

Literature Review: The use of PjBL-Based Teaching Materials Integrated with STEAM to Improve Science Literacy of Elementary School Students

Balgis Miftahul Jannah¹, Agung Purwanto², Ika Lestari³

^{1,2,3}Master of Basic Education, State University of Jakarta, Indonesia

balgisjanah@gmail.com

Abstract: The purpose of this study was to analyze the use of PjBL-Based Teaching Materials Integrated with STEAM to improve science literacy of elementary school students. The method used is descriptive qualitative using literature study as a data collection technique. PjBL integrated with STEAM is a global educational trend that fosters interdisciplinary collaboration and cultivates student creativity. The use of PjBL-based teaching materials integrated with STEAM at elementary schools can help increase the interest in learning science among elementary school students, so that they are more motivated to study science and develop science skills. Also, The STEM-PjBL learning model implementation in this research has demonstrated its effectiveness in enhancing science literacy, promoting interactive learning, boosting enthusiasm, facilitating subject matter comprehension, and cultivating creative attitudes. The research findings demonstrate that PjBL-based teaching materials integrated with STEAM empower students to confront future challenges. This review synthesizes findings from various studies to identify best practices that foster literacy, critical thinking, problem-solving skills, and innovation among elementary school students. The overall analysis provides in-depth insights into transforming elementary schools into innovation hubs, equipping students to face future challenges and honing their literacy skills through the PjBL-STEAM education approach.

Keywords: PjBL, Scientific Literacy, STEAM.

Article History:

Received: 30-04-2025

Online : 23-05-2025



This is an open access article under the [CC-BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) license

----- ◆ -----

A. INTRODUCTION

Education in the 21st century impacts multiple facets of life and demands a diverse set of skills to navigate the evolving landscape, including rapid developments in science and technology. Skills for the 21st century are now a major emphasis in education, especially in science education (Nisrina et al., 2020). Elementary education is a crucial foundation in shaping students' literacy skills. The application of scientific knowledge is a fundamental requirement in science education, yet it remains suboptimally addressed in schools (Fuadi et al., 2020).

Scientific literacy involves the ability to scientifically define and understand phenomena (Afriana et al., 2016). Scientific literacy generally focuses on four interrelated aspects: knowledge, context, competence, and attitude (Nisrina et al., 2020). The knowledge aspect

consists of: mastery of basic scientific material, namely physical systems, living systems, and technological systems; knowledge about science, including understanding of inquiry and the ability to provide scientific explanations (Yuliati, 2017).

Elementary education is a crucial foundation in shaping students' literacy skills. Scientific literacy is the ability of an individual to apply knowledge to define questions, construct new knowledge, provide scientific explanations, draw conclusions based on scientific evidence, and develop reflective thinking patterns to engage in discussions and debates about scientific questions and ideas (OECD, 2019). The general purpose of scientific literacy is to improve the quality of human resources so that they can thrive in the current era. Research indicates that the scientific literacy level of Indonesian students remains relatively low to average (Mazidah & Suwarna, 2024; Wibowo, 2021). The role of scientific literacy is crucial in facing the dynamics of environmental and societal changes. Scientific literacy is often referred to as being 'science-literate' (Wibowo, 2021).

The PISA evaluation is conducted every three years to assess education systems by measuring the performance of students in basic education, particularly in three main areas: mathematics, science, and literacy. Referring to the results of the 2022 PISA assessment, Indonesia ranked 67th out of 81 participating countries in the science domain, with an average score of 383 (OECD, 2023). To enhance students' scientific literacy, learning methods are needed that can prepare students to have good competence in science and technology, think logically, critically, and creatively, argue correctly, communicate effectively, and collaborate with others.

A potential solution to improve students' scientific literacy is to develop project-based learning materials that integrate STEAM. The STEM-PjBL model has been shown to positively influence students' scientific literacy abilities (Winarno & Maulana, 2020). Through the PjBL model, students are guided to discuss and collaborate in analyzing environmental issues and finding solutions to environmental problems. Also, Students explore, assess, interpret, synthesize, and explore information to produce various forms of learning outcomes (Tohir, 2019). The PjBL learning model is applied by linking learning materials with real conditions that exist in the student environment (Wahyuni & Rahayu, 2021).

