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DEVELOPMENT OF AN INTEGRATED STEM DESIGN THINKING LEARNING MODEL TO IMPROVE STUDENTS' CREATIVE THINKING SKILLS IN SCIENCE LEARNING ON ENVIRONMENTAL TOPICS IN ELEMENTARY SCHOOLS

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ABSTRACT
This study aims to identify the needs for developing an integrated STEM Design Thinking learning model to enhance students' creative thinking skills in science lessons on environmental topics in elementary schools. The research uses a mixed methods approach with a sequential explanatory design. The subjects consist of 178 fifth-grade students from three elementary schools in South Tangerang City, along with several science teachers. Data collection techniques include tests of creative thinking skills, questionnaires, observations, and interviews. The data are analyzed using both quantitative and qualitative descriptive methods. The results show that students' creative thinking skills are still relatively low, especially in aspects of originality and fluency. Learning activities are still dominated by listening to teacher explanations, while environmental exploration activities and the creation of tangible products are still limited. Additionally, students are more interested in practice-based learning, projects, and STEM integration. Therefore, developing an integrated STEM Design Thinking learning model is necessary to create more active, contextual, collaborative learning environments that can improve students' creative thinking skills in solving environmental issues in elementary schools.
Keywords: Creative Thinking Skills, STEM, Design Thinking, Elementary Schools

INTRODUCTION
Education plays an important role in fostering awareness and responsibility among students towards the environment (Mubarok et al., 2024). Strengthening environmental education aligns with the Sustainable Development Goals (SDGs), particularly Goals 4 on quality education, 13 on climate action, and 15 on life on land. Environmental learning in elementary schools is expected not only to provide students with knowledge but also to develop thinking skills and tangible actions in addressing environmental issues. In Indonesia, environmental education is fundamentally integrated into Science (IPA) subjects, and at the elementary level, it is combined into the Science and Social Studies (IPAS) subjects. (Farhan et al., 2025). IPAS learning in elementary schools is expected to provide a contextual and meaningful learning experience through observation, investigation, and solving real-world problems. IPAS learning offers students the opportunity to gain learning experiences through various activities, such as observation, discussion, and problem-solving (Nuraini et al., 2026). However, various studies show that environmental education in Indonesia still tends to focus on knowledge transfer and has not yet involved students in the process of developing ideas or formulating solutions to environmental issues around them (Rustan et al., 2024).

According to Torrance, 1966 Creative thinking skills include the ability to generate many ideas (fluency), the ability to see problems from various perspectives

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(flexibility), the ability to produce unique ideas (originality), and the ability to develop ideas in detail (elaboration). OECD through the Programme for International Student Assessment (PISA) in 2022 also emphasized that Indonesian students' creative thinking abilities are still relatively low compared to the OECD average (OECD, 2024). Preliminary study results conducted at three elementary schools in South Tangerang City on 178 fifth-grade students indicate that students' creative thinking skills in environmental pollution topics are still low. The average score for students' creative thinking skills is only 1.68 out of a 4.0 scale. The lowest aspects are fluency and originality. Students tend to give simple and repetitive answers and have not yet been able to develop more diverse alternative solutions.

Additionally, the results of student learning experience surveys indicate that science learning about the environment is still dominated by activities such as listening to the teacher's explanation at 47.6%, group discussions at 24.2%, working on practice questions at 21.3%, creating tangible works or products at 12.4%, and observing the surrounding environment at 4.49%. This condition shows that the learning process has not fully supported the development of students' creative thinking skills. The survey results for teachers also show that the use of innovative learning models is still limited. Most teachers use cooperative learning models, while the use of problem-based and project-based learning models remains low. Teachers also stated that they do not yet understand the steps of environmental learning that can encourage students to think creatively and produce real solutions to environmental problems. This condition highlights the need for developing learning models that can provide contextual, reflective, and interdisciplinary learning experiences. One relevant approach is the integration of Design Thinking and STEM. Design Thinking is a learning approach focused on understanding real problems through empathy, developing creative ideas, creating prototypes, testing solutions, and conducting reflection and iterative improvements (Salam et al., 2025). Meanwhile, STEM integrates science, technology, engineering, and mathematics in real-world problem-solving processes (Davidi et al., 2021). The integration of Design Thinking and STEM is believed to be able to provide a more meaningful learning experience for elementary school students because it actively involves students in understanding environmental issues, generating creative solutions, developing products or designs, and testing the effectiveness of the solutions produced. (Hendranti et al., 2025). Therefore, this study aims to identify the development needs of an integrated STEM Design Thinking learning model to improve students creative thinking skills in science lessons on environmental topics in elementary schools.

