JPPIPA 12(5) (2026)

Jurnal Penelitian Pendidikan IPA

http://jppipa.unram.ac.id/index.php/jppipa/index

Analysis of Problem-Solving Ability in Ecosystem Material Through Open Essay Question Instrument Test

Feni Rianti[1*], Yulianti Fitiyani[1], Atep Sujana[1], Encep Supriatna[1]

[1] Indonesian University of Education, Bandung, Indonesia.

Received: December 19, 2025
Revised: March 23, 2026
Accepted: May 25, 2026
Published: May 31, 2026

Corresponding Author:
Feni Rianti
fenirianti@upi.edu

DOI: 10.29303/jppipa.v12i5.14004

Abstract: This study was conducted to analyze the problem-solving abilities of fifth-grade elementary school students through instrument testing. By using Polya's problem-solving indicators through open-ended Urian test instruments, students were guided to be able to explore their abilities in understanding, planning, implementing, and evaluating the results of their thinking in solving factual problems that occur in rice field and garden ecosystems. The method used in this study was quantitative descriptive with 27 fifth-grade students as subjects in an elementary school. The results of the analysis showed that the average problem-solving abilities of students were in the fairly good category, with an average overall score of 6.47 out of a maximum score of 10. The indicator with the highest achievement was the evaluation of results, while the indicator with the lowest achievement was the implementation of strategies. These results indicate that students' problem-solving abilities were still in the sufficient category, with a stronger tendency in the ability to evaluate results and understand problems than in planning problem-solving strategies.

Keywords: Elementary school students; Open-ended descriptive questions; Problem solving skills

Introduction

Elementary school students are in the concrete operational cognitive stage, where their thinking processes are still heavily dependent on direct experience and real objects. According to Jean Piaget's developmental theory, at this stage of elementary school age, students begin to be able to perform simple logical reasoning, but still experience difficulties in abstract thinking. This indicates that elementary school students' thinking abilities develop from basic thinking to more complex thinking skills, thus requiring appropriate and contextual learning stimuli. This is also stated in Ilhami (2022) his research, "if teachers can develop students' cognitive abilities well, students will more easily understand and apply the lessons given."

When teachers optimize problem-based contextual learning activities, students not only remember and understand concepts, but are also trained to analyze phenomena, evaluate observation results, and conclude new concepts. Thus, discovery learning is relevant to developing Higher Order Thinking Skills (HOTS) (Kartini et al., 2019; Rosarina et al., 2016). In the context of learning in elementary schools, this ability reflects students' critical, creative, and logical thinking abilities in dealing with various contextual situations.

Higher-order thinking skills are one of the essential competencies that must be developed in 21st-century learning. HOTS encompasses the ability to analyze, evaluate, and create, enabling students not only to master factual knowledge but also to use that knowledge critically and reflectively in various problem-solving contexts (Doyan et al., 2022). Developing these skills is becoming increasingly relevant as the world of education demands that teachers provide learning that trains students in critical thinking, problem-solving, and decision-making to prepare them for real-life challenges (Fanani et al., 2025).

Polya's problem-solving skills encompass four key indicators: understanding the problem, planning a strategy, implementing the strategy, and evaluating the results. The 2022 PISA results showed that 66% of

How to Cite:
Rianti, F., Fitiyani, Y., Sujana, A., & Supriatna, E. (2026). Analysis of Problem-Solving Ability in Ecosystem Material Through Open Essay Question Instrument Test. *Jurnal Penelitian Pendidikan IPA*, *12*(5), 602–606. https://doi.org/10.29303/jppipa.v12i5.14004

Indonesians scored 383 out of 80 participants at level 66 (Pursitasari et al., 2025). This shows that Indonesian people recognize phenomena and use knowledge to solve simple problems, which indicates moderate scientific literacy skills.

Jonassen (2011) emphasizes that problem-solving is the core of meaningful learning , so from elementary school, students need to be accustomed to facing problems close to their lives. Students must be able to interpret problem situations, recognize relevant information, and connect it to prior knowledge. In the context of elementary school students, this ability is seen when they can identify what is known and what is asked, as well as the conditions or limitations of the problem. Science subjects are very suitable for practicing this way of thinking because they present many everyday life facts that contain elements of cause and effect (Susilawati et al., 2021). Some students still have difficulty in formulating steps to solve problems, especially in the planning stage. Therefore, it is necessary to analyze students' problem-solving abilities using open-ended essay questions on science material designed to improve these abilities (Muliyadi et al., 2026).