The implementation of the PjBL model can be integrated with the STEM approach in classroom learning. The National Science Foundation (NSF) initially developed the STEAM approach by adding Arts to the existing STEM fields of Science, Technology, Engineering, and Mathematics (Ramadhana et al., 2022). The STEAM approach is able to improve learning outcomes and creative thinking skills in students through creating and designing product activities. The PjBL-STEAM model has several stages, including: posing essential questions, designing projects, creating schedules, monitoring students during project development and tracking progress, conducting tests and evaluating project results, and evaluation. The integration of PjBL-STEAM has a positive impact on students' critical thinking skills (Priantari et al., 2020). The PjBL-STEAM model focuses students on collaborating to investigate environmental issues (Nurfadhillah, S., Nurfalah, K., Amanda, M., Kauniyah, N., & Anggraeni, 2021).

Through STEAM-integrated project-based learning, students are guided to apply knowledge in real-world contexts, enabling them to develop critical thinking skills and solve problems by identifying goals and finding appropriate solutions. By using PjBL, students are expected to experience the relevance of the material to real life, with challenges to solve real-world problems through projects and investigative questions. Students are given opportunities to explore various sources of information, such as websites, books, field observations, and interviews with relevant resource persons (Halimah, 2022). Project-based learning materials integrated with STEAM can facilitate active and engaging learning experiences, enhance students' understanding of the material, and foster critical and creative thinking skills in tackling real-world (Afriana et al., 2016; Triana et al., 2020).

The purpose of this review is to analyze the use of STEAM-integrated PjBL teaching materials to improve the scientific literacy skills of elementary school student. This study also aims to provide policy recommendations to support the large-scale implementation of PjBL-STEAM in Indonesia. This study uses a literature review consisting of empirical research that has been tested and published in reputable national and international journals. Through this learning model, students are expected to improve their scientific literacy skills, facilitate teachers and students in the learning process, and keep pace with the 21st century in education.

B. METHOD

This research uses a descriptive qualitative method with a literature study as a data collection technique. The descriptive qualitative method is used to gain an in-depth understanding of the PjBL learning model integrated with STEAM to improve the scientific literacy skills of elementary school students. This process involves identifying, evaluating, and integrating relevant articles, including international and national publications from the past 10 years. The descriptive qualitative method is used to describe a phenomenon or event in detail and in-depth by paying attention to the context and related situations (Creswell, 2019). Data analysis involved a thorough review of prior research and relevant documents to deepen the understanding of how integrating STEAM with PjBL can enhance scientific literacy among elementary school students. Thus, the descriptive qualitative method using a literature study is the right method to answer the problem formulation in this research.

C. RESULTS AND DISCUSSION

Based on the literature review that combines previous studies, it is evident that the implementation of the PjBL-STEAM integrated model can improve students' scientific literacy skills. Implementing the PjBL-STEAM model can enhance students' scientific literacy skills (Rosiningtias et al., 2023). The following presents relevant research findings on PjBL integrated with STEAM to enhance scientific literacy skills of elementary school students.

Table 1. Collection of Srticles to Analyze

No	Name & Year	Title	Result
1	Afriana et al., (2016)	Implementation of Project-Based Learning Integrated with STEM to Enhance Students' Scientific Literacy Viewed from a Gender Perspective	In terms of scientific attitude, the female class differed significantly from the male class. Overall, student responses indicated that almost all students enjoyed the PjBL-STEM learning experience and gained memorable experiences throughout the learning stages, which motivated and sparked their interest in learning."
2	Winarno & Maulana, (2020)	The Implementation of Project Based Learning (Pjbl) Based on STEM: A Reflection of Concept and Reality Within Learning Process in Business Department of Vocational High School	The research results show that the implementation of the STEM-based Project-Based Learning (PjBL) model provides benefits in strengthening student learning outcomes.
3	Nisrina et al., (2020)	Development Of Worksheet Based on Blended Learning to Improve Students' Scientific Literacy	The results of the development of LKPD based on blended learning that have been applied to natural science learning have an effect in the form of an increase in students' scientific literacy on material magnetism by 80%. This worksheet is very effective and practical in learning today and can be used for learning with 21st century learning models.
4	Anggreni et al., (2020)	The Effect of Project-Based Learning Model Assisted by Portfolio Assessment on Scientific Literacy	model Project Based Learning assisted by an influential portfolio assessment had an effect of the science literacy on fifth grade elementary students of Cluster IV in Sawan Subdistrict.
5	Atiaturrahmaniah et al., (2022)	The Role of Science, Technology, Engineering, Arts, and Math (STEAM) Model in Enhancing Critical	STEAM education helps address the problem by fostering critical thinking and scientific literacy,

