Indonesian Local Wisdom-Based Physics Learning: Strategy and Media

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ABSTRACT

Aim. This systematic literature review (SLR) research explores strategies and media for learning physics based on local wisdom in Indonesia at all levels of education.

Methods. The review involved Scopus-indexed journals and conference papers published between 2014 and 2024. SLR was performed by defining research questions, setting eligibility criteria, searching and selecting documents, reviewing documents in-depth, and disseminating results. The document search and selection strategy employed the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) method, which comprised identification, screening, eligibility, and included stages.

Results. The analysis results indicate that the strategies and media are primarily designed to enhance cognitive learning outcomes. Additionally, various Indonesian local wisdoms containing physics concepts are dispersed across Java, Bali, Sumatra, Kalimantan, Sulawesi, Maluku, Nusa Tenggara, and Papua, Indonesia. Physics concepts are related to electromagnetism, fluids, heat and temperature, measurement, mechanics, nuclear physics, oscillations and waves, optics, quantity and unit, and the solar system. Additionally, most research related to local wisdom concerns traditional games.

Conclusion. Various print and digital learning media support the learning strategy. The findings of this study may serve as a foundation for developing strategies and media for further local wisdom-based physics learning.

Keywords: local wisdom, media, physics learning, strategy, SLR

Introduction

The integration of local wisdom in science learning is suggested in classroom learning. This integration aims to contextualise science in a way that makes it more accessible to students, enabling them to grasp concepts that are relevant to their daily experiences (Ha, 2024). Furthermore, the integration of local wisdom allows students to learn in a manner that aligns with their native culture (Vlaardingerbroek, 1990). This integration has been demonstrated to enhance the quality of science learning (UNESCO, 1991). This is because the success of learning is influenced by culture (UNESCO, 2008).

The integration of local wisdom in learning has a positive impact on the quality of physics learning. Empirical evidence indicates that this approach facilitates the integration of physics with students' everyday experiences, thereby enhancing their scientific understanding (Gumbo et al., 2021). Furthermore, this learning enables the meaningful comprehension of abstract physics concepts (Anantanukulwong et al., 2022). The integration also has a positive effect on student motivation and attitudes (Moro & Billote, 2019). Consequently, this interdisciplinary approach facilitates the construction of knowledge, the examination of concepts, and the development of scientific and technical abilities (Ha, 2024).

Although various learning strategies and media based on local wisdom have been implemented, some student competencies have not been achieved optimally. The concept mastery was still low and students were still found to have misconceptions (Morales, 2017a). Students' Higher Order Thinking Skills (HOTS) improvement remained suboptimal (Martawijaya et al., 2023). Furthermore, the enhancement of students' comprehension was also still inadequate (Hariyono et al., 2023). The results of those studies indicate a need for further investigation into the use of local wisdom-based learning strategies and media using systematic literature review (SLR) to provide an overview of the potential applications, developments, and creation of learning strategies and media based on local wisdom. It aims to provide teachers and lecturers with a framework for designing learning environments that optimise the quality of learning.

SLR on physics learning based on local wisdom has not been extensively conducted. Prior SLRs have focused on ethnobiology learning (Sotero et al., 2020) which primarily concerns biology learning. Other SLRs have examined the impact of local wisdom-based physics digital media on student competence (Susanto et al., 2023). Other research is in the form of bibliometric reviews on local wisdom-based learning in various fields (Muhammad et al., 2022), ethnoscience research trends (Supriyadi et al., 2023), and local wisdom research trends in physics education (Misbah et al., 2022). However, there has been no critical analysis of local wisdom-based physics learning strategies and media based on research publications from 2014 to 2024, especially in the Indonesian context. This SLR focuses on the Indonesian context because Indonesian researchers conduct the majority of research on local wisdom-based learning (Misbah et al., 2022; Supriyadi et al., 2023). Furthermore, research articles on local wisdom-based learning in Indonesia are referenced more than those from other countries (Muhammad et al., 2022). Consequently, the findings of this SLR on physics learning based on Indonesian local wisdom are expected to serve as a reference for researchers. Therefore, an SLR on physics learning based on Indonesian local wisdom was conducted to identify learning strategies and media.

Method

This research was a systematic literature review that refers to Mark Petticrew and Helen Roberts (2006). The research was completed in the following stages: defining research

questions, setting eligibility criteria, searching and selecting documents, reviewing documents in-depth, and disseminating results, as illustrated in Figure 1. The research questions included: (a) What are the general characteristics of local wisdom-based physics learning research? (b) What are the strategies for learning media with local wisdom? (c) How to develop the following local wisdom-based physics learning strategies and media?

