JPPIPA 12(5) (2026)

Jurnal Penelitian Pendidikan IPA

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

The Effectiveness of Problem Based Learning Integrated with Local Wisdom in Enhancing Students' Scientific Literacy: A Systematic Literature Review

Hikmah Cahya Utami[1*], Yuni Sri Rahayu[2], Sifak Indana[2]

[1] Department of Science Education, Universitas Negeri Surabaya, Indonesia.
[2] Department of Biology Education, Universitas Negeri Surabaya, Indonesia.

Received: March 11, 2026
Revised: April 27, 2026
Accepted: May 25, 2026
Published: May 31, 2026

Corresponding Author:
Hikmah Cahya Utami
20030795021@mhs.unesa.ac.id

DOI: 10.29303/jppipa.v12i5.14792

Abstract: This study aims to analyze the effectiveness of implementing Problem Based Learning (PBL) integrated with local wisdom in improving students' scientific literacy in science and biology learning. Studies examining the integration of PBL and local wisdom in relation to scientific literacy remain limited; therefore, this research was conducted to provide a comprehensive overview of research trends and their impact on learning. This study employed a Systematic Literature Review (SLR) method following the PRISMA guidelines. Data were collected through article searches in the Google Scholar, DOAJ, Portal Garuda/SINTA, and Scopus databases, covering publications from 2020 to 2025. Based on the processes of identification, screening, and selection, 45 articles met the inclusion criteria. The data were analyzed qualitatively and strengthened through bibliometric mapping using VOSviewer. The findings indicate that the implementation of PBL integrated with local wisdom is effective in improving students' scientific literacy through investigation activities, problem-solving, and discussions based on local contextual phenomena. The most frequently studied topics include ecology, interactions between living organisms and their environment, and biotechnology. Bibliometric analysis also revealed a strong relationship among the keywords "PBL," "local wisdom," and "scientific literacy." These findings contribute to the development of contextual, meaningful, and relevant science learning that aligns with students' daily lives.

Keywords: Local wisdom; Problem based learning (PBL); Science literacy

Introduction

Education is a fundamental pillar in developing high-quality and competitive human resources amid global dynamics. Today's education must adapt to the developments of the 21st century in order to enhance competencies in accordance with increasingly complex and dynamic demands. The 21st century is characterized by the abundance of information and easy access to it, leading to a shift in learning paradigms toward student-centered learning that focuses on learners' characteristics and needs to achieve competencies in knowledge, attitudes, and skills (Mahrunnisya, 2023). The essential 21st-century skills are commonly known as the 4C: critical thinking, creativity, communication, and collaboration.

The relationship between the 4Cs and scientific literacy lies in the mastery of these skills. Scientific literacy encourages individuals to think critically, creatively, innovatively, and analytically (Dewi et al., 2024). In the context of 21st-century learning, which requires mastery of the 4Cs, achieving these goals demands scientific knowledge, the ability to adapt to technological developments, and innovative thinking, all of which are fundamentally supported by scientific literacy skills (Sureni, 2023). Scientific literacy includes knowledge, conceptual understanding, data interpretation, and the strengthening of scientific

How to Cite:
Utami, H. C., Rahayu, Y. S., & Indana, S. (2026). The Effectiveness of Problem Based Learning Integrated with Local Wisdom in Enhancing Students' Scientific Literacy: A Systematic Literature Review. *Jurnal Penelitian Pendidikan IPA*, *12*(5), 123–136. https://doi.org/10.29303/jppipa.v12i5.14792

processes and attitudes to support decision-making, socio-cultural participation, and economic productivity (Januarti et al., 2024). Therefore, scientific literacy is crucial for addressing environmental challenges related to scientific issues at local, national, and global levels, enabling students to develop sustainable and ethical environmental awareness (Wulandari, 2025). The urgency of scientific literacy is closely related to individuals' ability to comprehensively understand scientific concepts and processes, make appropriate decisions, actively participate in discussions, and solve everyday problems rationally and evidence-based (Khery, 2020).

However, these expectations contrast with the results of the Programme for International Student Assessment (PISA), which showed a decline in Indonesia's average scientific literacy score from 396 in 2018 to 383 in 2022 (OECD, 2022). Although the 2022 PISA survey indicated an improvement in Indonesia's ranking in scientific literacy, the achievement remains relatively low globally. Indonesia ranked 66th out of 81 countries, reflecting students' limited ability to analyze science-based information. Scientific literacy assessed in PISA includes three main aspects: (1) explaining scientific phenomena, (2) evaluating and designing scientific inquiry, and (3) interpreting scientific data and evidence. According to Nuzula et al. (2022), one of the causes is students' limited experience in solving contextual problems and the suboptimal integration of scientific literacy into learning processes. This condition highlights the urgency of implementing more effective learning strategies and strengthening students' scientific thinking skills through authentic and meaningful learning experiences.

One potential solution for enhancing scientific literacy is the implementation of Problem Based Learning (PBL) integrated with local wisdom. PBL is a learning model that positions students at the center of the learning process through solving authentic problems relevant to real-life contexts, enabling them to acquire essential knowledge and concepts from the subject matter (Eka & Rahayu, 2025; Muliyadi et al., 2026). Through stages of problem identification, hypothesis formulation, information gathering and analysis, collaborative discussion, and evidence-based solution development, PBL is believed to strengthen scientific communication skills, collaboration, critical thinking, and students' independent learning, making learning more meaningful and contextual (Fatonah et al., 2026).

The implementation of PBL positively impacts students' ability to understand scientific concepts, interpret data, and solve problems independently and collaboratively through inquiry and scientific discussion processes (Ramadhani et al., 2026). The stages of PBL correspond to indicators of scientific literacy, particularly in explaining scientific phenomena, using evidence as the basis for arguments, and developing scientific thinking skills. This aligns with the OECD scientific literacy framework, which emphasizes the importance of critical thinking and problem-solving based on real-world contexts (Lendeon, 2022). Consequently, the relationship between PBL stages and scientific literacy aspects makes this model effective in improving students' scientific literacy skills (Utami, 2022).

Nevertheless, PBL also has limitations. If students are not confident that the problems being studied can be solved, they may hesitate to engage in the learning process. Therefore, integrating local wisdom into PBL becomes highly relevant, as it connects learning materials with local cultural values, traditions, and community social practices. This enables students to relate problems to their surrounding culture and believe they can solve them by scientifically collecting and analyzing information derived from local wisdom practices (Yulianto, 2022). When such values are used as learning resources, learning becomes more relevant, grounded, and meaningful for students (Ramadani, 2025). The integration of PBL and local wisdom is expected not only to improve students' conceptual understanding but also to strengthen their character and environmental awareness based on local culture (Awaluddin, 2025). Local wisdom serves as a learning context that can enhance scientific literacy because it encourages students to logically explore contextual phenomena and apply scientific knowledge to explain and solve everyday life problems (Erman, 2024).

The syntax of PBL is closely related to scientific literacy competencies. In the problem orientation stage, students are trained to explain phenomena scientifically based on the given problems. In the organizing stage, students develop these competencies by formulating problems and identifying learning needs. During the investigation stage, students are trained to design and evaluate investigations and interpret scientific data and evidence. These skills are further strengthened during the presentation stage, where students construct and communicate data-based solutions. In the evaluation stage, students reinterpret scientific evidence more deeply to assess the effectiveness of the proposed solutions (Kurniati, 2023). This is further supported by Hidayanti (2020), who found that learning based on local wisdom and PBL can improve students' scientific literacy.