No	Name & Year	Title	Result
		Thinking and Scientific Literacy of Elementary School Students.	leading to improved competency development in students.
6	Kumalasari & Hasanah, (2023)	Evaluating The Implementation of Steam-Based Pjbl in Ipas Learning for Grade 5 Elementary School.	The STEAM approach has proven to encourage students to learn and explore all their abilities in their own unique ways.
7	Ramadhan, (2023)	Steam-Based Learning Through Project-Based Learning (PjBL) to Enhance Elementary School Students' Scientific Literacy	PjBL-based STEAM implementation significantly enhances students' scientific literacy, with students exhibiting better conceptual understanding, observational skills, critical thinking, and communication skills compared to those in traditional learning settings
8	Khoiriya et al., (2023)	Implementation of Steam Approach in Science Learning to Enhance Critical Thinking Skills and Scientific Literacy of 4th Grade Students at SD Anak Saleh Malang	These findings affirm that the STEAM approach can be an effective strategy in enhancing students' critical thinking and scientific literacy skills while providing insights for the development of more innovative science education methods in the future.
9	Permatasari et al., (2023)	Implementation of Project-Based Learning (PjBL) Model to Enhance Scientific Literacy in Science Learning at Elementary Schools	The goal of helping students build their scientific literacy can be effectively achieved by using contextual learning strategies that are constructivist in nature and consistently connect what is learned to real-world situations.
10	Putri et al., (2024)	Literature Review: Practices and Research Findings on Steam Implementation in Elementary Schools	The national study reveals a significant increase in the implementation of the STEAM approach integrated with local cultural contexts and needs, showcasing various innovative methods that support the achievement of national education goals

In the 21st century, scientific literacy has become a crucial skill. The findings from several articles suggest that elementary school students' scientific literacy can be enhanced through the use of an innovative learning model, namely the PjBL model integrated with STEAM. STEM education provides students with opportunities to learn science, mathematics, and engineering through solving problems that are relevant to the real world (National Research Council, 2012). STEM education is essential for addressing global challenges such as environmental protection, clean water, and food security. The implementation of the PjBL-STEAM model to enhance students' scientific literacy can be examined from a gender perspective, where both male and female students show positive responses and enjoyment towards learning using the PjBL-STEAM model. Students enjoy working in groups (Afriana et al., 2016).

The PjBL learning model with the STEM approach can improve student learning outcomes because in the learning process students are required to be active in solving problems and making projects monitored by the teacher (Winarno & Maulana, 2020). Through the integration of the four disciplines, the STEM approach encourages students to develop problem-solving skills in various contexts. The availability of supporting facilities plays a crucial role in determining the success of learning objectives. By avoiding obstacles, the combination of PjBL and STEM can be a suitable choice.

Other research findings suggest that to improve students' scientific literacy, teaching materials such as LKPD (Lembar Kerja Peserta Didik/Student Worksheet) based on blended learning can also be utilized. This LKPD focuses not only on students' ability to solve problems but also on their ability to read and analyze phenomena scientifically through an inquiry model integrated into the scientific inquiry process (Nisrina et al., 2020). LKPD with a blended learning approach can be an effective tool for students to draw accurate conclusions based on the data they obtain.

Assessment of scientific literacy is a crucial component in learning and education. The perspective of scientific literacy encompasses a broad understanding of science that goes beyond mere subject concepts and scientific investigation procedures. Therefore, students must be serious in learning science, as it is essential for understanding the natural environment and our surroundings, with the goal of improving scientific literacy among elementary school students (Anggreni et al., 2020).