Problem-solving skills are an important competency that must be developed in learning, particularly through a constructivist approach. From a constructivist perspective, learning is viewed as an active process in which students construct knowledge through experience, interaction, and reflection (Efgivia et al., 2021; Zajda, 2021). Therefore, problem-solving becomes the primary means for students to construct their own understanding, rather than simply passively receiving information from a teacher (Munandar et al., 2024; Supriatna et al., 2025).

A study shows that this ability has not developed optimally because the learning approach tends to focus on memorizing concepts and does not provide much space for students to explore ideas independently. Assessment instruments used in schools are still dominated by multiple-choice questions, thus not encouraging students to display high-level thinking processes comprehensively. Question instruments based on Higher Order Thinking Skills (HOTS) developed in accordance with the revised Bloom's taxonomy are able to measure complex thinking skills that not only focus on mastering facts or procedures, but also on the ability to analyze, evaluate, and create answers from various possible solutions. The development process that applies Design-Based Research and validity and reliability testing produces open-ended question instruments (Yuliandini et al., 2019). In the Independent Curriculum, it plays a strategic role in developing students' higher-order thinking skills, because this type of question does not only require one correct answer, but also encourages students to express diverse, flexible, and original ideas according to their individual thinking processes (Rifani et al., 2025).

Method

Time and Place of Research

This research was conducted in the second semester of the 2025 academic year at an elementary school involving fifth-grade students. The study took place during a science learning activity focused on problem-solving tasks. The research location was selected based on accessibility considerations and the relevance of student characteristics to the research objectives.

Research Design

This study uses a quantitative descriptive research design that aims to objectively describe the problem-solving abilities of elementary school students based on numerical data obtained from test results. The population of this study consisted of all fifth-grade students in the selected elementary schools. The sample consisted of 27 students, and the sampling technique used was total sampling because the population size was relatively small, thus allowing all members of the population to participate as research respondents. According to Sugiyono (2019), total sampling is a sampling technique in which all members of the population are used as samples when the population is limited in number. The selection of fifth-grade students was based on the consideration that students at this level generally have relatively stable concrete operational thinking skills and are beginning to develop logical thinking and simple problem-solving skills.

The research variable examined in this study was students' natural science problem-solving abilities. Data were collected using an open-ended descriptive test consisting of 10 questions designed based on Polya's problem-solving indicators, namely: (1) understanding the problem, (2) planning a strategy, (3) implementing the strategy, and (4) evaluating the results. Each item has a maximum value of 4, so the total maximum value is 40. The test questions are presented in contexts related to students' real-life experiences to comprehensively measure their problem-solving abilities.

The instruments and materials used in this study included test sheets, assessment rubrics, stationery, and supporting learning materials. Student responses were assessed using an analytical assessment rubric to ensure consistency and objectivity in evaluating each indicator of problem-solving ability. In line with Nguyen et al. (2025), the use of open-ended problem-solving tests allows students to apply their knowledge and skills in solving contextual problems comprehensively.

Research Procedures

The research procedure was carried out in several stages. The first stage was the preparation stage, which included identifying the research problem, reviewing relevant literature, designing research instruments, and developing an assessment rubric based on Polya's problem-solving indicators. The second stage was the implementation stage, in which the researcher administered a problem-solving test to fifth-grade students during the learning process. Before the test, students were given instructions on how to answer the questions. During the test, students were encouraged to solve problems independently based on their understanding and reasoning abilities. The final stage was the data processing and interpretation stage. At this stage, students' answers were assessed using an analytical rubric, then tabulated and analyzed to determine the level of students' problem-solving abilities for each indicator and overall performance.

Data Analysis

The data obtained from the test results were analyzed using descriptive statistical techniques. This analysis included calculating average scores, achievement percentages, and categorizing students' problem-solving abilities for each indicator and overall results. The findings were then interpreted to describe the profile of students' mathematical problem-solving abilities and to identify indicators that had developed well and those that still needed improvement in the learning process.