METHOD

This research uses a mixed methods approach with a sequential explanatory design. Mixed methods is a procedure that involves collecting, analyzing, and combining quantitative and qualitative research methods within a study (Creswell, 2014). In addition, mixed methods research encourages the use of multiple approaches in collecting and analyzing data within a single study, recognizing the limitations of using only one method (Migiro & Magangi, 2011). The goal is to provide a deeper and more comprehensive understanding of a phenomenon or research problem (Nasution et al., 2024). In addition, the goal is to gain a more complete, in-depth, and comprehensive understanding of a research problem by combining quantitative and qualitative approaches in a single study (Doyle et al., 2009). The first stage involves collecting quantitative data through a test of students' creative thinking skills. The goal is to measure

the extent of students' creative thinking levels. This test also aims to assess and train students' ability to generate new ideas, think broadly and flexibly, and solve problems creatively and logically (Hidayat et al., 2018). The second stage involves collecting qualitative data through questionnaires, observations, and interviews to gain a deeper understanding of students' learning experiences and teachers' needs related to the learning model. A questionnaire is a series of questions posed to individuals to obtain useful statistical information about a particular topic (Roopa & Rani, 2012). Then, observation is conducted to understand a person's behavior and life from the participant's perspective directly (Baker, 2006). And lastly, an interview is a special form of interaction where the researcher asks questions about the participant's life experiences, views, hopes, and thoughts to gain a deeper understanding (Knott et al., 2022).

The research subjects consisted of 178 fifth-grade students from three elementary schools in South Tangerang City and several fifth-grade teachers who teach Science subjects. The research subjects are individuals or humans who participate in the study and must be protected throughout the research process (Steinbrook, 2002). One of the research instruments used is a creative thinking skills test. A research instrument is a tool or procedure used to collect data in a study (Zohrabi, 2013). The creative thinking skills instrument is developed based on Torrance indicators, which include fluency, flexibility, originality, and elaboration.

Data collection was conducted through:

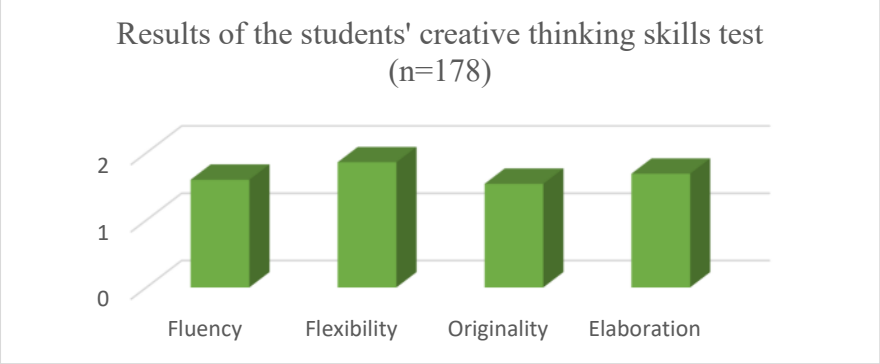
1. Student creative thinking skills tests.
2. Student learning experience questionnaires.
3. Teacher usage of the learning model questionnaires.
4. Teacher interviews regarding the implementation of environmental education.
5. Observation of science lessons in the classroom.

Quantitative data were analyzed descriptively using averages and percentages. Qualitative data were analyzed through data reduction, data presentation, and conclusion drawing.