Based on the research findings, scientific literacy can be improved by using the PjBL model assisted by portfolio assessment. Through this model, students are very happy in learning, becoming more active and enthusiastic about participating in the learning process. This is because elementary school students inherently enjoy concrete activities that can convince them that they can do and accomplish things on their own.

The STEAM model is implemented systematically by integrating Science, Technology, Engineering, Arts, and Mathematics as a medium to develop inquiry, communication, and critical thinking skills in students during the learning process (Atiaturrahmaniah et al., 2022). The project-based STEAM model is highly relevant to implement, as it provides students with ample time to work on tasks, allowing them to better explore their potential

(Rahmawati et al., 2022). With STEAM, students can enhance their ability to solve problems and manage data in science and mathematics learning. The STEAM learning model helps students enhance their scientific and technological literacy, evident in their ability to read, write, observe, and conduct experiments, as well as apply these skills in everyday life related to STEAM fields.

Introducing STEAM can be done by creating a safe and enjoyable learning environment. Providing opportunities for children to explore, discover, build, conduct experiments, predict, seek temporary answers, and connect knowledge to real-life situations (Marwiyah, 2022). The STEAM model, which combines four fields of science in thematic learning, facilitates the application of basic concepts to everyday problems, influencing students' success in comprehension and critical thinking by motivating them to understand the material (Prasetya et al., 2022).

STEAM enables students to explore and develop their potential in a more optimal and personalized way. The STEAM-based project approach can enhance learning processes and outcomes in multiple subjects, beyond just evaluation (Kumalasari & Hasanah, 2023). Project-Based Learning (PjBL) with a STEAM approach is a learning model designed to position students as the center of learning, emphasizing a process that culminates in a tangible product (Wahyuningsih et al., 2020).

Project-Based Learning (PjBL) with a STEAM approach can enhance students' scientific literacy skills. The effective application of the STEAM model necessitates active student involvement and self-motivation to attain optimal outcomes (Ramadhan, 2023). Project Based Learning (PjBL) is an approach in learning that involves students in activities centered on complex projects or tasks (Syahlan et al., 2023). Project-based learning with a STEM approach enhances students' creative thinking skills and improves their science learning outcomes (Dewi et al., 2023).

Scientific literacy involves utilizing scientific knowledge to recognize issues and make informed conclusions based on evidence, thereby understanding the natural world and human-induced changes (OECD, 2019). Scientific literacy involves understanding and applying scientific concepts in daily life, including the skills to communicate scientific ideas, solve problems, and utilize scientific knowledge for the benefit of individuals and society (Khoiriya et al., 2023). This study found that using the STEAM approach can improve students' scientific literacy. With STEAM, elementary school students can develop critical thinking skills and scientific literacy skills to identify, analyze, and solve problems related to force and its applications.

D. CONCLUSIONS AND SUGGESTIONS

Scientific literacy generally focuses on four interrelated aspects: knowledge, context, competence, and attitude. The knowledge aspect consists of: mastery of basic scientific material, namely physical systems, living systems, and technological systems; knowledge about science, including understanding of inquiry and the ability to provide scientific explanations. The STEM-PjBL model has been shown to positively influence students'

scientific literacy abilities. Through the PjBL model, students are guided to discuss and collaborate in analyzing environmental issues and finding solutions to environmental problems. The implementation of Project-Based Learning (PjBL) integrated with STEAM (Science, Technology, Engineering, Art, and Mathematics) can enhance the scientific literacy skills of elementary school students. Through PjBL integrated with STEAM, students can develop critical thinking skills, identify problems, analyze data, and draw conclusions based on scientific evidence. Additionally, this approach can also improve students' ability to communicate science and apply scientific knowledge in everyday life. The PjBL model integrated with STEAM can be implemented by teachers in elementary science education to enhance students' scientific literacy. The science curriculum in elementary schools can be developed to incorporate the PjBL approach integrated with STEAM to improve students' scientific literacy skills.

ACKNOWLEDGMENTS

The researcher would like to express gratitude to the advisor who has provided guidance and direction in this proceeding article. And thank you to all parties who have helped and contributed to the making of this article.