However, the implementation of these two approaches in the context of biology education in Indonesia remains limited and has not been systematically studied. Most previous studies focused separately on PBL or local wisdom, thus failing to provide a comprehensive understanding of the

effectiveness of integrating both approaches in enhancing scientific literacy. Therefore, this study is important to fill this gap through a systematic review of various studies discussing the implementation of PBL integrated with local wisdom and its impact on students' scientific literacy skills. The limited number of integrative studies may be attributed to the differing focuses of each approach: PBL emphasizes investigation, problem-solving, and product development, while local wisdom focuses on cultural values, social practices, and community environmental contexts. Integrating these approaches requires more complex instructional designs because they must connect scientific concepts with local cultural contexts while simultaneously developing students' abilities to understand, evaluate, and communicate scientific information. As a result, studies examining PBL integrated with local wisdom in biology education to enhance scientific literacy remain relatively limited and have not yet been systematically mapped.

Biology is a branch of science that studies living organisms and their environment (Azizah & Alberida, 2021). Biology learning provides students with direct and meaningful learning experiences to scientifically understand their surrounding environment. Biological topics related to humans, animals, plants, microorganisms, and their environments are closely connected to everyday life, making them highly suitable for integration with local cultural contexts and community practices.

PBL and local wisdom have a strong relationship in biology learning because both connect scientific concepts with real-life contexts. Local wisdom helps students understand biological phenomena through cultural practices, values, and local community knowledge, while PBL facilitates students in exploring these problems through investigation activities and project-based product development. Their integration encourages students to think contextually, increases environmental awareness, and develops scientific literacy through the ability to understand, evaluate, and communicate scientific information in everyday life. In line with this perspective, this study focuses on analyzing the effectiveness of implementing PBL integrated with local wisdom in enhancing scientific literacy in biology learning through a systematic literature review

Method

Research Design

This study employed a Systematic Literature Review (SLR) to examine the implementation of Problem Based Learning (PBL) integrated with local wisdom in improving scientific literacy in science and biology education in Indonesia. The search process was divided into several stages, including identification, screening, eligibility, and inclusion. These stages followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. PRISMA is an evidence-based minimum set of reporting guidelines designed to assist researchers in systematically reporting systematic reviews and meta-analyses. The guidelines emphasize transparency and completeness of information at every stage of the research process, from literature searching and study selection to the synthesis of findings, thereby producing reports that are clearer, traceable, and easier to replicate (Sastypratiwi & Nyoto, 2020).

Data Collection

The literature search was conducted through several databases, including Google Scholar, DOAJ, Portal Garuda/SINTA, and Scopus, covering publications from 2020 to 2026. The keywords used included "Problem Based Learning," "PBL," "local wisdom," "scientific literacy," "biology education," and "science education." Keyword combinations were applied using Boolean operators, for example: ("Problem Based Learning" OR "PBL") AND ("local wisdom") AND ("scientific literacy") AND (biology OR science).

The inclusion criteria were specifically established to ensure that the selected articles were relevant to the objectives of the study, namely: (1) articles published between 2020 and 2026; (2) studies employing experimental, quasi-experimental, or qualitative research designs; (3) research subjects consisting of elementary, junior high, senior high school students, or university students; (4) studies discussing the implementation of PBL, local wisdom, or the integration of PBL and local wisdom in biology or science learning; (5) articles presenting empirical data in the form of scientific literacy test results, observations, interviews, or learning document analyses; and (6) articles published in peer-reviewed journals in either Indonesian or English.

The exclusion criteria included: articles that did not present empirical data; studies conducted outside the context of biology or science learning; conference proceedings, project reports, theses, dissertations, or non-peer-reviewed preprints; and duplicate articles retrieved from different databases.

Relevance assessment was conducted by examining the title, abstract, and research objectives to ensure that the articles addressed Problem-Based Learning (PBL), local wisdom, or the integration of both in science/biology education, as well as the measurement of scientific literacy. The research quality assessment encompassed the appropriateness of the research design (experimental, quasi-experimental, or qualitative),

clarity of data collection procedures, reporting of scientific literacy measurement instruments, accuracy of data analysis, and publication status in reputable journals. Articles were categorized as having empirical data if they presented data collection results obtained through research instruments—such as scientific literacy tests, observations, or interviews—in the form of either quantitative or qualitative data. Articles that did not present empirical data were excluded from the analysis.

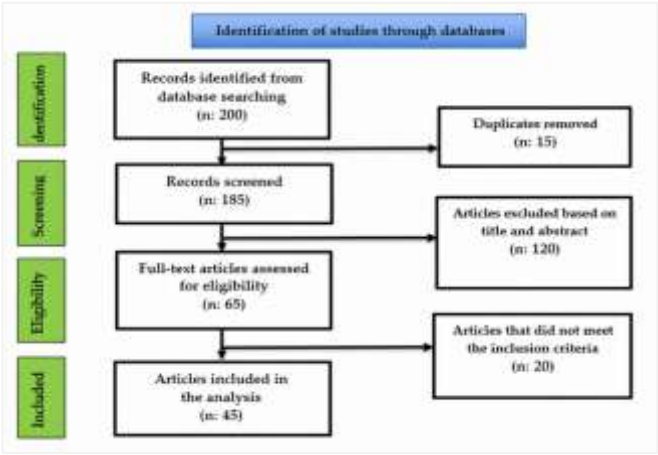

Figure 1. Research chart

The initial search yielded 200 articles relevant to the research variables. After screening based on the inclusion and exclusion criteria, a total of 45 articles met the requirements for further analysis. These articles were then evaluated based on methodological quality, clarity of research procedures, reporting of scientific literacy instruments, accuracy of data analysis, and the validity of the findings. Research instruments were utilized to establish the article selection criteria, specifically the inclusion and exclusion criteria. Initial data analysis was performed using VOSviewer software to map research trends and identify research gaps through network visualization. Relevant articles were selected based on thematic alignment, particularly regarding the title, abstract, and the quality of the research procedures and techniques employed. The obtained data were analyzed systematically, and the visualization results were subsequently interpreted to assess the effectiveness of implementing PBL integrated with local wisdom in cultivating scientific literacy. A literature review is a comprehensive study of articles, books, and other scholarly sources related to a specific research field or theory, containing both a descriptive summary and a critical evaluation of the work (Bancong, 2025).

The article selection process was carried out in several stages. In the identification stage, 200 articles were retrieved from various databases using relevant keywords. The screening stage involved removing duplicate articles, resulting in 185 unique articles. Next, during the eligibility stage, titles and abstracts were reviewed, leading to the exclusion of 120 irrelevant articles, leaving 65 articles. Further selection based on inclusion criteria aligned with the research variables such as a direct correlation with PBL integrated with local wisdom and the measurement of scientific literacy eliminated 20 articles that failed to meet the criteria. Consequently, 45 articles were determined as the final sample for analysis to gain a comprehensive understanding of the effectiveness of implementing PBL integrated with local wisdom in cultivating scientific literacy in science/biology education.

Data Analysis

The data analysis technique employed in this study was qualitative analysis. Qualitative data were obtained by studying topics related to the research and gathering or compiling data from various credible literature sources. The researcher compiled and collected data from studies relevant to the current research that also supported the research problems, sourced from various articles specifically regarding the relevance of the PBL model and local wisdom in enhancing scientific literacy from 2020 to 2026.

Result and Discussion

Based on the search results of 45 out of the 200 identified national and international articles, the selected papers were reviewed according to predetermined criteria, and the chosen journals were thoroughly analyzed by examining each section. The selection process was conducted with reference to the established inclusion and exclusion criteria. In this study, articles related to Problem-Based Learning, Local Wisdom, and Scientific Literacy were identified.

