thinking skills were assessed using a rubric based on the FRISCO indicators: Focus, Reason, Inference, Situation, Clarity, and Overview. The results indicate that students' critical thinking skills improved through the implementation of the PBL approach supported by the Science Escape Room medium. From an initial baseline score of 52.65%, the average critical thinking score rose to 70.94% in Cycle I and subsequently to 84.42% in Cycle II. This improvement reflects student progress in areas such as problem comprehension, reasoning, drawing conclusions, considering context, effectively communicating ideas, and reviewing their own thought processes. Thus, fifth-grade students at SDN Tingkir Lor 02 Salatiga were able to enhance their critical thinking skills while studying the IPAS topic of Ecosystem Harmony through the use of the Science Escape Room medium combined with the Problem-Based Learning model.

Keywords: Problem Based Learning, Escape Room Sains, critical thinking skills, IPAS, FRISCO.

INTRODUCTION

Educating the next generation is just one area where digital technology has become crucial in the 21st century. According to Ghazy et al. (2025), the digitalization process in education entails a transformation in how learning is conducted, shifting from predominantly traditional techniques toward a broader use of digital technology. This shift in mindset suggests that to create a more engaging and beneficial learning environment, educators should integrate traditional classroom methods with digital tools. Achieving digital innovation in education requires the creation of learning activities, instructional resources, and media that help students become more digitally competent (Resti et al., 2024). Learning experiences that foster critical thinking, problem-solving, collaboration, and active engagement can be created through the appropriate use of technology going beyond mere content delivery (Resti et al., 2024).

One field that can effectively leverage advancements in digital technology is Natural and Social Sciences (IPAS). IPAS instruction for elementary school students focuses on helping them grasp

Vol. 7 No. 2 2026| e-ISSN: 2723-8199
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abstract concepts and apply what they have learned to practical problems. According to Ghazy et al. (2025), critical thinking is a vital skill to be cultivated through IPAS instruction. The "Harmony in Ecosystems" unit for Grade 5 encompasses many aspects of this skill; students study food webs, energy flow, and the interdependence of ecosystem components, as well as how to identify and address issues that threaten that balance (Khumaimah, 2026).

Preliminary observations of the "Harmony in Ecosystems" lessons in the Grade 5 class at SDN Tingkir Lor 02 Salatiga indicate that students' critical thinking skills still require improvement. The overall learning process needs refinement, as it has not yet provided sufficient opportunities for students to engage in problem-solving (Uno & Mohamad, 2022). Therefore, learning methods and media are needed that can make lessons more relevant and engaging for students, while also encouraging them to think critically and creatively (Mubarrok et al., 2025).

Problem-Based Learning (PBL) is an instructional strategy that can help students enhance their critical thinking skills. Within the PBL framework, students are presented with a problem to solve through a series of steps: identifying the problem, gathering relevant information, discussing and analyzing it, and ultimately formulating their own solutions. Research findings indicate a significant impact, with most effect sizes falling into the high to very high categories. Darmawati et al. (2025) conducted a meta-analysis of nine research articles and found that PBL is effective in improving the critical thinking skills of elementary school students in science subjects. Furthermore, Hudiyana et al. (2025) demonstrated that PBL has a substantial impact on students' critical thinking abilities (with an effect size of 0.8) when applied to Natural and Social Sciences (IPAS) instruction in elementary schools. Based on these results, it can be confidently concluded that PBL holds great potential for enhancing students' critical thinking skills.

Digital media can facilitate the development of learning models and create educational opportunities that are more engaging and participatory. Research by Rosyada et al. (2025) shows that the critical thinking skills of fifth-grade students improved significantly when Project-Based Learning (PBL) was combined with digital pop-up books. Similarly, Purnama et al. (2026) found that fifth-grade IPAS classes utilizing PBL supported by the "Digital Box" achieved better learning outcomes, with an N-Gain score of 0.5665 and an increase in the average score from 54.40 to 81.00 following the learning sessions. According to Diyanti et al. (2025), students' critical thinking skills and learning enthusiasm are significantly influenced by the implementation of PBL supported by "Qreatif" media. Based on these findings, the combination of PBL and digital media appears to offer a novel approach to making learning more engaging and interactive while simultaneously encouraging students to think critically.