REFERENCES

- Afiana, J., Permanasari, A., & Fitriani, A. (2016). Penerapan Project Based Learning Terintegrasi STEM untuk Meningkatkan Literasi Sains Siswa ditinjau dari Gender. *Jurnal Inovasi Pendidikan IPA*, 2(2), 202. <https://doi.org/10.21831/jipi.v2i2.8561>
- Anggreni, L. D., Jampel, I. N., & Diputra, K. S. (2020). Pengaruh Model Project Based Learning Berbantuan Penilaian Portofolio Terhadap Literasi Sains. *Mimbar Ilmu*, 25(1), 41. <https://doi.org/10.23887/mi.v25i1.24475>
- Atiaturrahmaniah, A., Bagus, I., Aryana, P., & Suastra, I. W. (2022). Peran Model Science, Technology, Engineering, Arts, and Math (STEAM) dalam Meningkatkan Berpikir Kritis dan Literasi Sains Siswa Sekolah Dasar. *JPGI (Jurnal Penelitian Guru Indonesia)*, 7(2), 368-375.
- Creswell, J. W. (2019). *A concise introduction to mixed methods research*. SAGE publications.
- Dewi, N. N. S. K., Arnyana, I. B. P., & Margunayasa, I. G. (2023). Project Based Learning Berbasis STEM: Meningkatkan Kemampuan Berpikir Kritis dan Hasil Belajar Siswa. *Jurnal Ilmiah Pendidikan Profesi Guru*, 6(1), 133-143. <https://doi.org/10.23887/jippg.v6i1.59857>
- Fuadi, H., Robbia, A. Z., Jamaluddin, J., & Jufri, A. W. (2020). Analisis Faktor Penyebab Rendahnya Kemampuan Literasi Sains Peserta Didik. *Jurnal Ilmiah Profesi Pendidikan*, 5(2), 108-116. <https://doi.org/10.29303/jipp.v5i2.122>
- Halimah, L. (2022). *Project Bsed Learning untuk Pembelajaran Abad 21*. PT. Refika Aditama.
- Khoiriya, R. M., Oktariano, M. L., & Rohmiati, D. P. (2023). Penerapan Pendekatan Steam Dalam Pembelajaran Ipa Untuk Meningkatkan Keterampilan Berpikir Kritis Dan Literasi Sains Siswa Kelas IV SD Anak Saleh Malang. *JTIEE*, 7(2), 142-147.
- Kumalasari, K., & Hasanah, D. (2023). Evaluasi Pelaksanaan PjBL Berbasis STEAM dalam Pembelajaran IPAS SD Kelas V. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, 08(03).
- Marwiyah, M. (2022). *Analisis Pembelajaran STEAM (Science, Technology, Engineering, Art, and Mathematics) untuk Menanamkan Keterampilan 4C (Communication, Collaboration, Critical*