Table 1. List of Articles Reviewed in the SLR Study

Main Focus	Number of Article	Example Topics
PBL & Scientific Literacy	17	The effect of PBL on students' scientific literacy at elementary, junior, and senior high school levels
PBL + Local Wisdom	14	Integration of local culture/ethnoscience in learning
PBL & Critical Thinking	6	Improvement of critical thinking skills through PBL
Module/E-Module/LKPD Development	8	PBL-based e-modules, worksheets, and teaching material
Literature Review / SLR	4	Studies on the effectiveness of PBL and local wisdom
Learning Outcomes & Activities	5	The effect of PBL on students' learning outcomes

The relationships between the articles were revealed through an analysis of titles and abstracts that had been aligned with the research variables. Based on the mapping results obtained using the VOSviewer software, a visualization map was generated to display the interconnected variables across the articles. Terms that frequently co-occurred or shared similar meanings were subsequently mapped into the same cluster.

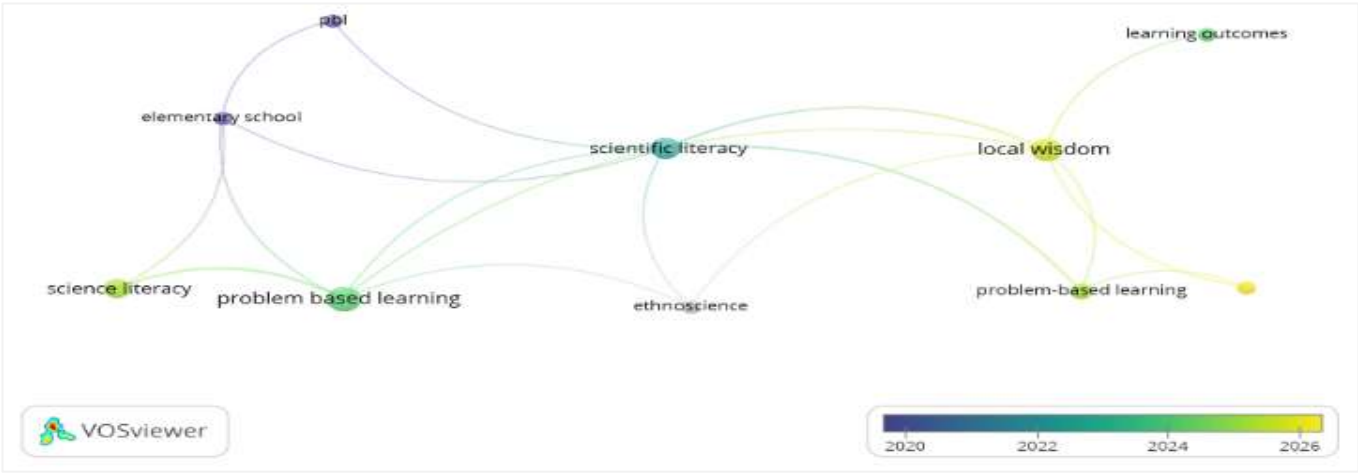

Figure 2. Visualization of keyword network results from VOSviewer analysis

The figure was created to identify and interpret research trends and gaps based on the color visualization of the keyword network. The colors in the VOSviewer visualization map indicate the average year of appearance for each keyword, thereby illustrating the development of research topics over time. Based on the literature analysis, the visualization map shows that the keyword clusters related to Problem-Based Learning (PBL), scientific literacy, and local wisdom have a strong correlation and are relatively interconnected within the network. This indicates that most studies focus on the integration of problem-based learning models with local wisdom contexts to enhance students' scientific literacy in science and biology education.

Furthermore, the visualization reveals a connection between the keyword "ethnoscience" and both "scientific literacy" and "problem-based learning," suggesting that some studies have begun to integrate local knowledge or ethnoscience into problem-based learning. This integration aims to link scientific concepts with cultural practices and environmental phenomena in society, making the learning process more contextual and meaningful for students. However, the visualization results also show several keywords positioned relatively further from the core cluster, such as "learning model," "science education," and "biology education." This indicates that research specifically examining the development of learning models or instructional materials based on PBL integrated with local wisdom within the context of science and biology education remains relatively limited.

Table 2. Keyword Clustering Based on VOSviewer Analysis

Cluster Color	Keyword	Cluster Description
Biru Tua	Problem-Based Learning	The dark blue cluster represents the core concept that serves as the centerpiece of the analyzed research. The keyword "Problem-Based Learning" (PBL) is positioned at the center of the network and is interconnected with several other variables, such as scientific literacy, local wisdom, and learning models. This indicates that PBL is the most dominant learning approach utilized in the reviewed studies. This model is employed to enhance students' active engagement through investigation and problem-solving activities related to real-world phenomena in science and biology education.
Green	PBL, Science Literacy	The green cluster illustrates the correlation between PBL and scientific literacy, focusing on the effectiveness of the problem-based learning model in enhancing students' ability to understand scientific concepts, analyze scientific phenomena, and apply science in daily life.
Light Blue	Scientific Literacy, Ethnoscience	The light blue cluster highlights the research focus on learning outcomes, specifically the development of students' scientific literacy. The keywords "scientific literacy" and "ethnoscience" demonstrate that the research focuses not only on the learning model but also on students' ability to comprehend scientific

Cluster Color	Keyword	Cluster Description
		concepts, interpret data, and utilize scientific evidence in decision-making. The presence of the ethnoscience concept signifies the integration of scientific knowledge with community-based local knowledge within the science learning process.
Yellow	PBL, Local Wisdom	The yellow cluster signifies the integration of local wisdom into the problem-based learning model. Studies within this cluster extensively discuss learning based on local cultural contexts to enhance conceptual understanding, critical thinking skills, scientific literacy skills, and student engagement in science education

Most research still focuses on testing the effectiveness of learning models in improving scientific literacy, while studies investigating the development of learning tools, implementation strategies, or evaluation of local context-based learning have not been widely conducted. The imbalance between the dominance of research on the effectiveness of Problem-Based Learning and the limited research on the systematic development of instructional materials and local wisdom integration highlights a significant research gap in this field. Therefore, future research needs to further examine the development of learning tools such as modules, student worksheets (LKPD), assessments, teaching materials, and digital learning media based on PBL integrated with local wisdom, along with implementation strategies that can optimally support the improvement of students' scientific literacy in science and biology education.

Based on the review of the analyzed articles, the most dominant research method employed was quantitative with an experimental design. In addition, several studies also utilized qualitative and Research and Development (R&D) approaches, depending on their respective research objectives. The following table summarizes the research methods and designs used in these studies.

Based on the analysis of the 45 selected articles, it was found that the quantitative research method was the most dominantly used approach, accounting for 28 articles. The majority of the studies utilizing this method applied experimental or quasi-experimental designs to test the effectiveness of implementing PBL integrated with local wisdom in enhancing various student skills, such as scientific literacy, critical thinking, and learning outcomes. Generally, these studies employed a pretest-posttest control group design and analyzed data using statistical tests such as t-tests, ANOVA, and N-Gain calculations to determine the improvement in students' abilities following the implementation of the learning model. Aside from the quantitative method, several articles adopted a qualitative approach—totaling 9 articles—which generally aimed to describe the learning process, analyze the implementation of problem-based learning models, or examine the integration of local wisdom (ethnoscience) in biology and science education. This approach typically utilized descriptive, case study, or classroom action research (CAR) designs to gain a deeper understanding of the classroom learning process. Furthermore, there were 4 articles that employed the Research and Development (R&D) method. These studies focused on developing instructional tools or teaching materials based on PBL and local wisdom, such as student worksheets (LKPD), electronic student worksheets (e-LKPD), modules, and lesson plans. The development designs used generally referred to the ADDIE, 4D (Define, Design, Develop, Disseminate), or Borg & Gall models. This R&D approach allows researchers to produce valid, practical, and effective instructional products for use in the science learning process. On the other hand, 4 articles utilized mixed methods. Overall, the dominance of the quantitative method with an experimental design indicates that most research in this field focuses on testing the effectiveness of both the PBL learning model and the integration of local wisdom in enhancing students' abilities, particularly in science education.