The development of digital game-based learning media is also being adopted to enhance student engagement in the learning process. Puspitasari et al. (2025) demonstrated that using the digital game Wordwall in primary school instruction improved critical thinking skills; this was evidenced by an increase in average proficiency from 74.40 at baseline to 82.98 in Cycle I and 88.59 in Cycle II. Research by Roheti et al. (2025) on the use of educational escape rooms with fifth-grade students also revealed improvements in understanding, engagement, collaboration, communication, critical thinking skills, and learning motivation. These findings indicate that digital games including escape rooms have the potential to create more challenging learning activities that actively involve students.

Escape rooms have also been studied in conjunction with Problem-Based Learning (PBL) across various classroom settings. In their study, Agustina et al. (2026) showed that a PBL-based escape room game used to teach fluid mechanics yielded an N-Gain score of 0.74, a significance level of $p < 0.0005$, and an effect size of 0.82. Meanwhile, Sihombing et al. (2025) demonstrated that the performance of fifth-grade primary students improved when Project-Based Learning (PjBL) was used to teach ecosystem concepts. Students' average scores rose from 31.75 on the pretest to 81.25 on the posttest, with an N-Gain score of 0.73. Both studies indicate that ecology content, PBL, and escape rooms can assist students in developing their critical thinking skills. Although Agustina et al. (2026) examined PBL within the context of secondary school physics where findings showed improved learning outcomes Sihombing et al. (2025) also found that critical thinking skills can be improved using the PBL model.

EPISTEMA
Vol. 7 No. 2 2026| e-ISSN: 2723-8199
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This study presents the material "Harmony in Ecosystems" along with other topics from the IPAS (Natural and Social Sciences) curriculum to fifth-grade students at SDN Tingkir Lor 02 Salatiga by utilizing a Science Escape Room as a supporting medium for the Problem-Based Learning (PBL) model. By incorporating challenges, clues, questions, feedback, and mission resolutions related to ecosystem principles, the Science Escape Room serves as a tool that facilitates the problem-solving stages of PBL. However, this method offers more than just an enjoyable learning experience; integrating the PBL paradigm with the Science Escape Room provides students with greater opportunities to hone their critical thinking skills within a learning environment that is dynamic, engaging, and challenging.

This research aims to enhance the critical thinking skills of fifth-grade students by implementing the Problem-Based Learning (PBL) model for the topic "Harmony in Ecosystems." Accordingly, the study focuses on how the implementation of the PBL model, supported by the Science Escape Room medium, can improve the critical thinking abilities of fifth-grade students at SDN Tingkir Lor 02 Salatiga.

METHOD

This study was conducted as a Classroom Action Research (CAR) project in the fifth-grade class at SDN Tingkir Lor 02 Salatiga during the odd semester of the 2026/2027 academic year. Twenty-six students served as the research subjects. The study employed the classroom action model developed by Stringer, comprising three main stages: Look, Think, and Act (Yaumi, 2016: 45). These three stages were implemented cyclically and served as the basis for planning, executing, and refining instructional actions.

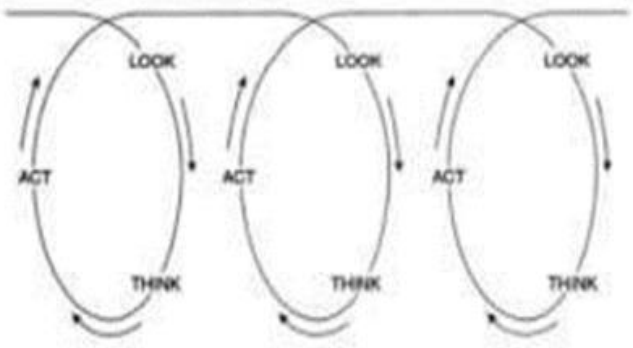


Figure 1. Stringer Model in Classroom Action Research

In the "Look" phase, the researcher observed the initial state of the IPAS (Natural and Social Sciences) instruction and identified students' critical thinking skills regarding the topic "Harmony in Ecosystems." Baseline data were obtained through observation and an assessment of critical thinking skills. Subsequently, the "Think" phase involved analyzing the observation results to identify instructional issues and determine appropriate alternative interventions. Based on this analysis, the researcher and the collaborating teacher designed an intervention involving the implementation of the Problem-Based Learning (PBL) model supported by "Science Escape Room" media. The "Act" phase was carried out by implementing the instructional intervention according to the established design.

The study was conducted over two cycles. Following Cycle I, the researcher revisited the "Look" phase to observe the instructional process and the students' critical thinking performance. The observation results were then analyzed during the "Think" phase to identify areas requiring improvement. This analysis served as the basis for refinements in the "Act" phase of Cycle II. After Cycle II, further observation and analysis of the intervention's outcomes were conducted to determine the extent of improvement in students' critical thinking skills.

