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Literature Review: The Role of Local Wisdom-Based Physics Learning with Patil Lele in Enhancing Students' Scientific Literacy

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Abstract

According to PISA 2022, the level of scientific literacy among students in Indonesia is considered low. One contributing factor is the lack of contextual learning in science education. In line with the Sustainable Development Goals (SDGs), particularly Goal 4 (Quality Education), it is essential to ensure the provision of relevant education that is connected to real-life experiences. One way to create contextual learning is by integrating local wisdom into the learning process. This study aims to explore the role of Patil Lele as a form of local wisdom in enhancing students' scientific literacy. The research method used is a literature review. Data were collected by reviewing five previous studies related to the application of local wisdom in physics education. The collected data were analyzed using the principles of organization, synthesis, and identification. The findings reveal that Patil Lele can serve as an interactive learning medium, support students in understanding the relationships between physical quantities in real contexts, and provide opportunities to practice decision-making and problem-solving based on physics concepts. Therefore, it can be concluded that the integration of patil lele as a local wisdom approach plays a significant and positive role in improving students' scientific literacy.

Keywords: Local wisdom, patil lele, scientific literacy
SDGs: Goal 4 (Quality Education) and Goal 11 (Sustainable Cities & Communities)

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INTRODUCTION

In the 21st century, marked by the rapid advancement of science and technology, the ability to think critically, analytically, and reflectively about natural and social phenomena has become increasingly important. This era demands individuals who are not only knowledgeable but also capable of evaluating information and making decisions grounded in logical reasoning. Therefore, scientific literacy is considered a fundamental competency that must be developed in every individual to meet the demands of a dynamic and complex world (Atiaturrahmaniah et al., 2022). Scientific literacy is not limited to understanding scientific concepts, but also includes critical thinking, problem-solving abilities, and decision-making skills based on evidence (Banila et al., 2021). Individuals who possess a high level of scientific literacy are better equipped to navigate the challenges of modern life, including environmental, technological, and health-related issues. As such, scientific literacy should be cultivated through the learning process to prepare responsive and informed individuals. Without a solid understanding of science, society may struggle to deal with the emerging issues around them, and this could lead to misinformation, poor decision-making, and lack of participation in scientific discourse (Wulandari et al., 2023).

One effective way to develop scientific literacy is through physics education, as physics is a discipline that emphasizes scientific processes and attitudes (Khoiri, 2023). Physics serves as a foundation for understanding the natural world through empirical observation, experimentation, and logical reasoning. It

involves a series of scientific procedures or steps used to obtain knowledge or solve problems, including hypothesis formulation, data collection, analysis, and drawing conclusions (Lestari I et al., 2022). These procedures align with the fundamental competencies of scientific literacy, namely understanding scientific concepts, evaluating data-based information, and applying scientific knowledge to real-life decision-making (Zhang et al., 2023). Hence, physics learning serves as an effective means to foster students' scientific literacy, enabling them to think critically, analytically, and apply their knowledge in daily life with confidence and competence.

Strengthening scientific literacy in physics education also contributes to achieving the Sustainable Development Goals 4 (SDGs 4) regarding quality education. This goal emphasizes inclusive and equitable quality education and the promotion of lifelong learning opportunities for all. In the context of education, enhancing scientific literacy is intended to encourage individuals to become more aware and actively involved in addressing global issues (López-Iñesta et al., 2022). Scientific literacy empowers students to better assess information, distinguish between facts and opinions, and make informed decisions based on scientific evidence (Alhusni et al., 2024). Moreover, it fosters responsible citizenship by encouraging individuals to use scientific reasoning in personal and societal matters. Thus, scientific literacy provides a strong foundation for achieving the SDGs of ensuring quality education for all, while also preparing future generations to contribute positively to sustainable development on both local and global scales.

Quality learning can be realized by applying a contextual approach, which connects scientific concepts with real-life experiences and cultural contexts. Physics learning becomes more meaningful when integrated with phenomena that are familiar to students and are part of their lived experiences (Setyowati et al., 2023). One such way to implement this is through the use of local wisdom, which encompasses traditional knowledge, cultural practices, and values that have been passed down through generations. Local wisdom is deeply rooted in the community and often becomes part of their daily activities, rituals, and problem-solving strategies (Erman & Suyatno, 2022). Communities interpret phenomena based on their beliefs and environment, which is known as indigenous science. This indigenous knowledge reflects how people understand their world, and it offers a valuable entry point for teaching formal scientific concepts. Indonesia is a culturally diverse country (Lestari S et al., 2022), with over 370 ethnic groups (Hadi et al., 2019), each contributing unique forms of knowledge. Therefore, the ethnoscience approach is seen as an effective strategy to develop scientific knowledge through local wisdom while fostering cultural identity and respect for diversity.