Table 3. Recapitulation of Research Methods

Research Method Type	Number of Articles	Description
Quantitative	28 Journal	Utilizes experimental designs, such as pretest-posttest formats.
Qualitative	9 Journal	Includes descriptive research, case studies, systematic reviews, reflective studies, and bibliometric studies that describe processes, trends, or conceptual findings
Research and Development	4 Journal	Focuses on product development using models such as ADDIE or 4D, which have been tested for validity and practicality.
Mixed Method	4 journal	Research that combines quantitative and qualitative methods within a single study

In addition, several articles utilized the Research and Development (R&D) method. This research design focuses on the process of developing and validating instructional products that can be used in classroom learning activities. The products developed in these studies generally consist of PBL-based learning tools integrated with local wisdom, such as student worksheets (LKPD), electronic student worksheets (e-LKPD), learning modules, and project-based learning materials. The development models used in these studies varied, including ADDIE, the 4D model (Define, Design, Develop, Disseminate), and Borg & Gall. This R&D approach allows researchers to produce learning materials that are not only conceptually valid but also practical and effective for implementation in the learning process.

Overall, the analysis results indicate that research on the application of PBL and the integration of local wisdom in science education remains largely dominated by quantitative approaches with experimental or quasi-experimental designs. Nevertheless, there is also an increase in the use of qualitative approaches and research and development (R&D) in several studies. This demonstrates a shift in research orientation that focuses not only on testing the effectiveness of learning models but also on developing contextual, local culture-based learning innovations that are relevant to the needs of science education in schools. Such approaches provide a more comprehensive understanding of how PBL integrated with local wisdom can enhance students' skills, such as scientific literacy, critical thinking, and creativity in science education.

Based on the data the recapitulation of research designs, the literature demonstrates a diverse range of methodologies tailored to specific educational objectives. The experimental design is the most predominant, utilized in 25 journals to rigorously test the effectiveness of various learning models. Descriptive designs are employed in 6 journals to illustrate students' scientific literacy skills naturally, without any experimental interventions. Furthermore, both Research and Development (R&D) and Classroom Action Research (CAR) designs are represented equally, with 5 journals each; R&D designs focus on developing, validating, and testing the practicality of instructional products such as digital learning materials, modules, and student worksheets (LKPD) while CAR designs are implemented to directly improve the teaching-learning process and resolve existing classroom issues. Finally, 4 journals utilize a literature review design, which serves to map current research trends and conceptual findings across the field. An analysis of 45 selected articles reveals distinct trends in the pedagogical approaches, subject topics, and educational levels examined in the literature. Regarding the instructional models utilized, 18 articles focused on Problem-Based Learning (PBL) as the primary approach, while 4 articles exclusively employed local wisdom as the foundation or context for learning.

Notably, the majority of the studies comprising 23 articles integrated PBL with local wisdom, making it the most dominant category. This strong preference for a collaborative approach suggests that combining PBL with local wisdom is highly regarded for creating contextual and meaningful learning experiences. This integration enables students to actively engage in problem-solving while simultaneously connecting scientific concepts with cultural practices, indigenous knowledge, and local environmental phenomena, thereby rendering lessons more relevant to their real lives. Synthesis of these studies indicates that both standalone PBL and its integration with local wisdom significantly enhance various student competencies, including scientific literacy, critical thinking, creativity, and overall learning outcomes. Problem-based frameworks inherently encourage active participation through scientific inquiry, group discussions, problem analysis, and the formulation of solutions to real-world challenges.

Cumulatively, these findings demonstrate a progressive shift in science education research toward merging innovative learning models with local cultural contexts, moving away from purely theoretical instruction toward more contextual, applicable, and student-centered learning. Despite this positive trend, research specifically exploring the intersection of PBL and local wisdom within the domain of scientific literacy or the development of culturally-embedded instructional tools remains relatively limited, presenting valuable opportunities for future investigation.

In terms of subject matter, the research topics span various science concepts, with Ecology and Biodiversity emerging as the most heavily investigated area, featuring in 7 articles. This is followed by 3 articles focusing on the interaction between living things and their environment, and 2 articles centering on biotechnology. The prominence of ecology suggests that researchers frequently select topics with direct ties to students' daily lives and immediate surroundings. Similarly, the selection of biotechnology highlights its strong connections to daily activities and traditional local practices, such as the production of fermented foods like tempeh, tape, yogurt, shrimp paste (*terasi*), fermented milkfish (bekasam), and organic fertilizers. Such topics allow students to conduct hands-on experiments rooted in local issues, making them highly compatible with the PBL framework. Meanwhile, topics like the interaction of living things with their environment, water pollution, and environmental change are also widely utilized because they help

students comprehend the relationships between organisms and their biotic or abiotic environments.

Through problem-based or project-based learning, students are trained to conduct direct observations, analyze environmental degradation or waste management issues, and formulate scientifically sound solutions. Other specific topics addressed in fewer numbers include the properties of matter and its changes (3 articles), classification of living things (2 articles), reaction rates (2 articles), human digestive systems (1 article), waves and sound (1 article), pressure (1 article), colloids (1 article), viruses (1 article), and the human reproductive system (1 article). Overall, this distribution underscores a tendency among researchers to prioritize highly contextual topics, though the overall thematic variety remains somewhat constrained, leaving room for future studies to explore a wider array of scientific disciplines.

Regarding the educational stages targeted in these studies, the research is primarily concentrated in secondary education, with 20 articles conducted at the Senior High School (SMA) level and 17 articles at the Junior High School (SMP) level, while Elementary School (SD) education was explored in 5 articles. The dominance of high school-level research is largely attributed to the advanced cognitive development of older students, which better accommodates complex, innovative instructional designs like PBL and local wisdom integration. At this level, students possess a greater capacity for critical analysis, scientific investigation, collaborative debate, and linking abstract scientific principles to real-world phenomena, directly supporting the development of scientific literacy, critical thinking, and higher-order problem-solving skills. Nevertheless, the substantial body of research at the junior high school level highlights its importance as a foundational stage for nurturing scientific reasoning.

The integration of local context at the junior high level is highly effective due to the integrated nature of the science curriculum, which aligns seamlessly with 21st-century skills such as collaboration, communication, and basic inquiry. Conversely, while elementary school research remains less frequent, existing studies indicate a growing interest in introducing innovative, experience-based learning designs at an early age to build an early foundation for scientific literacy and cultural appreciation. Ultimately, this distribution indicates that contemporary science education research heavily favors secondary and upper-secondary levels, highlighting a clear opening for future research to expand into other dimensions, including higher education, to provide a more comprehensive overview of these instructional models across all academic level.

