



Problem-Based Learning in Science Learning on Elementary School Students' Science Process Skills: Systematic Literature Review

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Abstract

This study aims to systematically analyze how the application of the Problem-Based Learning (PBL) model affects the science process skills of elementary school students in science learning. Science process skills are important for developing students' abilities in observing, classifying, measuring, and thinking critically. PBL is believed to be one of the effective learning models because it encourages students to actively learn through solving real problems.

This study used the Systematic Literature Review (SLR) method by identifying and reviewing 14 relevant articles obtained from Google Scholar. The selected articles focused on the application of PBL in science learning at the elementary school level. The results of the study showed that most studies support the use of the Problem Based Learning model in improving students' science process skills. Students who learn with the PBL approach tend to be more active, critical, and collaborative. However, several limitations were still found such as the narrow scope of the material and the readiness of teachers to apply this model. Further research and training for teachers are highly recommended so that the implementation of this model can run optimally.

1. Introduction

Science process skills play an important role in learning Natural Sciences (IPA) in Elementary Schools (SD). Literally, science process skills apply the concept of thinking, reasoning, and acting logically which is aimed at building and researching scientific concepts in solving a problem. Science process skills include several abilities such as cognitive, affective, and psychomotor abilities so that they can create authentic and meaningful learning. Research by Rahmawati and Ridwan (2020) shows that developing science process skills in elementary school students can significantly increase understanding of science concepts. In addition, a study by Nugraha and Hidayat (2019) found that students with good science process skills showed more effective problem-solving abilities in the context of science learning.

One approach that is considered effective in developing science process skills is Problem-Based Learning (PBL). PBL is a student-centered learning model, where they are faced with real problems that must be solved, thus encouraging active involvement and the development of critical thinking skills. Through PBL, students learn to identify problems, formulate hypotheses, collect and analyze data, and conclude solutions, all of which are in line with science process skills.

Although several studies have discussed the application of PBL in science learning, there are still few that specifically discuss how PBL can improve science process skills at the elementary school level as a whole. For example, research conducted by Khansa (2024) shows that PBL can improve students' science process skills, but the study is still limited to one material and only certain sample groups. Therefore, a more systematic literature review is needed in order to get a more complete picture of how and how effective PBL is at the elementary school level.

Thus, the purpose of this study is to analyze the results of research related to the use of PBL in improving elementary school students' science process skills in science learning. This study will discuss the research gaps that still exist in elementary schools and consider opportunities for study development.

2. Method

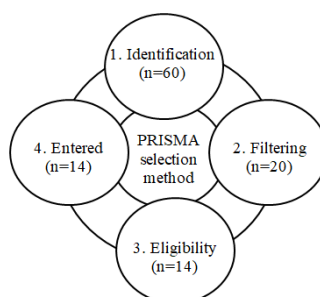
To examine the problem, the researcher used the Systematic Literature Review (SLR) method to detail and present findings from various literature sources regarding the use of problem-based learning methods in science learning on elementary school students' science process skills. The first step in this study was to identify the topic, focus of the study, and formulation of the problem to be analyzed. The topic focused on the application of Problem-Based Learning (PBL) in science learning in elementary schools, especially in relation to improving science process skills.

Next, a literature search process was carried out using online databases such as Google Scholar with certain relevant keywords, such as "Problem-Based Learning", "science process skills", and "elementary school science learning". The articles found were then filtered using inclusion and exclusion criteria. Inclusion criteria include articles published in the last five years, in Indonesian or English, and have a focus on elementary school students and science learning using the PBL model. The exclusion criteria include articles that do not have full access or do not contain data relevant to the focus of the study.

The next stage is a more specific article selection process by reviewing the title, abstract, and full content to ensure the relevance of the content to the research focus. Articles that have passed the selection are then analyzed using a thematic and descriptive approach to identify key findings, methods used, and emerging research trends. Data are presented in the form of synthesis tables to facilitate reading and drawing conclusions.