Result and Discussion

Student Problem Solving Ability Categories

The results of this study provide an overview of science problem-solving abilities based on a test instrument administered to fifth-grade elementary school students. Analysis was conducted to determine the distribution of student abilities across several achievement categories. Through this analysis, researchers were able to identify the overall level of students' problem-solving abilities as well as variations in achievement among students.

The results of the instrument test on 27 students showed an overall average score of 6.47 out of a maximum score of 10, indicating that the students' abilities were generally in the "Sufficient" category. This indicates that most students still need further guidance to achieve optimal abilities, particularly in higher-order thinking skills indicators.

The distribution of scores shows variation in ability among students, with scores ranging from 4 to 9.25, indicating differences in understanding and problem-solving skills. These differences may be influenced by individual factors, such as learning motivation, prior experience, and problem-solving strategies used.

Table 1. Distribution of Student Ability Categories

Ability Category	Score Range	Number of Students	Percentage
Very good	8.5 – 10	5 students	18.5%
Good	7 – <8.5	7 students	25.9%
Enough	5.5 – <7	9 students	33.3%
Not enough	<5.5	6 students	22.2%

In terms of ability, only 5 students (18.5%) were in the "Very Good" category, while 7 students (25.9%) were in the "Good" category. This indicates that less than half of the students were able to demonstrate good to very good mastery of the material. In contrast, there were 9 students (33.3%) in the "Fair" category and 6 students (22.2%) in the "Poor" category, indicating that almost half of the students still faced difficulties in solving the questions.

The results of the instrument test indicate that students' abilities are in the moderate category with an average score of 6.47. This condition is in line with findings Supriatna et al. (2025) that confirm that elementary school students' higher-order thinking and problem-solving abilities are generally still developing and are greatly influenced by the learning experiences provided in the classroom. Students who are not accustomed to facing challenging problems tend to have difficulty in systematically integrating knowledge and problem-solving strategies. Variations in students' abilities in solving problems are a normal phenomenon, especially when learning has not fully accommodated differences in students' characteristics and initial abilities. This is reflected in the distribution of ability categories, where some students have reached the "Good" and "Very Good" categories, but there is still a significant proportion in the "Fair" and "Poor" categories.

Analysis of Student Achievement on Problem Solving Indicators

To obtain a more detailed picture of students' problem-solving abilities, researchers also analyzed student achievement across each problem-solving indicator. The indicators analyzed in this study were based on Polya's problem-solving stages: understanding the problem, planning a strategy, implementing the strategy, and evaluating the results. Analysis of each indicator was conducted to identify which aspects of problem-solving had developed well and which still needed improvement.

The following are the scores resulting from the analysis of student achievement for each problem-solving indicator, namely:

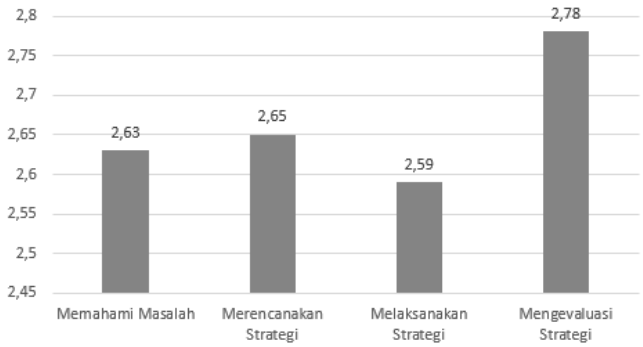

Figure 1. Score per indicator

Students' problem-solving abilities across each indicator yield a relatively balanced picture across various aspects. For the problem understanding indicator, the average score of 2.63 indicates that most students were able to identify the known and required information in the problem, although some difficulties remained in interpreting the problem comprehensively.

Strategic planning indicators obtained an average score of 2.65, indicating that students were quite capable of determining the appropriate steps or approaches to solving problems. However, their strategic planning was not yet fully systematic and still needed to be strengthened, especially in selecting the most effective method.

Strategy implementation, with an average score of 2.59, indicates that students' ability to implement solution plans is still adequate. Some students were less consistent in carrying out the planned steps, which affected the accuracy of the final results.