Discussion

The synthesis of various studies demonstrates that the application of Problem-Based Learning (PBL) integrated with local wisdom serves as an effective instructional approach to enhance students' scientific literacy in science and biology education. The interconnectedness among PBL, local wisdom, and scientific literacy is evident in a learning process that places students at the center of instruction through authentic problem-solving relevant to their daily lives and socio-cultural environments. By anchoring learning within real-world contexts, this model optimally fosters active student engagement in scientific inquiry, collaborative discussion, and the formulation of evidence-based solutions. In problem-based learning, students transition from passive recipients of information into active problem solvers engaged in formulating hypotheses, collecting and analyzing data, and scientifically communicating their findings. This process directly trains multiple components of scientific literacy, such as the ability to explain scientific phenomena, interpret scientific data and evidence, and critically as well as systematically evaluate investigation outcomes. Various studies indicate that the implementation of the PBL model successfully improves scientific literacy skills because it offers authentic learning experiences through observation, experimentation, group discussion, and solution presentations, thereby allowing students to better comprehend the relationship between scientific concepts and daily phenomena (Nuzula, 2022).

Within the learning process, the PBL syntax plays a critical role in cultivating these scientific literacy components. In the problem orientation stage, students are prompted to identify and formulate problems related to real-world phenomena in their surroundings, encouraging them to analyze and explain scientific phenomena more critically. The organization and investigation stages guide students to design investigative activities, seek information, and analyze various scientific data sources, which sharpens their ability to interpret data and scientific evidence as a core competency of scientific literacy. Subsequently, during the solution presentation and evaluation stage, students present their solutions and draw evidence-based conclusions, thereby reinforcing their scientific communication and analytical thinking skills. Furthermore, the collaborative nature of PBL encourages students to develop higher-order thinking skills, such as analysis, evaluation, and scientific argumentation, which constitute essential components of 21st-century skills (Zahroh, 2022).

The integration of local wisdom into PBL further strengthens the effectiveness of this approach by making the learning context highly relevant to students'

experiences and socio-cultural environments. Consequently, scientific concepts are not understood abstractly but are directly connected to cultural practices, traditions, and natural phenomena existing within the community. Local wisdom represents knowledge that has evolved across generations through community interactions with the environment, making it an excellent contextual learning resource for science education. When local cultural practices are utilized as the problem context in PBL, students can bridge scientific concepts with the tangible experiences they encounter daily, rendering the learning process more meaningful and digestible (Rumansyah, 2023). Incorporating local cultural contexts has also been proven to boost learning motivation and student engagement, as the material holds direct relevance to their lives, turning learning from a purely theoretical exercise into an applicable one (Verawati & Wahyudi, 2024).

In practice, the integration of PBL with local wisdom can be operationalized through various learning scenarios that link science concepts with local phenomena. These include analyzing environmental pollution issues through the lens of local cultural practices, exploring traditional biotechnology processes such as the production of tempeh and tape, or investigating biodiversity through local conservation practices. This approach aligns closely with ethnoscience-based learning, which emphasizes the integration of modern science, technology, and indigenous knowledge as contextualized, meaningful learning resources (Hidayah et al., 2024). The analysis of the 45 reviewed articles reveals that the majority of research employed quantitative methods with experimental designs (28 articles) to measure improvements in students' scientific literacy following the implementation of local wisdom-integrated PBL. These research designs typically utilized a pretest–posttest approach to evaluate differences in scientific literacy performance before and after the intervention. Additionally, several studies adopted a Research and Development (R&D) approach focusing on the development of PBL modules or instructional materials embedded with local wisdom (Wulandari, 2025). The development of these learning tools aims to assist teachers in executing problem-based instruction more effectively while boosting student engagement.

Bibliometric analysis using VOSviewer confirms this positive trend. The keyword network visualization map shows that clusters related to problem-based learning (PBL), scientific literacy, and local wisdom exhibit strong correlations and are highly interconnected within the network. This indicates a dominant research focus on integrating PBL with local wisdom contexts to cultivate scientific literacy. Moreover, the VOSviewer visualization shows a strong linkage between the keyword "ethnoscience" and both "scientific literacy" and "problem-based learning," illustrating that recent research has begun to systematically integrate indigenous knowledge into problem-based learning frameworks. However, keywords such as "learning model," "science education," and "biology education" are positioned relatively farther from the core cluster. This suggests that research specifically examining the development of models or instructional tools based on PBL integrated with local wisdom within mainstream science and biology education remains relatively limited (Chamdani, 2025).

Despite the predominantly positive outcomes reported, implementing local wisdom-integrated PBL still faces practical pedagogical challenges. A primary challenge is teacher readiness in designing problem scenarios that effectively merge scientific concepts with local cultural contexts. Furthermore, instructional time constraints pose a hurdle, as problem-based investigative activities require extensive, deep discussions. Discrepancies in students' initial comprehension of scientific concepts can also influence participation levels, requiring teachers to provide more intensive scaffolding. Nonetheless, beyond improving conceptual understanding, a local wisdom-based PBL model effectively develops students' critical thinking, creativity, and scientific communication skills by encouraging systematic discussion, collaboration, idea exploration, and solution presentations. These activities grant students the opportunity to advance problem-solving skills through the analysis of real-world phenomena. Beyond impacting the cognitive domain, local wisdom-integrated PBL contributes significantly to students' affective and social development; linking science concepts to local traditions fosters an awareness of cultural preservation and heightens environmental consciousness. Additional research confirms that integrating local cultural contexts into science instruction significantly enhances student learning outcomes and scientific literacy, as students grasp concepts much more readily when anchored to everyday experiences (Rifa'i et al., 2025).

In conclusion, extensive research evidence indicates that the integration of Problem-Based Learning (PBL) and local wisdom represents a highly promising instructional strategy for comprehensively enhancing students' scientific literacy. This approach moves beyond the mere mastery of scientific concepts by actively connecting scientific knowledge with real social, cultural, and environmental contexts. As a result, the learning process becomes highly contextual, meaningful, and aligned with 21st-century educational demands, ultimately equipping students with the

scientific reasoning skills necessary to understand and resolve various challenges in their daily lives

Conclusion

A systematic literature review of 45 articles demonstrates that the application of Problem-Based Learning (PBL) integrated with local wisdom effectively cultivates and enhances students' scientific literacy skills in science and biology education. PBL facilitates students' active engagement through problem orientation, investigation, collaborative discussion, and the presentation of evidence-based solutions, while local wisdom provides an authentic, relevant, and meaningful problem context. The combination of both approaches has proven successful in fostering students' abilities to explain scientific phenomena, interpret scientific data and evidence, and draw critical conclusions as core competencies of scientific literacy. The findings also reveal that the majority of the literature (28 articles) utilized quantitative methods with experimental designs and pretest–posttest approaches to measure improvements in scientific literacy following the implementation of local wisdom-integrated PBL, consistently showing significant increases. Furthermore, several Research and Development (R&D) studies yielded instructional tools such as modules or student worksheets (LKPD) based on PBL integrated with local wisdom. Topics surrounding ecology, biodiversity, biotechnology, and environmental pollution were the most widely utilized due to their direct relevance to students' daily lives and local traditions. Bibliometric analysis using VOSviewer confirmed this positive trend, showing a strong cluster relationship among the keywords "problem-based learning," "local wisdom," and "scientific literacy." The VOSviewer results also identified a distinct research gap regarding the currently limited development of instructional tools and implementation strategies for local wisdom-based PBL. Ultimately, the integration of PBL and local wisdom proved more effective than standalone applications, as it provides stronger cognitive stimulation through real and meaningful problem-solving contexts. Based on these findings, PBL integrated with local wisdom is highly recommended as a potential instructional approach to enhance scientific literacy while creating learning experiences that are more contextual, meaningful, and relevant to students' lives. This approach has the potential to be applied across various science topics at all educational levels, from elementary to senior high school. Future research needs to focus on developing local context-based scientific literacy assessment instruments, designing more structured PBL instructional materials integrated with local wisdom, and evaluating long-term classroom implementation to gain a more comprehensive understanding of its impact on both learning processes and outcomes.