RESULTS AND DISCUSSION

Results of Student Creative Thinking Skills Test

The results of the creative thinking skills test on 178 fifth-grade students indicate that students' creative thinking abilities in STEM learning about environmental pollution are still relatively low. The assessment was conducted based on four indicators of creative thinking skills: fluency, flexibility, originality, and elaboration. The following presents the results of the students' creative thinking skills test:



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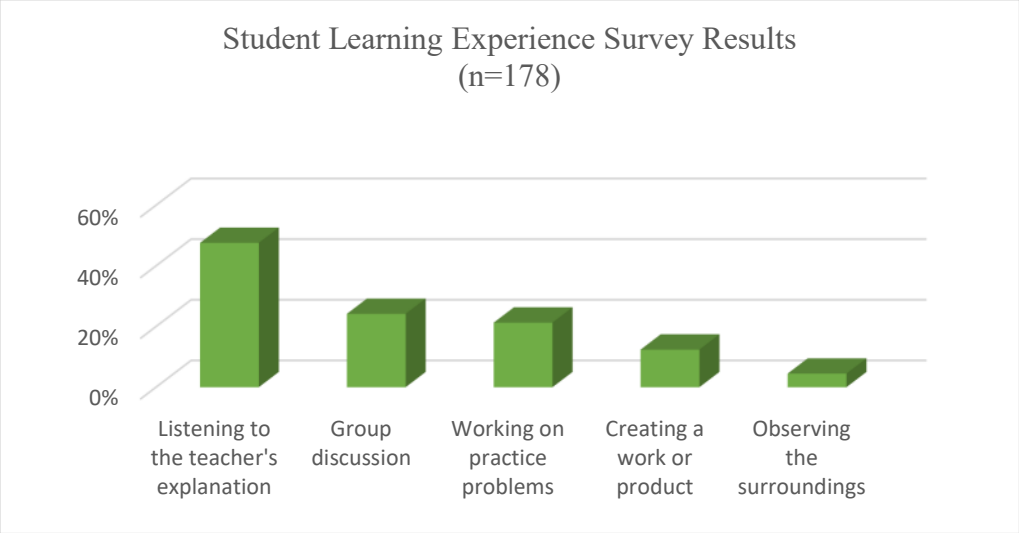
Based on the chart, it is known that the originality indicator received the lowest score, which is 1.54. This result indicates that students still have difficulty generating unique and different ideas from common answers. Additionally, the low fluency score shows that students have not yet been able to produce many alternative solutions to environmental problems. The analysis of students' answers reveals that most students only provide simple responses such as 'littering' without developing other possible causes or more creative alternative solutions. This condition shows that students are still fixated on single answers and have not yet become accustomed to divergent thinking. These findings suggest that the ongoing learning process has not yet provided students with optimal opportunities to explore ideas and solve problems creatively. In fact, design thinking is a human-centered learning approach to solving problems creatively, innovatively, and systematically through processes of understanding the problem, seeking ideas, creating solutions, testing, and improving solutions based on evaluation results (Azizah et al., 2024). Arifin and Mahmud explained that the application of design thinking in STEM learning focuses on problem solving, designing activities, and collaborative learning, thereby enhancing students' creativity in solving real-world problems (Arifin & Mahmud, 2021).

In addition, Carroll explained that design thinking helps students develop creative confidence as well as divergent thinking skills through the stages of empathize, define, ideate, prototype, and test (Carroll, 2015). This stage provides students with the opportunity to explore ideas more broadly and generate innovative solutions based on real-world problems. Additionally, other research also confirms that design thinking is a creative and analytical process that allows for experimentation, model development, prototyping, feedback collection, and redesign (Syaheeda et al., 2024).

Student Learning Experience Survey Results

The survey results regarding students' learning experiences indicate that science learning about the environment is still dominated by listening to the teacher's explanation. The Student Learning Experience Survey results are presented in the following chart.