From the initial 65 articles found, three stages of screening were carried out based on inclusion and exclusion criteria until 14 relevant articles were obtained. Selection was carried out based on the year of publication (2018–2024), topic relevance, and completeness of data.

The article selection process is presented in the PRISMA flowchart below:



Identification: The researcher collected 60 articles from two main sources, namely Google Scholar. These articles were collected using a combination of keywords such as "Problem-Based Learning", "Science", "Elementary School", and "Science Process Skills". This identification process was carried out thoroughly to ensure a broad and relevant coverage of literature.

Filtering: From the initial 65 articles, 40 articles were removed because they were duplicated or irrelevant to the research focus. Relevance was determined based on an initial analysis of the title and abstract. Articles that did not discuss science at the elementary school level or did not apply the PBL model were also eliminated at this stage.

Eligibility: From the remaining 20 articles, a full content review was conducted. This stage evaluated the completeness of the data, research methods, participants, and the suitability of the content to the problem formulation. A total of 14 articles were further filtered because they did not meet the criteria such as a lack of focus on science process skills or not using an explicit learning approach.

Entered: A total of 14 articles that met all inclusion criteria were included in the final stage of the review. These articles were selected because they were appropriate to the context of science

learning in elementary schools, explicitly used the PBL model, and presented relevant data related to science process skills. These articles were then analyzed in depth through thematic and narrative synthesis

3. Results and Discussion

The findings of this study directly address the research objective stated in the introduction, namely to examine how the implementation of the Problem-Based Learning (PBL) model improves elementary school students' science process skills in science learning. Based on the analysis of 14 relevant articles, most studies reported significant improvements in students' process skills, such as observing, classifying, measuring, and drawing conclusions. The discussion provides a scientific interpretation of these findings by explaining how PBL effectively fosters active student participation and critical thinking through real-world problem solving, which aligns with the core of science process skills. These results are consistent with previous studies, such as Nugraha & Hidayat (2019), which demonstrated a notable increase in students' observation skills after using PBL. However, differences were found across studies, often influenced by the scope of the material, teacher readiness, and the availability of instructional resources. For instance, Khansa (2024) found that the effectiveness of PBL was limited to certain topics and could not be generalized to all areas of science. Meanwhile, Lestari (2021) emphasized that successful implementation of PBL strongly depends on teacher preparedness and the availability of learning media. The discussion also highlights the implications of these findings, suggesting that PBL holds great potential for enhancing students' science process skills in elementary education. Nevertheless, challenges remain, particularly related to teachers' lack of training and limited learning resources. Future research is encouraged to cover a broader range of science topics and employ more diverse methods. Additionally, teacher training should be prioritized to ensure optimal implementation of the PBL model in elementary science classrooms.

Table 1. Primary Study of Problem Based Problem-Based Learning in Science Learning on Elementary School Students' Science Process Skills				
No	Author Name and Year	Article Title	Research Method	Research Result
1	Wulandari, IA, Mu'min, MB, & Firdaus, MG (2021)	Improving Critical Thinking Skills (KBKr) through Biology Learning Based on Science Process Skills	Literature Review	This study shows that science process skills-based learning can improve students' critical thinking skills gradually. By actively involving students in the learning process, they can develop analytical and evaluation skills towards various scientific phenomena in biology learning.
2	Royani, I., Mirawati, B., & Jannah, H. (2018)	The Influence of the Practical-Based Direct Learning Model on Students' Science Process Skills and Critical Thinking Abilities	Nonequivalent Control Group Design	This study found that the use of a hands-on learning model based on practicum has an effective effect on improving students' science process skills and critical thinking skills. Through practicum activities, students find it easier to understand science concepts concretely and hone their scientific skills.