Acknowledgments
Thank you to all parties who have helped in this research so that this article can be published.

Author Contributions
All authors contributed to writing this article.

Funding
No external funding.

Conflicts of Interest
No conflict interest.

References

Agustina, S., & Mutmainah, P. A. (2024). Implementasi model problem based learning (PBL) berbasis kearifan lokal untuk meningkatkan keterampilan berpikir kritis pada materi koloid kelas XI SMAN 3 Kota Bima. *Jurnal Redoks: Jurnal Pendidikan Kimia dan Ilmu Kimia*, *7*(2), 58–64. Retrieved from https://stkipbima.ac.id/jurnal/index.php/RE/article/view/2209

Andayani, A. A., & Agustina, L. (2025). Efektivitas model pembelajaran problem based learning terhadap literasi sains siswa pada materi klasifikasi makhluk hidup kelas VII SMP. *Bioscientist: Jurnal Ilmiah Biologi*, *13*(1), 117–125. https://doi.org/10.33394/bioscientist.v13i1.14909

Aradia, F. F., Fitri, R., & Helendra, H. (2023). Pengaruh model problem based learning terhadap kemampuan literasi sains biologi SMA. *Symbiotic: Journal of Biological Education and Science*, *4*(1), 10–17. Retrieved from http://symbiotic.jurnal.iainkerinci.ac.id/index.php/symbiotic

Asyfa, H. S. A. Q., Tambunan, I. S., Purba, K. R., Siregar, N. Z., Maylani, P., Mukra, R., & Arwita, W. (2026). Analisis penerapan model problem based learning dan integrasi kearifan lokal pada pembelajaran ekosistem kelas X di SMAS Imelda Medan. *Jurnal Bioshell*, *15*(1), 173–183. https://doi.org/10.56013/bio.v15i1.5530

Awaluddin, R. (2025). Penerapan model problem based learning (PBL) berbasis kearifan lokal pada materi pencemaran lingkungan untuk meningkatkan pemahaman siswa kelas X di SMAN 2 Bolo. *Jurnal Jendela Pendidikan*, *5*(02), 312–321. https://doi.org/10.57008/jjp.v5i02.1340

Azizah, N., & Alberida, H. (2021). Seperti apa permasalahan pembelajaran biologi pada siswa SMA? *Journal for Lesson and Learning Studies*, *4*(3),

388–395. Retrieved from https://ejournal.undiksha.ac.id/index.php/JLLS

Bancong, H. (2025). *Strategi reviu riset dan konstruksi teori: Metode, analisis, dan studi kasus*. Indonesia Emas Group.

Bidahyani, R. Y., Utami, S. D., & Dewi, I. N. (2024). Efektivitas model problem based learning (PBL) berorientasi kearifan lokal pada materi keanekaragaman hayati terhadap literasi lingkungan siswa. *Empiricism Journal*, *5*(2), 509–518. https://doi.org/10.36312/ej.v5i2.2316

Cahyani, G., Enawaty, E., Erlina, E., Muharini, R., & Ulfah, M. (2023). Pengembangan lembar kerja peserta didik (LKPD) berbasis kearifan lokal pada materi bioteknologi di SMPN 1 Jagoi Babang. *Jurnal Basicedu*, *7*(5), 3004–3017. https://doi.org/10.31004/basicedu.v7i5.6095

Chamdani, M., & Suryandari, K. C. (2025). The project-based learning integrated ethnoscience: A model of learning to enhance scientific literacy. *Jurnal Penelitian Pendidikan IPA*, *11*(1). Retrieved from https://jppipa.unram.ac.id/index.php/jppipa/article/view/9679

Cristanty. (2025). Pengaruh problem based learning (PBL) terhadap kemampuan literasi sains serta kemampuan kolaborasi dan berkomunikasi siswa pada materi virus kelas X SMA Swasta Sultan Iskandar Muda Medan. *Jurnal Teknologi Pendidikan*, *18*(2). https://doi.org/10.24114/jtp.v18i2.70214

Damayanti, S. (2025). Pengaruh model pembelajaran problem based learning terhadap kemampuan literasi sains siswa sekolah dasar. *Terpadu: Jurnal Ilmiah Pendidikan Dasar*, *3*(2), 506–516. Retrieved from https://pelitaaksara.or.id/index.php/terpadu/article/view/72

Danissih, P. N. W., Fadilah, M., & Rahmi, F. O. (2024). Pengaruh model problem based learning (PBL) berpendekatan kearifan lokal terhadap keterampilan berpikir kritis peserta didik fase E. *Jurnal Biogenerasi*, *10*(1), 152–159. https://doi.org/10.30605/biogenerasi.v10i1.4471

Dewi, S. P., Suriani, A., & Nisa, S. (2024). Penerapan literasi sains untuk meningkatkan kualitas pembelajaan IPA di sekolah dasar. *Journal of Practice Learning and Educational Development*, *4*(2), 95–99. https://doi.org/10.58737/jpled.v4i2.282

Eka Khafifah, T., & Rahayu, W. (2025). Systematic literature review: Lingkungan belajar yang menerapkan model problem based learning (PBL) dalam pembelajaran matematika. *De Fermat: Jurnal Pendidikan Matematika*, *8*(2), 405–416. https://doi.org/10.36277/defermat.v8i2.2313

Erman, Setiawan, B., Hariyono, E., Suyatno, & Wakhidah, N. (2024). *Pembelajaran sains berbasis kearifan lokal*. Pascasarjana Unesa.

Fatmawati, Sholahuddin, A., & Sari, M. M. (2021). Bahan ajar IPA SMP berbasis literasi sains dan kearifan lokal lahan basah pada materi tanah dan keberlangsungan kehidupan. *Jurnal Pendidikan Sains dan Terapan*, *1*(1), 77–88. Retrieved from https://ppjp.ulm.ac.id/journals/index.php/jpst/article/view/6057

Fatonah, F., Juriah, J., & Siburian, J. (2026). Literatur review: Efektivitas model pembelajaran problem based learning (PBL) dalam mengembangkan literasi sains dan higher order thinking skills (Hots) peserta didik. *Jurnal Pendidikan MIPA*, *16*(1), 45–57. https://doi.org/10.37630/jpm.v16i1.3625

Fitriani, W., Yuliati, Y., & Damayanti, I. (2025). Pengaruh model pembelajaran problem based learning terhadap kemampuan literasi sains siswa kelas V sekolah dasar. *Didaktik: Jurnal Ilmiah PGSD STKIP Subang*, *11*(03), 270–279. https://doi.org/10.36989/didaktik.v11i03.7716

Fuadati, M., & Yusro, A. C. (2023). Penerapan model PBL terintegrasi kearifan lokal untuk meningkatkan hasil belajar IPA siswa SMP. *Jurnal IPA Terpadu*, *7*(2), 169–177. https://doi.org/10.35580/ipaterpadu.v7i2.48435

Herman, H., Nurfathurrahmah, N., Ferawati, F., Ariyansyah, A., & Suryani, E. (2022). Penerapan model problem based learning (PBL) untuk meningkatkan hasil belajar literasi sains siswa SMP kelas VIII. *Jurnal Ilmiah Mandala Education*, *8*(4), 3087–3093. http://dx.doi.org/10.58258/jime.v8i4.4068

Hidayah, A., Rokhimawan, M. A., & Suherman, R. (2024). Implementation of ethnoscience-based project-based learning on science literacy learning outcomes. *Journal of Innovation in Educational and Cultural Research*, *5*(1). Retrieved from http://jiecr.org/index.php/jiecr/article/view/1278