EPISTEMA
Vol. 7 No. 2 2026| e-ISSN: 2723-8199
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Teachers and students served as the data sources for this study. Students' critical thinking skills were designated as the dependent variable, while the implementation of Problem-Based Learning (PBL) using "Science Escape Room" media served as the independent variable. Data collection was carried out through observation and documentation. A rubric based on the FRISCO indicators Focus, Reason, Inference, Situation, Clarity, and Overview was used to assess students' critical thinking skills. The research data were analyzed using a descriptive quantitative approach, utilizing average critical thinking scores from the initial stage, Cycle I, and Cycle II. Data were collected via tests. The assessment rubric used by Siti Zubaidah adapted from the concepts of Finken and Ennis along with a critical thinking observation sheet framework, served as the foundation for developing the critical thinking rubric used in this study.

Table 1. Critical Thinking Observation Sheet Grid

Definition of Critical Thinking	Aspects	Descriptor	Item No.
The ability to analyze and evaluate information logically, systematically, and reflectively, thereby enabling the making of sound decisions appropriate to the situation at hand.	*Focus & Situation*	Identify the primary issue within the ecosystem and describe the condition of the biotic and abiotic components associated with that issue.	1
	Inference & Reasoning	Formulating conclusions based on obtained information and providing scientific reasons regarding the relationships between components within an ecosystem.	2
	Situation & Reason	Analyze issues regarding interactions between living organisms based on the given situation and provide relevant scientific reasons.	3
	Overview & Rationale	Analyzing ecosystem issues comprehensively and explaining the impact of human activities on ecosystem balance based on scientific reasoning.	4
	Clarity & Reason	Clearly and logically explains the flow of energy within a food chain and provides scientific reasons regarding energy changes at each trophic level.	5

Students' critical thinking abilities were evaluated using observation sheets. A comparative descriptive analysis method was employed to examine the collected data. Quantitative data specifically, critical thinking scores were detailed to provide an overview of student abilities throughout the study. Results were then compared across the initial stage, Cycle I, and Cycle II to determine the intervention's impact on participants' critical thinking skills. The intervention's effectiveness was assessed through cross-cycle comparative analysis. Success was defined as achieving an average score of at least 72% of the maximum possible score, accompanied by an improvement in students' critical thinking abilities. The study was concluded once it was demonstrated that students' critical thinking skills had improved following the implementation of the PBL paradigm supported by Science Escape Room media.

RESULTS

Critical Thinking Skills

This classroom action research was conducted with fifth-grade students at SDN Tingkir Lor 02 Salatiga, focusing on the topic "Harmony in Ecosystems" within the IPAS (Natural and Social Sciences) subject. The FRISCO framework comprising Focus, Reason, Inference, Situation, Clarity, and Overview

Vol. 7 No. 2 2026| e-ISSN: 2723-8199
https://doi.org/10.21831/ep.v7i2.102363

was used to evaluate students' critical thinking skills. Data were collected during the initial assessment stage, as well as during Cycle I and Cycle II. The average critical thinking score at the initial assessment stage was 52.65. Regarding the students' critical thinking abilities, 12 were classified as "Critical" (46.15%) and 14 as "Moderately Critical" (53.85%). No students fell into the "Highly Critical" category.

The average critical thinking score increased by 18.29 points from the initial level of 70.94 following the intervention in Cycle I. The results showed considerable variation, with 22 students (84.62%) falling into the "Critical" category and 4 students (15.38%) into the "Highly Critical" category. No students remained in the "Moderately Critical" category or any lower categories.

Table 2. Descriptive Statistics of Critical Thinking Skills

Stage	Highest Score	Lowest Score	Average
Initial Ability	72	35	52,65
Cycle I	82,5	62	70,94
Cycle II	97,5	75	84,42

The next step, following the data presentation, is to classify the students' critical thinking skills within the context of the PBL model assisted by the Science Escape Room. The categories to be used are presented in Table 2 below.