Local wisdom manifests in various forms, including traditional games, which are rich in cultural values and community engagement. These games are not only a source of entertainment but can also be utilized as media to explain physics concepts, such as motion, force, and energy transfer (Dani et al., 2022). Traditional games offer an authentic and engaging way to contextualize abstract scientific theories and make them more accessible to students. One such traditional game that can be applied in physics learning is patil lele (Jamaluddin & Nuraini, 2024), a game originating from East Java and known by various names across regions, such as patok lele, benthik, or Geulengkue Teu Peu Poe (Sandra et al., 2021). The game involves striking a small piece of wood, called janak, with a longer stick, known as benthik, to make it travel through the air—an action that naturally demonstrates projectile motion and energy principles (Maghfiroh & Kuswanto, 2021). Integrating such games into the curriculum not only supports the learning of physics but also instills pride in local heritage among students.

Several studies have examined the integration of the patil lele traditional game in physics education. It has been implemented as an interactive learning medium through applications (Jamaluddin & Nuraini, 2024), enrichment books (Handayani et al., 2022), and educational comics (Maghfiroh & Kuswanto, 2021). These studies indicate that patil lele has primarily been utilized to support students' conceptual understanding of physics. However, no research to date has specifically investigated the use of patil lele to develop one of the essential 21st-century skills—scientific literacy. In response to this gap, the present study aims to explore the impact of the patil lele traditional game in physics instruction on enhancing students' scientific literacy skills.

METHOD

This study employs a descriptive qualitative approach, selected because the research method used is a literature review. According to Neuman (2011), this method is conducted with the awareness that knowledge continuously evolves over time, and the topic under study has already been discussed by several previous researchers. To deepen understanding, data were collected from libraries and prior studies. The data collection technique involved reviewing eight articles from previous research related to the use of local wisdom in enhancing scientific literacy. Through this technique, the researcher aims to identify patterns, approaches, and

relevant findings that can serve as a foundation for developing a strong conceptual framework, as well as contributing both theoretically and practically to the advancement of scientific literacy based on local wisdom values.

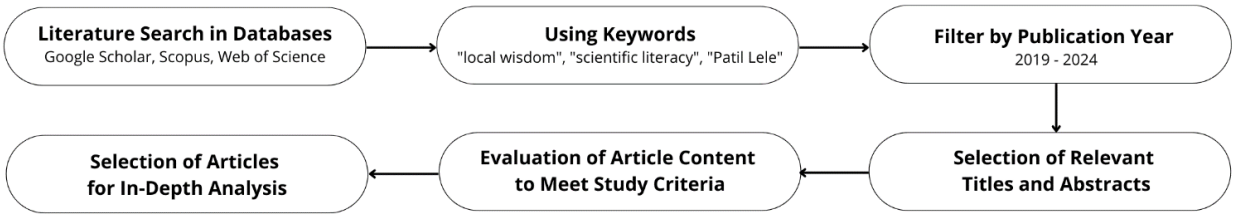

Figure 1. Flowchart of Data Collection Method

The procedure for data collection is illustrated in Figure 1. The data sources used in this study are secondary data. the literature search was conducted using several reputable academic databases, including Google Scholar, Scopus, and Web of Science. Specific keywords used in the search were "local wisdom," "scientific literacy," "physics learning," and "Patil Lele." The search was limited to publications from 2019 to 2024. Research articles related to the application of *Patil Lele* local wisdom and scientific literacy that met the criteria were selected and will be analyzed in depth.Then, identifying the articles and then systematically classifying them based on the type of research from titles and abstracts. After that, Further reviewing through data extraction from the articles that meet the criteria for analysis in this study. The criteria used in this study consist of two points, articles that discuss *patil lele* local wisdom and the development of local wisdom in enhancing scientific literacy. Finally, a deeper analysis was performed.

RESULTS AND DISCUSSION

The data obtained will be analyzed by organizing the scientific articles to be reviewed. Then, the results will be combined into an integrated literature. Finally, the articles will be identified to draw conclusions. The articles analyzed include in Table 1.