Hidayanti, I., & Wulandari, F. (2023). Pengaruh model problem based learning (PBL) berbasis etnosains terhadap kemampuan literasi sains sekolah dasar. *Umsida Proceeding Series*. https://doi.org/10.21070/ups.988

Ibad, M. I., Husniati, H., & Novitasari, S. (2025). Pengaruh model problem based learning terhadap literasi sains siswa dalam pembelajaran IPAS kelas V SDN 26 Cakranegara. *Es-Syajar: Journal of Islam, Science and Technology Integration*, *3*(1), 281–296. https://doi.org/10.18860/es.v3i1.33280

Januarti, I. M., & Muliyadi, L. (2024). Development of Ethnoscience-Based Student Worksheet Using the Guided Inquiry Learning Model to Increase

Students' Learning Motivation and Scientific Literacy: A Review. *International Journal of Science Education and Science*, *1*(1), 13–18. https://doi.org/10.56566/ijses.v1i1.109

Khery. (2020). Urgensi pengembangan pembelajaran kimia berbasis kearifan lokal dan kepariwisataan untuk menumbuhkan literasi sains siswa. *Jurnal Kependidikan*, *6*(3), 460–474. https://doi.org/10.54297/jpmd.v1i1.880

Kurniati, E., & Adelia, K. A. C. (2023). Pengaruh model pembelajaran problem based learning terhadap literasi sains siswa SMA. *Magnetic: Research Journal of Physics and It's Application*, *3*(2), 248–252. https://doi.org/10.59632/magnetic.v3i2.387

Kurniawan, M. A. T., Dewi, N. P. S. R., & Heny, A. P. (2026). Systematic literature review: Efektivitas pembelajaran berbasis kearifan lokal dalam meningkatkan keterampilan literasi sains. *Jurnal Pendidikan Biologi Undiksha*, *13*(1), 40–53. https://doi.org/10.23887/jjpb.v13i1.112315

Larasati, A. A. (2025). Kemampuan literasi sains melalui model pembelajaran problem based learning pada materi kelas VII SMP di Sukoharjo. *Jurnal Pendidikan Biologi*, *16*(1), 67–74. http://dx.doi.org/10.17977/um052v16i1p67-74

Lendeon, G. R., & Poluakan, C. (2022). Pengaruh model problem based learning (PBL) terhadap kemampuan literasi sains siswa. *Sciening: Science Learning Journal*, *3*(1), 14–21. https://doi.org/10.53682/slj.v3i1.1076

Mahrunnisya, D. (2023). Keterampilan pembelajar di abad ke-21. *Jupenji: Jurnal Pendidikan Jompa Indonesia*, *2*(1), 101–109. https://doi.org/10.57218/jupenji.vol2.iss1.598

Mamora, B., & Setyawarno, D. (2026). Pengaruh model pembelajaran berbasis masalah bermuatan potensi lokal garam krosok terhadap literasi sains. *Jurnal Pendidikan Sains Progresif*, *2*(1), 36–48. Retrieved from https://journal.kopialinea.com/index.php/JPSE/article/view/39

Mondaylisa, F. P., & Wilujeng, I. (2026). Analisis bahan ajar IPA model PBL terintegrasi kearifan lokal dan tingkat literasi lingkungan peserta didik. *Eduproxima: Jurnal Ilmiah Pendidikan IPA*, *8*(1), 436–447. https://doi.org/10.29100/.v8i1.8382

Mufidah, F., & Setiawan, B. (2024). Penerapan model problem based learning berbasis kearifan lokal untuk meningkatkan keterampilan berpikir kritis peserta didik. *Pensa E-Jurnal: Pendidikan Sains*, *12*(3), 104–108. https://doi.org/10.26740/pensa.v12i3.62029

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

Muliarsa, I. K., Sudiatmika, A. R., & Pujani, N. M. (2024). Problem based learning bermuatan kearifan lokal terhadap kemampuan berpikir kritis dan kreatif siswa SMP. *Jurnal Ilmiah Pendidikan Profesi Guru*, *7*(2), 415–425. https://doi.org/10.23887/jippg.v7i2.83804

Ningrum, S. D., Trimaryun, T., & Munawaroh, F. (2026). Penerapan model problem based learning (PBL) untuk meningkatkan literasi sains peserta didik pada materi sistem reproduksi manusia. *Science Education National Conference*, *7*(1), 667–675. Retrieved from https://conference.trunojoyo.ac.id/pub/senco/article/view/1039

Nurhayati, Hermanto, I. M., Samatowa, L., & Gimnastiar, A. N. (2024). Penerapan model Problem Based Learning (PBL) terhadap kemampuan literasi sains siswa SMP pada pembelajaran IPA (literature review). *Normalita (Jurnal Pendidikan)*, *11*(3). Retrieved from https://ejurnal.pps.ung.ac.id/index.php/JN/article/view/2451

Nuzula, N., & Sudibyo, E. (2022). Penerapan model problem based learning untuk meningkatkan kemampuan literasi sains siswa SMP pada pembelajaran IPA. *Pensa E-Jurnal: Pendidikan Sains*, *10*(3). https://doi.org/10.26740/pensa.v10i3.45386

OECD. (2022). *PISA 2022 results (Volume I): The state of learning and equity in education*. OECD Publishing.

Putri, W. P., Muntari, & Savalas, L. R. T. (2026). Kelayakan E-Modul IPA berbasis Problem Based Learning (PBL) dengan pendekatan kearifan lokal untuk meningkatkan kemampuan berpikir kritis dan literasi digital. *Journal of Classroom Action Research*, *8*(1), 195–201. https://doi.org/10.29303/jcar.v8i1.14783

Rahmadini, R., Marneli, D., Mardatillah, A., Delfita, R., & Syafitri, M. (2024). Efektifitas modul biologi terintegrasi kearifan lokal minangkabau berbantuan model problem based learning (PBL). *Edusainstika: Jurnal Pembelajaran MIPA*, *4*(2), 68–72. https://doi.org/10.31958/je.v4i2.13437

Ramadani, I. (2025). Integrasi bahan ajar berbasis kearifan lokal kajang dalam meningkatkan keterampilan berpikir kritis. *Jurnal Pengabdian Nasional (JPN) Indonesia*, *6*(1), 274–284. https://doi.org/10.35870/jpni.v6i1.1184

Ramadhani, A., Evintaras, M., Sebayang, B., & Prahesti, E. R. (2026). Literature review: Pengaruh penerapan model problem-based learning (PBL) terhadap keterampilan kolaborasi siswa. *Diajar*, *5*(1), 343–352. https://doi.org/10.54259/diajar.v5i1.4861

Ramadhani, W., Selaras, G. H., Arsih, F., & Kurniati, R. (2026). Pengaruh model problem based learning terhadap kemampuan literasi sains murid: Kajian literatur. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, *11*(02), 280–294. https://doi.org/10.23969/jp.v11i02.45859

Restiani, N. L. D., Margunayasa, I. G., & Paramita, M. V. A. (2023). Improving scientific literacy of elementary school students through problem-based learning model with Balinese local wisdom. *Jurnal Ilmiah Sekolah Dasar*, *7*(4), 590–598. https://doi.org/10.23887/jisd.v7i4.62080

Rifa'i, M., Taufik, L. M., & Novianawati, N. (2025). The ethnoscience-based project based learning model on learning outcomes and scientific literacy. *International Journal of Research and Educational Review*, *4*(1). Retrieved from https://www.etdci.org/journal/ijrer/article/view/3843