Meanwhile, the indicator that evaluates the results achieved the highest average score, namely 2.78. This indicates that students are relatively more capable of reflecting on their answers, such as reviewing the results and assessing the appropriateness of the solution to the problem. However, these evaluation skills still need to be developed so that students can make more in-depth and critical assessments of the problem-solving process and results (Anggraeni et al., 2021; Nilimaa, 2023; Susilawati et al., 2022).

The indicator with the highest achievement was evaluating results, while the indicator with the lowest achievement was implementing strategies. These results indicate that students' problem-solving abilities are still adequate, with a stronger tendency toward evaluating results and understanding problems than planning problem-solving strategies.

Conclusion

The results of the instrument testing in the study using open-ended essay questions with problem-solving indicators can be concluded that the abilities of fifth-grade elementary school students who were the subjects of the study are in the fairly good category with an average score of 6.47. The indicator with the highest achievement is the evaluation of results, while the indicator with the lowest achievement is the implementation of strategies. This study recommends that teachers optimize the use of contextual learning media and learning using models that hone students to improve their abilities in planning and implementing student problem-solving strategies such as problem-based learning, learning that carries out research actions, and project-based learning.

Acknowledgments

The authors would like to express their sincere gratitude to the fifth-grade elementary school students who participated in this study. They would also like to thank the lecturers for their valuable guidance, advice, and encouragement, which greatly contributed to the successful completion of this study.

Author Contributions

Conceptualization, M. and DH; methodology, M. and DH; validation, DH, AS, and ES; formal analysis, M.; investigation, M.; resources, M, DH, AS, and ES; data curation, AS; writing—original draft, M.; writing—review and editing, MDH, AS, and ES; visualization, M.; All authors have read and approved the published version of the manuscript.

Funding

This research did not receive external funding.

Conflict of Interest

The authors declare no conflict of interest.

References

Anggraeni, R. E., & Suratno. (2021). The analysis of the development of the 5E-STEAM learning model to improve critical thinking skills in natural science lesson. *Journal of Physics: Conference Series*, *1832*(1), 012050. https://doi.org/10.1088/1742-6596/1832/1/012050

Doyan, A., Susilawati, S., Hadisaputra, S., & Muliyadi, L. (2022). Analysis Validation of Quantum Physics Learning Devices using Blended Learning Models to Improve Critical Thinking and Generic Science Skills of Students. *Jurnal Penelitian Pendidikan IPA*, *8*(3), 1581–1585. https://doi.org/10.29303/jppipa.v8i3.1920

Efgivia, M. G., Adora Rinanda, R. ., Suriyani, Hidayat, A., Maulana, I., & Budiarjo, A. (2021). Analysis of Constructivism Learning Theory. *Proceedings of the 1st UMGESHIC International Seminar on Health, Social Science and Humanities*, *585*, 208–12. https://doi.org/10.2991/assehr.k.211020.032

Fanani, A., Kusmaharti, D., Fanny, A. M., Maulidha, Z., Ilmia, F. H., & Utari, M. S. (2025). User Response to

the Contribution of STREAM-Based IPAS V Elementary School Teaching Materials as a Support for the Achievement of Pancasila Student Profile. *Jurnal Penelitian Pendidikan IPA*, *11*(2), 192–197. https://doi.org/10.29303/jppipa.v11i2.10128

Ilhami, A. (2022). Implikasi Teori Perkembangan Kognitif Piaget Pada Anak Usia Sekolah Dasar Dalam Pembelajaran Bahasa Indonesia. *Pendas : Jurnal Ilmiah Pendidikan Dasar*, *7*(2), 605–619. https://doi.org/10.23969/jp.v7i2.6564

Jonassen, D. H. (2011). *Learning to Solve Problem: A Guide to Designing Problem-Solving Learning Environments*. New York: Routledge.