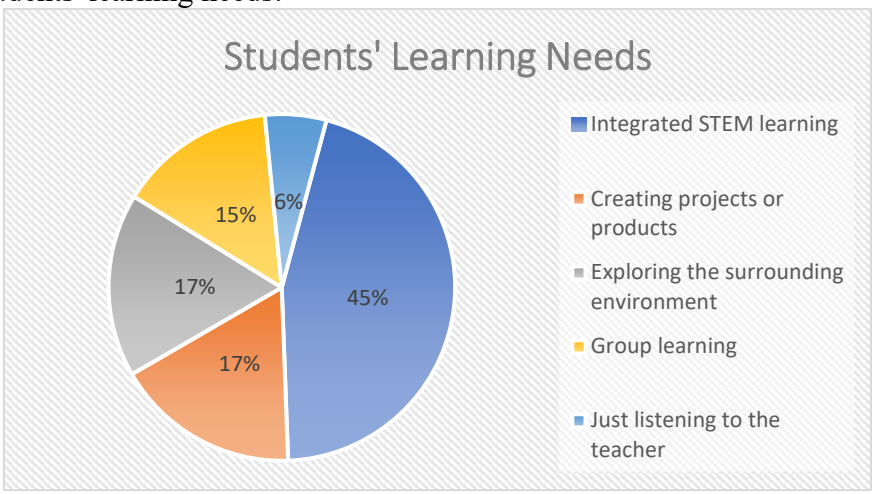
The above data shows that nearly half of students' learning experiences still consist of listening to the teacher's explanations. Learning activities that involve exploring the environment and creating tangible products are still very low. This condition indicates that science learning is still oriented toward knowledge transfer, so

students lack opportunities for contextual and meaningful learning experiences. Teacher-centered instruction causes students to be less actively involved in investigation processes, idea exploration, and solving real-world problems.

The observation results also show that teachers explain the material more often than involving students in experiment activities or environment-based projects. In fact, STEM-based learning with a design thinking approach emphasizes active student involvement in the problem identification process and the search for innovative solutions. Alashwal explains that STEM education can help students develop creativity, critical thinking, problem-solving, and innovative skills through integrated design thinking activities in the learning process. (Alashwal, 2020). In addition, other research also states that design thinking is a solution-oriented and learning approach (Avsec et al., 2024). Thus, design thinking-based learning can create a more active, collaborative, and meaningful learning experience for students.

Results of Student Learning Needs Analysis

The results of the student learning needs survey indicate that students are more interested in practice-based learning and STEM integration. The following presents the analysis of students' learning needs:



Based on the image above, it is known that most students prefer learning that involves hands-on practice, product creation, and environmental exploration compared to learning that is solely centered on teacher explanations. These findings indicate that students need more innovative and contextual learning. Students tend to be more interested in learning that provides opportunities to collaborate, experiment, and produce tangible products as solutions to problems in their surrounding environment.

Based on the research conducted, it explains that STEM broadens the scope of analysis through cross-disciplinary integration that requires multidimensional thinking, and the STEM approach also integrates various disciplines to solve problems holistically and practically (Kamila et al., 2026). Therefore, STEM learning can help students understand concepts more deeply because students learn through direct experience. Additionally, other research also states that design thinking not only helps students understand academic concepts but also builds problem-solving skills that enable learners to analyze complex problems, develop creative solutions, and effectively implement those solutions to face 21st-century challenges (Adeoye & Jimoh, 2023). Therefore, the implementation of STEM learning based on design thinking is considered appropriate for

21st-century student learning needs, which demand creativity, collaboration, communication, and problem-solving skills.

CONCLUSION

Based on the research results, it can be concluded that elementary school students' creative thinking skills in science learning about the environment are still relatively low, especially in the aspects of originality and fluency. This condition indicates that students have not yet been able to generate diverse, unique, and innovative ideas in solving environmental problems. The low creative thinking skills are influenced by the learning process, which is still dominated by activities of listening to the teacher's explanation and provides limited opportunities for students to explore, experiment, and solve problems practically.

The results of the learning needs analysis also show that students are more interested in practice-based learning, projects, environmental exploration, and STEM integration compared to conventional learning. Additionally, teachers still face limitations in implementing innovative learning models that can develop students' creativity in environmental education. Therefore, the development of a STEM-integrated Design Thinking learning model is considered relevant and necessary to create a more contextual, collaborative, reflective, and problem-solving-oriented learning experience.

The STEM-integrated Design Thinking learning model is expected to provide space for students to understand environmental issues through the processes of empathize, define, ideate, prototype, and test, so that students' creative thinking skills can develop optimally. Thus, the development of this learning model has the potential to support the creation of more meaningful science learning that aligns with 21st-century skills demands.

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