Rosidi, A., Rohman, F., Novianti, V., & Hariadi, I. (2023). Pengembangan e-module keanekaragaman makhluk hidup berbasis PBL bermuatan kearifan lokal dan pengaruhnya terhadap keterampilan berpikir kritis, pemecahan masalah, dan sikap lingkungan. *Bioscientist: Jurnal Ilmiah Biologi*, *11*(2), 1662–1677. https://doi.org/10.33394/bioscientist.v11i2.9414

Rosita, E., Utomo, A. P., Azizah, S. A., & Sukoco. (2023). Penerapan model pembelajaran problem based learning (PBL) berbasis kearifan lokal berbantuan media ular tangga untuk meningkatkan aktivitas dan hasil belajar biologi. *Jurnal Biologi*, *1*(3), 1–13. https://doi.org/10.23887/tscj.v1i2.20409

Rusmansyah, R., Leny, L., & Sofia, H. N. (2023). Improving students' scientific literacy and cognitive learning outcomes through ethnoscience-based project-based learning model. *Journal of Innovation in Educational and Cultural Research*, *4*(1). Retrieved from http://jiecr.org/index.php/jiecr/article/view/382

Sastypratiwi, H., & Nyoto, R. D. (2020). Analisis data artikel sistem pakar menggunakan metode systematic review. *Jurnal Edukasi dan Penelitian Informatika (JEPIN)*, *6*(2), 250. https://doi.org/10.26418/jp.v6i2.40914

Suleman, N., & Bahsuan, R. (2025). Pengaruh model pembelajaran problem based learning (PBL) terhadap kemampuan literasi sains siswa pada konsep laju reaksi. *Semnasfip*, *2*(2). Retrieved from https://jurnal.umj.ac.id/index.php/SEMNASFIP/article/view/28572

Sureni, S., Leksono, S. M., & Biru, L. T. (2023). Pengembangan modul elektronik (E-Modul) berbasis flip PDF profesional pada tema pencemaran lingkungan untuk meningkatkan literasi sains siswa SMP kelas VII. *Jurnal Pendidikan MIPA*, *13*(2), 350–357. https://doi.org/10.37630/jpm.v13i2.944

Suryati, S., Hatimah, H., Zohri, S. A., & Salim, A. (2024). Review LKPD PBL berbasis kearifan lokal Lombok untuk mendukung kurikulum merdeka pada materi koloid. *Jurnal Ilmiah IKIP Mataram*, *11*(1), 10–23. Retrieved from https://ojs.ikipmataram.ac.id/index.php/jiim

Sutrisno, T. (2025). Efektivitas problem-based learning (PBL) dengan digital dan integrasi budaya lokal madura terhadap literasi sains siswa sekolah dasar. *Tadrusuun*, *4*(2), 107–118. https://doi.org/10.62274/tadrusuun.v4i2.241

Syarif, S. A., & Syamsurizal, S. (2025). Pengaruh model problem based learning (PBL) terhadap hasil belajar siswa kelas fase E pada materi bioteknologi di SMAN 1 Bayang. *Jurnal Pendidikan Tambusai*, *9*(1), 846–854. https://doi.org/10.31004/jptam.v9i2.29460

Teuf, P. J., Dopong, M., Labeul, G. V., Lipikuni, H. F., Boimau, Y., Maubana, W. M., & Olla, A. (2026). Implementasi pembelajaran PBL berbasis kearifan lokal pada alat musik tradisional NTT materi gelombang untuk meningkatkan hasil belajar siswa SMP. *Magnetic: Research Journal of Physics and It's Application*, *6*(1), 541–546. https://doi.org/10.59632/magnetic.v6i1.475

Utami, F. P., & Setyaningsih, E. (2022). Kemampuan literasi sains peserta didik menggunakan pembelajaran problem based learning pada materi sistem ekskresi. *Journal of Educational Learning and Innovation*, *2*(2), 240. https://doi.org/10.46229/elia.v2i2

Verawati, N. N. S. P., & Wahyudi, W. (2024). Raising the issue of local wisdom in science learning and its impact on increasing students' scientific literacy. *International Journal of Ethnoscience and Education*, *2*(1). Retrieved from https://ojspanel.undikma.ac.id/index.php/ijete/article/view/10881

Wabdaron, D. Y., Parmiti, D. P., & Dantes, N. (2025). Pengaruh implementasi problem based learning (PBL) berbasis kearifan lokal munya-munya terhadap peningkatan berkomunikasi dan berpikir kritis pada siswa kelas V SD Gugus III Kabupaten Mimika. *Silampari Bisa: Jurnal Penelitian Pendidikan*

Bahasa Indonesia, Daerah, dan Asing, *8*(2), 144–153. https://doi.org/10.31540/silamparibisa.v8i2.3955

Wajipalu, D., Suleman, N., Munandar, H., Pikoli, M., & Thayban, T. (2025). Pengaruh model pembelajaran problem based learning (PBL) terhadap kemampuan literasi sains peserta didik topik laju reaksi. *Jurnal Entropi*, *20*(1), 37–43. https://doi.org/10.37905/je.v20i1.32543

Widana, F. M. G., & Sudibyo, E. (2025). Analisis model problem based learning (PBL) terhadap kemampuan literasi sains siswa SMP. *Jurnal Pendidikan Tambusai*, *9*(1), 6698–6702. https://doi.org/10.31004/jptam.v9i1.25551

Wulandari. (2025). E-book interaktif PBL (Problem Based Learning) pada materi ekosistem untuk melatihkan keterampilan literasi sains siswa kelas X SMA. *BioEdu*, *14*(3), 680–690. https://doi.org/10.26740/bioedu.v14n3.p680-690

Yulianto, D. E., Irfan, M., & Permata Sari, R. D. (2022). Pengaruh model PBL berbasis etnosains terhadap hasil belajar IPA siswa sekolah dasar. *Jurnal IKA Ikatan Alumni PGSD UNARS*, *12*(2), 272–280. https://doi.org/10.36841/pgsdunars.v12i2.2607

Yusuf, A. A. T. U., Husain, H. A. L. I. M. A. H., & Side, S. (2023). Pengaruh model problem based learning terhadap kemampuan literasi sains peserta didik kelas XI MIA SMA Angkasa Maros. *Secondary: Jurnal Inovasi Pendidikan Menengah*, *3*(1), 76–88. https://doi.org/10.51878/secondary.v3i1.1971

Zahara, L., Sudatha, I. G. W., Santosa, M. H., & Suartama, I. K. (2025). Integrasi kearifan lokal dalam penguatan literasi sains fisika di sekolah: Suatu kajian sistematis. *Lambda: Jurnal Pendidikan MIPA dan Aplikasinya*, *5*(3), 777–790. https://doi.org/10.58218/lambda.v5i3.1505

Zahroh, F., Suwarsi, E., & Ridlo, S. (2022). The effectiveness of project based learning based on local wisdom to improve students' science literacy ability. *Journal of Innovative Science Education*, *11*(2). Retrieved from https://journal.unnes.ac.id/sju/jise/article/view/45187

Zainuri, B. N. S., Gunawan, G., & Kosim, K. (2025). Pengenalan e-modul berbasis PBL terintegrasi kearifan lokal untuk meningkatkan literasi dan keterampilan proses siswa di SMPN 15 Mataram. *Indonesian Journal of Education and Community Services*, *5*(1), 48–53. Retrieved from https://journal.publication-center.com/index.php/ijecs/article/view/1828

Zainuri, B. N. S., Gunawan, G., & Kosim, K. (2024). Integrasi kearifan lokal dalam modul e-pembelajaran berbasis masalah: Dampaknya terhadap literasi sains dan keterampilan proses sains. *Jurnal Pendidikan STEM Indonesia*, *6*(1), 1–8. Retrieved from https://journal.publication-center.com/index.php/ijse/article/view/1627