3	Aiman, U., & Sunimbar. (2020)	Elementary School Students' Science Process Skills in Process-Oriented Guided Inquiry Learning using LKS Supplements	Post-test only control group design.	This study proves that guided inquiry learning using process-oriented LKS supplements can improve students' science process skills. Students become more focused in conducting observations, experiments, and drawing conclusions independently.
4	Khansa (2024)	Implementation of Problem-Based Learning in improving elementary school students' science process skills	Limited experimental studies	The results of this study indicate that the application of Problem-Based Learning is effective in improving elementary school students' science process skills. However, the scope of its application is still limited to the scope of certain materials so that it cannot be generalized to all fields of science.
5	Enjoni & Febriyanto (2020)	Improving elementary school students' learning outcomes using the PBL model based on science process skills	Quasi-experimental	The PBL model can significantly improve the learning outcomes and science process skills of elementary school students.
6	Christiana & Radia (2021)	Meta-analysis of the application of the PBL model in improving the science learning outcomes of elementary school students	Meta-analysis	Through a meta-analysis study, this study found that the application of the PBL model consistently has a positive effect on the science learning outcomes of elementary school students. PBL is able to strengthen conceptual understanding while increasing student involvement in learning.
7	Princess, Subekti, & Sari (2020)	Improving students' science process skills on environmental pollution material through the PBL model	Classroom action research (CAR)	PBL enhances students' active participation and observation skills.
8	Hartati et al. (2022)	Students' science process skills through PBL learning models on biology material	Experiment	There is an increase in science process skills through PBL in biology learning.
9	Habibie (2020)	Improving science process skills through PBL of grade IV students of SDN 1 Sembalun Bumbung	Classroom action research (CAR)	PBL encourages students to actively think critically and investigate contextual science problems.

10	Fahrezi et al. (2020)	Meta-analysis of the influence of the Project Based Learning model on elementary school science learning outcomes	Meta-analysis	PBL and Project-Based Learning are both effective in improving science learning outcomes.
11	Noviati (2023)	Implementation of the PBL model in improving science learning outcomes in elementary schools	Experimental study	PBL helps improve students' ability to understand science concepts in depth.
12	Musyadad, Supriatna, & Parsa (2019)	Implementation of PBL learning model in improving student learning outcomes in science lessons	Experimental study	PBL has a positive impact on students' understanding of physical environmental concepts.
13	Nuzulia, Adlim, & Nurmaliah (2017)	Relevance of curriculum and science process skills integrated into science students	Descriptive-qualitative study	This study reveals the importance of integrating science process skills into the education curriculum, starting from elementary school. These skills need to be built early on to support students' ongoing scientific development.
14	The Last Supper (2021)	Efforts to Improve Students' Science Process Skills in Heat Transfer Material through PBL	Classroom Action Research (CAR)	PBL significantly improves students' science process skills in heat transfer material.

3.1 Conclusion

Based on the results of the systematic study that has been conducted, the application of the Problem-Based Learning (PBL) model has a significant opportunity to improve elementary school students' science process skills in science learning. This model has been proven to encourage students to think critically, work collaboratively, and conduct in-depth observations and analysis. Most of the analyzed articles indicate that PBL has a positive impact on students' engagement during the learning process and contributes to better learning outcomes, particularly in the aspects of science process skills. However, the implementation of PBL still faces several challenges, especially related to teachers' limited understanding and ability to apply the model effectively in the classroom setting.

The findings of this study strengthen the argument that PBL is a promising model for developing scientific thinking from an early age, as it aligns with the goals of elementary science education. Nonetheless, the success of PBL greatly depends on teacher readiness and the availability of appropriate learning resources. Therefore, future research should explore broader subject areas and adopt more varied methodological approaches. It is also necessary to provide targeted professional development and training for teachers to ensure that the implementation of PBL in the classroom can be optimized and aligned with educational objectives at the elementary school level.

Author Contributions

Lailika Sukmawati: Conceptualization, Methodology, Data curation, Formal analysis, Writing – Original Draft.

Dr. Candra Utama, M.Pd: Supervision, Review & Editing, Validation, Consultation and Feedback during revisions.

All authors have equal contributions to the paper. All the authors have read and approved the final manuscript.

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The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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