Table 1. Reviewed Scientific Article Data

No.	Title	Author	Year	Journal
1.	Benthik Android Physics Comic Effectiveness for Vector Representation and Crtitical Thinking Students' Improvement	Maghfiroh, A., & Kuswanto, H.	2022	International Journal of Instruction
2.	Respon Siswa SMA terhadap Pembelajaran Fisika Berbasis Kearifan Lokal pada Alat Musik Tradisional Rebana untuk Meningkatkan Keterampilan Literasi Sains	Nugraha, B. S., & Prabowo, P	2022	PENDIPA Journal of Science Education
3.	Pengembangan Buku Pengayaan Fisika Berkonteks Etnosains Pada Permainan Patok Lele Dan Gobak Sodor	Dani, R., Jufrida, J., Basuki, FR, & Handayani, F.	2022	Jurnal Pendidikan Fisika dan Sains
4.	The Development of Interactive Learning Media of Parabolic Motion Lesson Materials with Patil Lele Traditional Games	Jamalludin, R. D., & Nuraini, L.	2021	Berkala Ilmiah Pendidikan Fisika
5.	Ethnophysics Analysis of Traditional Patil Lele Game: Unveiling Physics Concepts in Local Wisdom.	Rohmah, A. N., Agustinaningrum, N. A., Rohmah, N. L., Sabrina, N. M. N., Agustinur, S. C., Alemgadmi, K. I. K., & Deta, U. A.	2024	International Journal of Research and Community Empowerment
6.	Ethnoscience learning: How do teacher implementing to increase scientific literacy in junior high school.	Jufrida, J., Kurniawan, W., & Basuki, F. R.	2024	International Journal of Evaluation and Research in Education (IJERE)
7.	Science learning integrated ethnoscience to increase scientific literacy and scientific character.	Atmojo, S. E., Kurniawati, W., & Muhtarom, T.	2019	Journal of Physics: Conference Series

No.	Title	Author	Year	Journal
8.	Effectiveness of science learning model containing Balinese local wisdom in improving character and science literacy of junior high school students.	Sanjayanti, N. P. A. H., Suastra, I. W., Suma, K., & Adnyana, P. B.	2022	International Journal of Innovative Research and Scientific Studies

Table 1 presents eight articles included in this literature review. These articles were selected due to their strong relevance to the research focus, namely physics learning based on local wisdom and the development of innovative instructional media to enhance science literacy. The articles contribute comprehensively in terms of theoretical concepts, implementation strategies, and evaluation of learning approaches involving the integration of local wisdom in physics education. Moreover, these articles have been subjected to thorough analysis to extract critical insights that underpin the theoretical framework and methodology of the present study. Consequently, they provide a robust foundation for the development of both the theoretical and methodological aspects of this research.

Local Wisdom: *Patil Lele*

Local wisdom, which can be defined as "kearifan lokal" in Indonesian, consists of two words: *kearifan* (wisdom) and *lokal* (local). *Kearifan* refers to wisdom, while *lokal* refers to a place or region. Therefore, in a literal sense, local wisdom can be defined as the wise ideas that grow and develop in a particular region or place (Sudarmin, 2014). Local wisdom refers to the knowledge and practices that emerge and evolve in a specific area (Pratama et al., 2023). It reflects the worldview and way of life of the community in that region, passed down from generation to generation (Febrianty et al., 2023).

Local wisdom provides a vast and diverse body of knowledge that can be used as a source for learning. Ethnoscience is one method for integrating this knowledge into the context of scientific learning. Ethnoscience consists of two words: *ethno* and *science*. *Ethno* means culture, while *science* refers to knowledge. Therefore, ethnoscience literally describes the knowledge specific to an ethnic group or community (Mukti et al., 2022). Ethnoscience is used to build the local community's understanding of how nature works (Putra, 2021). It can also be seen as the integration of indigenous knowledge with scientific knowledge (Erman & Suyatno, 2022). In practice, ethnoscience can be studied in schools through science lessons, including physics education.

Local wisdom is closely related to the lives of students. Learning that integrates technology, science, and culture can create a more complex learning experience (Maghfiroh & Kuswanto, 2022). One example of local wisdom that can be applied is the traditional game *patil lele*. *Patil lele* is a traditional game popular in East Java. The game has different names in other regions, such as *Patok Lele* in West Java, *Benthink* in Central Java and Yogyakarta, and *Tak Tek* in the Bangka Belitung region (Burhan & Hidayat, 2023). *Patil lele* is played using two pieces of wood. The longer piece is called the “induk kayu” (mother wood), while the shorter piece is called the “anak kayu” (child wood) (Ningtias, 2021).