The eligible documents for review should follow these criteria including (a) published between 2014 and 2024, as we seek to review the latest research; (b) the database used is Scopus, as it contains a significant number of high-quality, reliable, and trusted sources (Muhammad et al., 2022); (c) documents published in English (due to its status as an international language) are eligible for review; (d) documents in the form of journal articles or conference papers as they contain empirical research (Muhammad et al., 2022; Sotero et al., 2020); (e) the document is open access, allowing for comprehensive examination; (f) the documents concern the application of learning strategies and learning media based on local wisdom to the acquisition of physics concepts; (g) the documents are not SLR research, bibliometric analysis, or meta-analysis; (h) the documents focus is exclusively on Indonesian local wisdom.

The stage of searching and selecting documents employed the PRISMA diagram (Jufriadi et al., 2023; Liberati et al., 2009; Moher et al., 2009; Suryadi et al., 2023), as illustrated in Figure A1. The article search employed a combination of three terms, each pertaining to local wisdom, education, and science (Sotero et al., 2020). The results of this search can be observed in Table A1. The search was conducted in May 2024 on the Scopus database (https://www.scopus.com). The search format employed the following parameters: "Article title, abstract, keywords." This approach was used to maximise the number of documents captured (Muhammad et al., 2022). The search and selection process yielded 70 documents that underwent a comprehensive review. Following this review, the findings and recommendations are presented in this article.

Figure 1

Scheme of SLR

Source. Petticrew & Roberts (2006).

Results

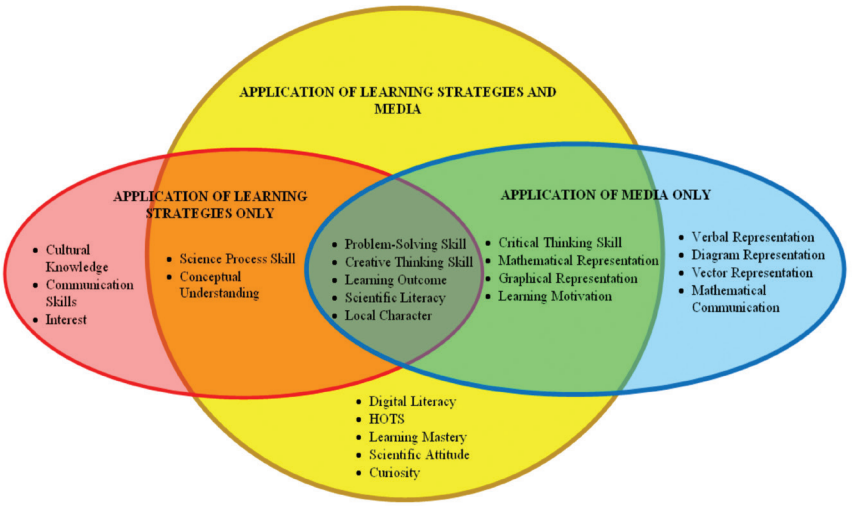
Based on the eight criteria established for screening the documents, 70 were deemed eligible. Among these documents, 30% were published in journals and 70% were conference paper articles. The development of this research publication is shown in Figure A2. In addition, the sample of each research is identified so that the educational level of the sample

can be determined, as listed in Figure A3. Furthermore, the research methods used by researchers can be seen in Figure A4. Based on this figure, it is known that the research methods vary according to the objectives of each study.

41 studies out of 70 research documents implement local wisdom-based physics learning strategies and/or media in the classroom to improve a particular competency. The distribution of competencies studied is presented in Figure A5. The remaining 29 articles did not implement strategies and media. They conducted needs analysis or validity testing. Furthermore, the results indicate that the application of local wisdom-based learning strategies and media has a positive impact on students' competencies, as illustrated in Figure 2.

Figure 2

Implementation of local wisdom-based learning strategy and media on various competencies



Source. Own research.

Furthermore, Figure A6 provides an overview of physics concepts and the origin of the local wisdom being investigated. Tables A2 to A4 describe the strategies and/or media for learning physics based on local wisdom. These tables also contain the research results, authors, and year of each research.

Discussion

The research on strategies and media with local wisdom has fluctuated. The most significant number of research publications occurred in 2021, which aligns with the findings of Misbah Misbah et al. (2022) and Supriyadi Edi et al. (2023). The most recent research in 2024 yielded only three articles, as the article search was conducted

in May 2024. This indicates that research on local wisdom-based strategies and media remains a compelling topic for investigation.