Table 2. Critical Reasoning Ability Category Criteria (Riduwan, 2011)

Value Range	Classification
81 – 100	Highly Critical
61 - 80	Critical
41 - 60	Moderately Critical
21 – 40	Less Critical
0 – 20	Very Low Criticality

Table 3. Distribution of Critical Thinking Skills in Cycle I

Category	Frequency	Percentage
Highly Critical	4	15,38%
Critical	22	84,62%
Moderately Critical	0	0%
Less Critical	0	0%
Very Low Criticality	0	0%

The results of Cycle I indicate that the majority of students have reached the "Critical" category. Based on observations and evaluations from this cycle, further strengthening is still required regarding the provision of contextual stimuli, deeper probing questions, opportunities for students to articulate their reasoning, and guidance during analysis and discussion.

The average critical thinking score rose to 84.42 in Cycle II. This figure represents an increase of 31.77 points from the baseline and a 13.48-point increase from Cycle I. With 18 students falling into the "Highly Critical" category (69.23%) and 8 students in the "Critical" category (30.77%), the results showed considerable variation. No students fell into the "Moderately Critical" category or any lower category.

Table 4. Distribution of Critical Thinking Skills in Cycle II

Category	Frequency	Percentage
Highly Critical	18	69,23%
Critical	8	30,77%
Moderately Critical	0	0%
Less Critical	0	0%
Very Low Criticality	0	0%

EPISTEMA
Vol. 7 No. 2 2026| e-ISSN: 2723-8199
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Table 5. Comparison of Critical Thinking Skills

Category	Initial Ability	Cycle I	Cycle II
Highly Critical	0%	15,38%	69,23%
Critical	46,15%	84,62%	30,77%
Moderately Critical	53,85%	0%	0%
Less Critical	0%	0%	0%
Very Low Criticality	0%	0%	0%
Highly Critical	52,65	70,94	84,42

Overall, critical thinking skills improved from an average of 52.65 at the initial stage to 70.94 in Cycle I and 84.42 in Cycle II. There was an increase of 18.29 points in Cycle I, 13.48 points in Cycle II, and 31.77 points compared to the initial stage. By incorporating various tasks and challenges that encourage students to understand problems, evaluate data, and discover answers, the Science Escape Room serves as an excellent tool for problem-based learning (PBL). Figures 1 and 2 show the Science Escape Room used in this study.

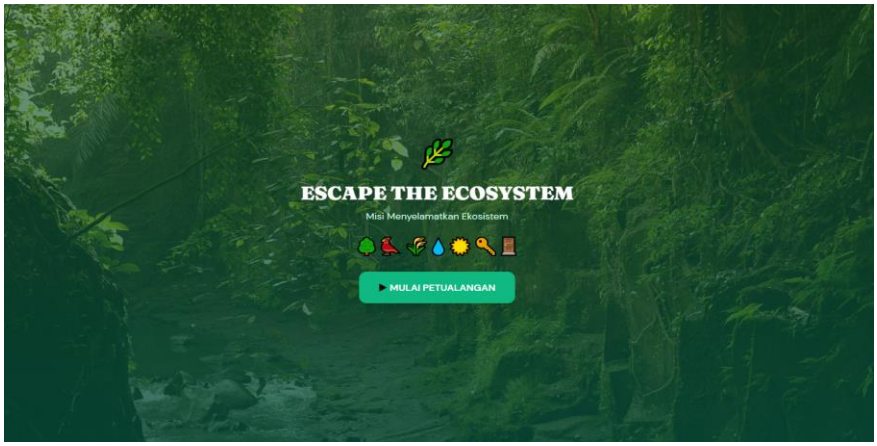


Figure 2. Science Escape Room interface.

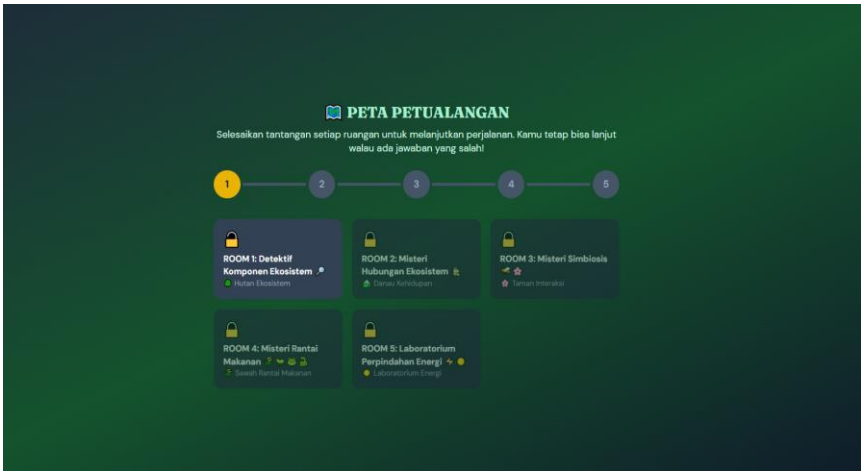


Figure 3. Science Escape Room Mission Map View

DISCUSSION

According to Astuti et al. (2024), learning media has the potential to facilitate engaging and effective instruction. Students' critical thinking skills were shown to improve after participating in Natural and Social Sciences (IPAS) lessons on the topic "Harmony in Ecosystems," which utilized the