According to Rohmah et al. (2024), there are three techniques in the game of patil lele. The first technique involves placing a small piece of wood horizontally in a hole, then striking it with a larger piece of wood so that the small piece is thrown and lands at a certain distance. The second technique involves placing one end of the small piece of wood into the hole, causing the wood to tilt. The small piece is then struck to make it fly, and struck again to throw it farther. The third technique requires the small piece of wood to be thrown upwards by hand, then struck with the larger piece of wood so that it is thrown far. These techniques demonstrate different ways to play the game in order to achieve the farthest throw.

Patil lele has been widely applied in physics education. A study by Jamaluddin & Nuraini (2024) showed that *patil lele* was used as a teaching media for the topic of projectile motion. Another study by Handayani et al. (2022) indicated that *patil lele* contributed to the development of enrichment books aimed at enhancing students' understanding of physics concepts. This was further supported by Maghfiroh and Kuswanto (2021), who found that *patil lele* could aid in the development of Android-assisted physics comics using the Discovery Learning model as a teaching medium for the topic of projectile motion.

Scientific Literacy

Scientific literacy is one of the essential needs of students in the 21st century. Scientific literacy can be defined as an individual's ability to apply knowledge in identifying natural phenomena and making decisions based on scientific evidence (Supraya et al., 2022). Scientific literacy is the foundation for students to face the

challenges of the Society 4.0 era. Students with scientific literacy skills will be able to solve problems in their environment in a structured and wise manner (Wulandari et al., 2023).

According to OECD (2022), there are three scientific competencies that students need to master. First, students should be able to explain phenomena scientifically. To achieve this, students need to be equipped with the ability to recall and use information to identify natural phenomena. Second, students should be able to design and evaluate scientific investigations, and critically analyze the data and evidence obtained. Third, students should be able to research, evaluate, and use scientific information for decision-making and actions. Based on these three competencies, indicators for scientific literacy have been developed by Deta et al.(2024), as shown in Table 2.

Table 2. Scientific Literacy Indicators

No	Competency	Competency Description	Indicator
1.	Explaining scientific phenomena in a scientific way	Recognizing, constructing, applying, and evaluating explanations for natural phenomena and technology.	a. Evaluating scientific concepts in explaining phenomena/problems. b. Evaluating explanations of a phenomenon/problem based on scientific concepts.
2.	Constructing and evaluating designs for scientific investigations and interpreting data and scientific evidence.	Assessing and evaluating methods to investigate a question scientifically, as well as interpreting and critically evaluating scientific data.	a. Identifying questions/issues explored in scientific studies. b. Designing scientific investigations based on issues/phenomena. c. Evaluating the design/results of scientific investigations based on issues/phenomena. d. Interpreting data and scientific facts to draw conclusions.
3.	Reviewing, evaluating, and using scientific information to make decisions and take actions.	Obtaining scientific information on issues related to specific global, local, or personal science, and evaluating its credibility, potential weaknesses, and implications for personal and group decisions.	a. Evaluating the credibility of scientific information obtained related to personal, local, and global science. b. Making decisions based on credible scientific information.

Based on Table 1, it can be seen that the indicators of scientific literacy do not only focus on students' ability to understand science theoretically. In scientific literacy, students are expected to apply scientific knowledge and communicate their scientific findings. These indicators can be used to demonstrate the extent to which an individual has mastered scientific literacy skills.

The Relationship Between Local Wisdom of Patil Lele and Scientific Literacy

Based on the results of the Programme for International Student Assessment (PISA) 2022, the scientific literacy performance of Indonesian students remains below the international average. Indonesia's average science literacy score was 383, a decrease from 396 in PISA 2018. With this score, Indonesia ranked 66th out of 81 participating countries. Murti and Sunarti (2021) state that the low scientific literacy in Indonesia is due to students' unfamiliarity with fully understanding concepts. Students tend to focus too much on formulas or equations. This statement is supported by Utama et al. (2019), who mention that students' competence in learning physics is limited to memorization. This situation is largely attributed to the fact that many teachers have yet to adopt contextual and life-relevant teaching approaches. As a result, the learning process tends to be less effective in fostering students' deep conceptual understanding and enhancing their critical thinking skills (Atmojo et al., 2019).

One way to create contextual learning is by implementing local wisdom-based learning. Local wisdom not only contains morals and rules but also reflects local cultural issues that can be used as a source for scientific literacy learning (Khery et al., 2024). Several studies have shown that Patil Lele has successfully served as an engaging learning tool. Patil Lele has been able to visualize several physics concepts, including projectile motion (Jamaluddin & Nuraini, 2024). Through the traditional game *Patil Lele*, students are provided

with the opportunity to directly explore and identify various physics concepts in a contextual and engaging manner. This hands-on experience not only helps learners connect abstract scientific principles with real-world phenomena, but also promotes active learning, curiosity, and a deeper understanding of the subject matter (Dani et al., 2022). An example, projectile motion is an abstract topic, and students often struggle to visualize the parabolic trajectory and the factors influencing it (Wilujeng et al., 2024).