Kartini, K., Doyan, A., Kosim, K., Susilawati, S., Khasanah, B. U., Hakim, S., & Muliyadi, L. (2019). Analysis of Validation Development Learning Model Attainment Concept to Improve Critical Thinking Skills and Student Learning Outcomes. *Jurnal Penelitian Pendidikan IPA*, *5*(2), 185–188. https://doi.org/10.29303/jppipa.v5i2.262

Muliyadi, L., Hamidi, H., Islami, A. V., Rizaldi, D. R., Hasanah, R., Yadaeni, A., Hariadi, M. H., Hanafi, M., & Wathoni, H. (2026). Analysis Validation of Physics Learning Devices Based on Problem Based Learning Assisted by PhET Simulation to Improve Students' Creativity and Critical Thinking. *Indonesian Journal of Science Education and Applied Research*, *1*(1), 27–31. Retrieved from https://journals.balaipublikasi.id/index.php/ijosear/article/view/743

Munandar, H., Doyan, A., Susilawati, S., Hakim, S., Muliyadi, L., & Hamidi, H. (2024). Increasing Motivation to Study Physics Using PhET Media on Mechanical Energy Material. *MANDALIKA : Journal of Social Science*, *2*(1), 1–5. https://doi.org/10.56566/mandalika.v2i1.70

Nguyen, H. H., & Duong, H. G. T. (2025). Application of Knowledge and Skills Competency of Elementary School Students in Science Subject in Vietnam. *Jurnal Penelitian Dan Pembelajaran IPA*, *11*(1), 1. https://doi.org/10.30870/jppi.v11i1.32183

Nilimaa, J. (2023). New Examination Approach for Real-World Creativity and Problem-Solving Skills in Mathematics. *Trends in Higher Education*, *2*(3), 477–495. https://doi.org/10.3390/higheredu2030028

Pursitasari, I. D., Permana, I., Jaenudin, D., Suriansyah, M. I., Sumiati, E. S., & Aqilah, S. (2025). Digital Literacy and Scientific Literacy of Science Teachers and Student Learning Styles in Science Learning. *Jurnal Penelitian Dan Pembelajaran IPA*, *11*(1), 26. https://doi.org/10.30870/jppi.v11i1.30532

Rifani, R., Prasetyo, T., Indra, S., & Hayu, W. R. R. (2025). Pengembangan Instrumen Asesmen Open Ended Question Pada Kurikulum Merdeka Untuk Mengukur Kemampuan Berpikir Kreatif Peserta Didik. *Jurnal Penjaminan Mutu*, *11*(01), 13–26. https://doi.org/10.25078/jpm.v11i01.3936

Rosarina, G., Sudin, A., & Sujana, A. (2016). Application of Discovery Learning Model to Improve Student Learning Outcomes in Material Change of Forms. *Journal of Scientific Pens*, *1*(1), 307–313. https://doi.org/10.20961/shes.v5i5.78109

Sugiyono. (2019). *Metode Penelitian Kuantitatif, Kualitatif dan RD*. Bandung: Alfabeta.

Supriatna, G. S., Nurani, D., & Adnan, B. A. (2025). Implementasi Pembuatan Ecobrick Di Sekolah Dalam Meningkatkan Literasi Lingkungan. *J-KIP (Jurnal Keguruan Dan Ilmu Pendidikan)*, *6*(2), 596. https://doi.org/10.25157/j-kip.v6i2.19544

Susilawati, S., Doyan, A., Hardjono, A., & Muliyadi, L. (2021). Development of Physics Learning Media based on Guided Inquiry Model to Improve Students' Concepts Mastery and Creativity. *Journal of Science and Science Education*, *2*(2), 68–71. https://doi.org/10.29303/jossed.v2i2.711

Susilawati, S., Doyan, A., Mulyadi, L., Abo, C. P., & Pineda, C. I. S. (2022). The Effectiveness of Modern Physics Learning Tools Using the PhET Virtual Media Assisted Inquiry Model in Improving Cognitive Learning Outcomes, Science Process Skills, and Scientific Creativity of Prospective Teacher Students. *Jurnal Penelitian Pendidikan IPA*, *8*(1), 291–295. https://doi.org/10.29303/jppipa.v8i1.1304

Yuliandini, N., Hamdu, G., & Respati, R. (2019). Pengembangan Soal Tes Berbasis Higher Order Thinking Skill (Hots) Taksonomi Bloom Revisi di Sekolah Dasar. *Pedadidaktika: Jurnal Ilmiah Mahasiswa Pendidikan Guru Sekolah Dasar*, *6*(1), 37–46. Retrieved from http://ejournal.upi.edu/index.php/pedadidaktika/index

Zajda, J. (2021). Constructivist Learning Theory and Creating Effective Learning Environments. In *Globalisation and Education Reforms* (pp. 35–50). https://doi.org/10.1007/978-3-030-71575-5_3