The considerable body of research on local wisdom-based strategies and media in Indonesia can be attributed to several factors. Indonesia is a nation rich in local wisdom (Misbah et al., 2022; Subali et al., 2023). Indonesia's pluralistic nature gives rise to cultural diversity, which presents an opportunity to teach physics in a contextual manner (Ernawati et al., 2024). Consequently, Indonesia can be regarded as a repository of local wisdom pertaining to physics concepts. Then, The Indonesian Government is similarly invested in preserving local wisdom. This is evidenced by implementing educational curricula, including the K-13 and Merdeka curricula. Both curricula emphasise the application of contextual learning based on local wisdom (Purnomo et al., 2023; Rohmah et al., 2024). Both are grounded in the conviction that education is inextricably linked to Indonesia's cultural diversity. Consequently, the curriculum places a premium on cultural excellence as a means of learning (Suprapto et al., 2021). The government encourages educational institutions to implement integrated learning, which integrates every physics lesson with local wisdom (Dwianto et al., 2017).

Based on the perceptions of prospective physics teacher students, it was concluded that a local wisdom-based learning model was needed and that it should be implemented in the classroom. The model is considered to help students understand the material and solve problems encountered in everyday life, as well as instill good attitudes (Martawijaya, 2018). In addition, teachers have indicated that local wisdom-based learning assisted students in mastering 21st-century skills (Abdurrahman et al., 2020; Suastra et al., 2017) and developed a noble character (Suastra et al., 2017). Consequently, local wisdom-based physics learning strategies and media are indeed required. Therefore, it is unsurprising that numerous studies on this topic have been performed in Indonesia.

Based on this explanation, it can be seen that education through local culture and community is urgently needed. However, the success of local culture and community is one of the determining factors for the success of learning. Learning will achieve the expected objective if it is influenced by local language and culture, so social participation from the community needs to be linked to the curriculum (UNESCO, 2008). In addition, local communities with their local culture and language can be a source of learning (Morales, 2017a). This further makes it easier for students to understand and master the content of the material because the content discussed can be seen, felt, and experienced (Purnomo et al., 2023; Rohmah et al., 2024). Education through local culture and community is also urgently needed because it is an alternative way to promote and preserve local wisdom from one generation to the next from an early age (Fitriah et al., 2021; Hartini, Firdausi et al., 2018; Husna & Kuswanto, 2018; Misbah et al., 2022; Raras & Kuswanto, 2019). Education through local culture and community becomes a cultural heritage in the midst of modern life.

The research was conducted at the elementary, secondary, and tertiary levels. This indicates a need for local wisdom-based strategies and media for students transi-

tioning from secondary to post-secondary education. This is corroborated by the findings of a need (Haspen & Syafriani, 2020; Kurniawan & Syafriani, 2020; Sani et al., 2021), response (Risdianto et al., 2021), and perception analysis (Abdurrahman et al., 2020) which demonstrates the necessity of integrating local wisdom-based physics strategies and media to enhance student competencies at various educational levels.

One of the research objectives of local wisdom-based strategies and media is to enhance student competencies. These competencies encompass the cognitive, affective, and psychomotor domains. The most extensively studied competency is the cognitive domain, specifically learning outcomes. The highest N-Gain of learning outcomes with a coefficient of 0.81 were observed when students learned using e-module (Matsun et al., 2019). The e-module presented the physics concept of sound wave in the traditional game of the Karbit Cannon, a large wooden object that produces an explosion due to a mixture of carbide and water. In addition, this game is also associated with collision and the law of conservation of momentum. This relevance made it easy for students to understand the material because it is contextual (Matsun et al., 2019). In addition, this success was achieved due to the module's ability to convey physics messages and content, facilitate understanding of the material, attract interest, arouse motivation, and stimulate learning activities (Arianti et al., 2022; Mastuang et al., 2019; Matsun et al., 2019).

Moreover, the integration of local wisdom into physics materials facilitates comprehension, as the delivery of the material is contextualised (Ha, 2024; Nisa et al., 2024). This integration also affects students' psychology. Students are motivated to learn because they study their own culture (Matsun et al., 2019). The digital module offers several advantages, including flexibility in learning. Students can learn at their own pace and in their own time, with the option of independent study using the internet (Matsun et al., 2019).