Another cause of low scientific literacy in Indonesia is that students are rarely given the opportunity to discover something through scientific procedures. This results in students not being well-trained in higher-order thinking. Science should be taught in alignment with its fundamental nature, which involves applying the scientific method collecting data through experiments and observations, then drawing conclusions to develop scientific concepts (Jufrida et al., 2024). According to Maghfiroh & Kuswanto (2022), the application of Patil Lele as a physics learning medium can illustrate how the principles of the game work and understand the relationships between the various quantities involved. In its application, students are trained to ask questions, form hypotheses, and predict the outcomes of various game techniques.

Another reason for low scientific literacy in Indonesia is the students' lack of problem-solving skills training (Atmojo et al., 2019). Local wisdom-based learning using Patil Lele can be a solution to this problem. Erman & Suyatno (2022) state that local wisdom contains interesting issues that can be discussed in the classroom. These issues require students to find solutions. Patil Lele is a traditional game that is usually used as a competition for children. The team that can throw the stick the farthest is declared the winner (Ningtias, 2021). Therefore, by applying Patil Lele, students can be trained to determine how to make a far throw to become the winner (Rohmah et al., 2024). Students will be trained to develop strategies by making plans based on data and physics concepts.

This study has several limitations that need to be considered. As a literature review, it relies solely on previously published secondary sources, meaning that the findings are dependent on the quality and relevance of the available literature. Furthermore, most of the analyzed studies are limited to the development of learning media or instructional materials based on traditional games such as *patil lele,* rather than a direct evaluation of the overall improvement in scientific literacy. Cultural and geographical contexts have also not been explored in depth, making it difficult to generalize the application of local wisdom-based learning across different regions.

Since this study does not involve field research or the collection of primary data, it does not provide direct empirical evidence regarding the effectiveness of *patil lele*-based learning in improving students' scientific literacy. Therefore, further experimental research is needed to concretely examine the impact of this approach within a learning context. By exploring and integrating local wisdom into the educational process, this approach not only enriches teaching methods but also promotes the preservation of local culture. If further developed and tested, learning based on traditional games such as *patil lele* can serve as an innovative alternative to enhance student engagement and overall scientific literacy. This aligns with Sustainable Development Goal (SDG) 4, which aims to ensure inclusive and quality education and promote lifelong learning opportunities for all. Contextual and culturally grounded learning opens opportunities for building a more relevant, participatory, and effective education system to address global challenges in the 21st century.

CONCLUSION

The local wisdom of Patil Lele plays an important role in enhancing scientific literacy skills in physics learning. Patil Lele can serve as an interactive learning medium that helps students analyze the physics concepts applied in the game. It can also be used as a tool for investigation, allowing students to understand the relationships between physical quantities through the Patil Lele game. Furthermore, Patil Lele serves as a valuable resource for training students in decision-making and problem-solving, particularly in determining how to achieve the farthest throw in the game. These findings have the potential to be further developed in future research, particularly through experimental approaches that can directly measure the impact of using the traditional Patil Lele game on improving students' scientific literacy in various learning contexts and educational levels.

AUTHOR CONTRIBUTIONS

Nur Afni Agustinaningrum: Conceptualization, Methodology, Formal Analysis, Investigation, Resources, Data Curation, Writing - Original Draft, and Writing - Review & Editing; and **Utama Alan Deta**: Validation and Supervison

DECLARATION OF COMPETING INTEREST

The authors declare no known financial conflicts of interest or personal relationships that could have influenced the work reported in this manuscript.

DECLARATION OF ETHICS

The authors declare that the research and writing of this manuscript adhere to ethical standards of research and publication, in accordance with scientific principles, and are free from plagiarism.

DECLARATION OF ASSISTIVE TECHNOLOGIES IN THE WRITING PROCCESS

The authors declare that Generative Artificial Intelligence and other assistive technologies were not excessively used in the research and writing process of this manuscript. Specifically, ChatGPT was utilized for brainstorming ideas, and Grammarly was employed for grammar and style correction, paraphrasing, and improving language clarity and coherence. All AI-generated content has been thoroughly reviewed and edited by the authors to ensure accuracy, completeness, and adherence to ethical and scientific standards. The authors take full responsibility for the final version of the manuscript.

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