Vol. 7 No. 2 2026| e-ISSN: 2723-8199
https://doi.org/10.21831/ep.v7i2.102363

Problem-Based Learning (PBL) model supported by "Science Escape Room" media. Research results indicated an upward trend: the average score rose to 70.94 in Cycle I and further increased to 84.42 in Cycle II. These changes demonstrate that the instructional interventions implemented across both cycles successfully helped students enhance their critical thinking abilities. A defining characteristic of Problem-Based Learning (PBL) is its emphasis on the practical application of knowledge through real-world problem-solving (Kusnandar & Mirza, 2025). In this approach, students do not merely receive information; they are also guided to understand problems, identify relevant details, examine cause-and-effect relationships, articulate their reasoning processes, and draw their own conclusions. The FRISCO indicators employed in this study Focus, Reason, Inference, Situation, Clarity, and Overview align with these procedural steps (Mappalesye et al., 2026).

Regarding initial proficiency, 53.85% of students fell into the "Moderately Critical" category, while no students were classified as "Highly Critical." This situation indicated a need to further develop students' abilities to provide reasons, conduct analyses, and formulate conclusions based on available information. Following the Cycle I intervention, all students shifted into the "Critical" and "Highly Critical" categories. Subsequently, in Cycle II, the proportion of students in the "Highly Critical" category rose to 69.23%. The decrease in the percentage of students in the "Critical" category—from 84.62% in Cycle I to 30.77% in Cycle II did not signify a decline in critical thinking skills; rather, this shift occurred because some students previously classified as "Critical" had advanced to the "Highly Critical" category. This is evident from the increase in the percentage of the "Very Critical" category from 15.38% to 69.23%, as well as the rise in the average score from 70.94 to 84.42.

. Based on reflections from Cycle I, the instructional approach was refined for Cycle II. The teacher's use of more contextual stimuli and guiding questions which encouraged students to articulate their thought processes proved to enhance the quality of learning. Furthermore, students received feedback and guidance during group work, fostering an environment that supported the development of their critical thinking skills (Cahyani Kusuma et al., 2023). These improvements provided greater opportunities for students to express their opinions, connect information, and formulate answers based on sound reasoning (Rahmiati & Amelia, 2026). The use of a Science Escape Room also facilitated instruction, as learning activities were structured as a series of stages or challenges for students to complete (Puryanti, 2026). This medium offered an interactive learning experience through the presentation of problems, questions, clues, scoring, and feedback. In this study, the Science Escape Room served not merely as a game but as a tool to support the problem-solving process within the Problem-Based Learning (PBL) framework.

The improvements observed in this study also demonstrate that instruction on the topic of "Harmony in Ecosystems" can be directed toward activities requiring students to observe, analyze, discuss, provide reasoning, and draw conclusions. By exploring topics such as food webs, ecosystem balance, and the impact of human activity, students were able to link classroom material to real-world issues. The researchers found that integrating a Science Escape Room with the Problem-Based Learning (PBL) model helped fifth-grade students think more critically about "Harmony in Ecosystems." These incremental instructional improvements helped students develop their abilities to comprehend problems, reason, analyze, and formulate conclusions; this progress was reflected in the rise in average scores and the shift in critical thinking skill categories from the initial assessment to Cycle II.

CONCLUSION

Based on the research findings, the use of a Science Escape Room incorporating the Problem-Based Learning (PBL) model proved effective in enhancing the critical thinking skills of fifth-grade students in the Science and Social Studies (IPAS) subject, specifically regarding the topic "Harmony in Ecosystems." Students' average scores rose from 52.65% at the initial stage to 70.94% in Cycle I and 84.42% in Cycle II. Consequently, the action hypothesis was confirmed, and the research objectives were achieved. The Science Escape Room serves as an alternative learning medium that supports PBL

through interactive problem-solving activities. Future research could develop similar media for other subject matter and learning competencies.

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