Learning strategies and media also succeeded in developing character achievement. Various studies showed these positive results (Fitriah et al., 2021; Hartini et al., 2017; Hartini, Isnanda et al., 2018; Hartini, Firdausi et al., 2018; Mastuang et al., 2019; Wati et al., 2020). The characters that develop are hard work (Hartini et al., 2017), multi-talented (Hartini, Isnanda et al., 2018), cooperation and tolerance (Hartini, Firdausi et al., 2018); religious (Mastuang et al., 2019), cooperation (Wati et al., 2020), union and deliberation (Fitriah et al., 2021). These characters develop well because learning is equipped with textbooks (Fitriah et al., 2021) and modules integrated with local wisdom (Hartini et al., 2017; Hartini, Isnanda et al., 2018; Hartini, Firduasi et al., 2018; Mastuang et al., 2019; Wati et al., 2020). These textbooks and modules not only contained physics concepts in local wisdom, but also contained character values contained in the local wisdom. At each class meeting, students learnt physics concepts in local wisdom while studying the character content and practicing it during learning. Therefore, students' characters developed.

The following competency that develops is the psychomotor domain, namely science process skills. These skills include observing, measuring, experimenting, and drawing

conclusions (Dwianto et al., 2017). These skills developed as local wisdom-based learning was implemented. Students were also given worksheets while practicing science process skills. Learning was associated with phenomena experienced in everyday life, namely the local wisdom of the region. This made students interested and happy to learn so that they were actively involved in learning activities. As a result, their skills improved.

The most prevalent research method employed is 4D. This method is a research and development design by Sivasailam Thiagarajan et al. (1974) comprising four stages: Define, Design, Develop, and Dissemination. This method is widely utilised due to its suitability for developing local wisdom-based learning strategies and media (Hariyono et al., 2023). Additionally, this method is straightforward and requires minimal time. This method has been demonstrated to yield learning strategies and learning media that are suitable for use in the classroom (Aminuddin et al., 2023; Dewi & Kuswanto, 2023). Furthermore, this method has been demonstrated to produce learning strategies and learning media that are effective in enhancing student abilities (Dwianto et al., 2017; Lubis et al., 2021; Nasution et al., 2018; Raras & Kuswanto, 2019).

Local wisdom-based learning strategies and media are suitable for teaching various physics topics. The three most explored physics concepts are mechanics, heat and temperature, and vibration and waves. This indicates that local wisdom-based strategies and media align with the characteristics of physics materials (Anantanukulwong et al., 2023). The abstract nature of physics becomes more concrete when it is contained in local wisdom that can be seen and felt (Alfianti et al., 2023; Anantanukulwong et al., 2023; Wahyudi et al., 2023). Local wisdom may take the form of materials, including games, food, and traditional musical instruments. Additionally, local wisdom can be immaterial, including traditions, characters, and beliefs.

The integration of physics concepts into Indonesian local wisdom offers a multitude of benefits. Physics concepts in local wisdom taught in the classroom serve as a conduit between traditional knowledge and modern science (Ha, 2024; Nisa et al., 2024). This aligns with the nature of science, which encompasses not only the acquisition of knowledge but also the process of discovering and reconstructing knowledge from the environment and society (Parmin & Trisnowati, 2024). Similarly, physics concepts are also embedded in the local wisdom of other countries, including South Africa (Fakudze, 2021; Gumbo et al., 2021), Mozambique (Baquete et al., 2016), Thailand (Anantanukulwong et al., 2022; Anantanukulwong et al., 2023; Chaijalearn et al., 2023; Xuto, 2019), Filipina (Morales, 2017a; Morales, 2017b; Moro & Billote, 2019), Vietnam (Ha, 2024), and South Korea (Kim, 2016). This represents a potential avenue for students to understand physics concepts through the lens of their local wisdom.

There are several local wisdom-based strategies for learning physics. All of these strategies are employed to develop students' competencies. All of these strategies implement a contextual approach to the learning process. This approach emphasises the acquisition of knowledge and experience based on the real world, to facilitate

meaningful learning (Bryce & Blown, 2024; Lestari et al., 2021; Novak, 2002; Zuliana et al., 2023).