- Thinking and Problem Solving, and Creativity and Innovation*) pada Anak Usia Dini (Vol. 33, Issue 1). Universitas Islam Negeri Sultan SYarif Kasim Riau.
- Mazidah, L. N., & Suwarna, I. P. (2024). Meta Analisis Kemampuan Literasi Sains pada Mata Pelajaran Fisika. *Ideguru: Jurnal Karya Ilmiah Guru*, 10(1), 381–388.
- National Research Council. (2012). *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. The National Academies Press.
- Nisrina, N., Jufri, A. W., & Gunawan. (2020). Pengembangan LKPD Berbasis Blended Learning untuk Meningkatkan Literasi Sains Peserta Didik. *Pijar MIPA*, 15(3), 192–199. <https://doi.org/10.29303/jpm.v15i3.1880>
- Nurfadhillah, S., Nurfalah, K., Amanda, M., Kauniyah, N., & Anggraeni, R. (2021). Penerapan Media Visual Untuk Siswa Kelas V Di SDN Muncul 1. *EDISI*, 3(2), 225–242.
- OECD. (2019). *PISA 2018 Results (Volume I): What Students Know and Can Do: Vol. I*. <https://doi.org/10.1787/5f07c754-en>
- OECD. (2023). *PISA 2022 Results (Volume I)*. OECD. <https://doi.org/10.1787/53f23881-en>
- Prasetya, P. M., Parmiti, D. P., & Bayu, G. W. (2022). TERPIKIR STEM : Instrumen Berorientasi Pendekatan STEM Tes Berpikir Kritis. *Jurnal Ilmiah Pendidikan Profesi Guru*, 5, 363–371.
- Priantari, I., Prafitasari, A. N., Kusumawardhani, D. R., & Susanti, S. (2020). Improving Students Critical Thinking through STEAM-PjBL Learning. *Bioeducation Journal*, 4(2), 94–102. <https://doi.org/10.24036/bioedu.v4i2.283>
- Rahmawati, L., Juandi, D., & Nurlaelah, E. (2022). Implementasi STEM dalam Meningkatkan Kemampuan Berpikir Kritis dan Kreatif Matematis. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, 11(3), 2002–2014.
- Ramadhan, W. (2023). Pembelajaran Berbasis Pendekatan STEAM Melalui Project-Based Learning (PjBL) untuk Meningkatkan Literasi Sains Siswa Sekolah Dasar. *Jurnal Kependidikan Dasar Islam Berbasis Sains*, 8(2).
- Ramadhana, S. D., Norra, B. I., & Rasyida, N. (2022). Keefektifan Perangkat Pembelajaran Daring dengan Model PjBL-STEAM pada Materi Lingkungan untuk Meningkatkan Literasi Lingkungan. *Jurnal Pendidikan (Teori Dan Praktik)*, 6(2), 75–81. <https://doi.org/10.26740/jp.v6n1.p75-81>
- Rosiningtias, W., Rosana, D., Ningseh, E. L., Jumadi, J., & Wilujeng, I. (2023). Junior High School Students ' Problem Solving Skill : PBL- STEM Model Implementation. *Jurnal Penelitian Pendidikan IPA*, 9(9), 6765–6771. <https://doi.org/10.29303/jppipa.v9i9.4259>
- Syahlan, I. D., Hidayat, D. R., & Hidayat, O. S. (2023). Application of the Project Based Learning Model in Elementary Schools: Obstacles and Solutions of Science and Environment Content. *Jurnal Penelitian Pendidikan IPA*, 9(4), 2060–2067. <https://doi.org/10.29303/jppipa.v9i4.3285>
- Tohir, M. (2019). *Materi Pelatihan Implementasi Kurikulum 2013*. <https://doi.org/https://doi.org/10.31219/osf.io/dp79n>
- Triana, D., Anggraito, Y. U., & Ridlo, S. (2020). Effectiveness Environmental Change Learning Tools Based on STEM-PjBL Towards Students' Collaboration and Communications Skills Article Info. *Journal of Innovative Science Education*, 9(3), 244–249.
- Wahyuni, L., & Rahayu, Y. S. (2021). Pengembangan E-book Berbasis Project Based Learning (PjBL) untuk Melatihkan Kemampuan Berpikir Kreatif pada Materi Pertumbuhan dan Perkembangan Tumbuhan Kelas XII SMA. *BioEdu: Berkala Ilmiah Pendidikan Biologi*, 10(2), 314–325.
- Wahyuningsih, S., Nurjanah, N. E., Rasmani, U. E. E., Hafidah, R., Pudyaningtyas, A. R., & Syamsuddin, M. M. (2020). STEAM Learning in Early Childhood Education: A Literature Review. *International Journal of Pedagogy and Teacher Education*, 4(1), 33. <https://doi.org/10.20961/ijpte.v4i1.39855>

- Wibowo, A. (2021). Analisis Literasi Sains Siswa Sekolah Dasar Pada Kasus Pandemi Covid-19. *Jurnal Educatio FKIP UNMA*, 7(2), 515-519. <https://doi.org/10.31949/educatio.v7i2.1107>
- Winarno, A., & Maulana, A. (2020). The Implementation of Project Based Learning (PjBL) Based on STEM: A Reflection of Concept and Reality within Learning Process in Business Department of Vocational High School. *Jurnal Pendidikan Bisnis Dan Manajemen*, 6(2), 78-86. <https://doi.org/10.17977/um003v6i22020p078>
- Yuliati, Y. (2017). Literasi Sains dalam Pembelajaran IPA. *Cakrawala Pendidikan*, 3(2). <https://doi.org/10.20961/prosidingsnfa.v2i0.16408>