Local wisdom-based learning strategies and media are based on specific learning theories. The learning strategies and media are rooted in David Paul Ausubel and Joseph Donald Novak's meaningful learning theory (Afrizon et al., 2020). This theory posits that the meaningful linking of new information with previous knowledge, as opposed to mere memorisation, will result in a more enduring and facile assimilation of subsequent knowledge (Bryce & Blown, 2024). The other theory is rooted in Jerome Bruner's learning theories of discovery, Lev Vygotsky's social constructivism, and the cone experience of Edgar Dale (Hariyono et al., 2023). Bruner emphasises exploratory learning environments where students learn the unknown through discovery (Hariyono et al., 2023). Furthermore, social constructivist learning theory posits that students construct knowledge based on experiences gained when socially interacting with their environment (Newman & Latifi, 2021). Then, the experience cone theory, as proposed by Edgar Dale, posits that students initially learn physics through direct experience and concrete reality in their environment, subsequently transferring this knowledge to artificial objects and finally to abstract symbols (Liliawati et al., 2016). The incorporation of hands-on learning through the performance of authentic tasks has been demonstrated to facilitate the acquisition and retention of knowledge, with an estimated 90% more excellent retention observed (Moro & Billote, 2019).

Other learning strategies and media are rooted in the taxonomy of science education proposed by Robert E. Yager and Alan J. McCormack (Dwianto et al., 2017). The taxonomy comprises five domains, namely knowledge, process, creativity, attitude, and application, and connection (Yager & Mccormack, 1989). Instruction that incorporates these five domains facilitates meaningful learning, which in turn enhances students' learning outcomes. This taxonomy provides students with opportunities for stimulation through the application and combination of concepts and process skills about the real world (Yager & Mccormack, 1989).

In comparison to the research conducted in other countries, the theory that forms the foundation for integrating local wisdom into physics learning strategies is the third-generation Cultural Historical Activity Theory (CHAT) proposed by Yrjo Engeström (Morales, 2017a). The minimum elements of this activity system are subjects, mediating artifacts, objects, rules, communities, and division of labour (Cong-Lem, 2022a; Engeström, 2000; Engeström & Sannino, 2021; Grimalt-Alvaro & Ametller, 2021). If curriculum materials are incongruous with the local environment and culture of students, they will experience difficulty processing the content, particularly if it adopts an unfamiliar context and uses a foreign language (Committee on Undergraduate Science Education, 1997). Furthermore, CHAt is predicated on sociocultural approaches to learning and development (Salloum & BouJaoude, 2021).

Other research on learning strategies that combine Western science and local South African knowledge have been carried out by Mishack T. Gumbo et al. (2021).

This learning integrates conceptualisation, meaning, and application of science in and out of school (Cong-Lem, 2022b; Gumbo et al., 2021). Students engage in discourse pertaining to the physical science acquired at school and the traditional knowledge acquired from their homes and communities (Cong-Lem, 2022b; Glăveanu, 2020; Gumbo et al., 2021). This incorporation is based on Vygotsky's sociocultural theory, which emphasises the cultural perspective of science and the social approach to science learning as enculturation (Gumbo et al., 2021). This theory is supported by research results indicating that local worldview presuppositions influence students' physics conceptions (Fakudze, 2021).

Another medium based on local wisdom is an electronic module designed based on the Technological Pedagogical Content Knowledge (TPACK) framework. This theory underscores the significance of integrating technology into the learning process (Celik, 2023; Kim et al., 2021; Ning et al., 2022; Purwaningsih et al., 2020). The efficacy of these media in enhancing student competence across the cognitive, affective, and psychomotor domains has been substantiated by empirical evidence (Dewi & Kuswanto, 2023; Dwianto et al., 2017; Hariyono et al., 2023). In comparison to other countries' local wisdom-based learning media research, module development in the Philippines is based on the progressive philosophy of John Dewey and Johann Pestalozzi (Moro & Billote, 2019). This philosophy states that learning should align with the reality of society.

Based on this explanation, it can be seen that the strategies and learning media based on local wisdom have strong basic theories. This theory includes learning theories, namely meaningful learning theory, discovery Bruner's learning theory, social constructivism theory, and the taxonomy of science education. Theories that support the development of learning media, namely the cone experience of Edgar Dale, the TPACK framework, and the progressive philosophy. Another basic theory is cultural activity theory, namely the third-generation CHAT. All of these theories support media and physics learning strategies to be integrated with local wisdom that students encounter in their surroundings so that they can more easily develop their competencies.

Moreover, this SLR suggests avenues for further research. While local wisdom-based learning strategies and media have a positive impact on the development of student competencies, there are still various student competencies that require improvement. For instance, students had the lowest N-gain in the creation indicator (Martawijaya et al., 2023). This is because students are accustomed to solving problems with formulas without understanding the meaning of the formula, which renders them unable to solve real-world problems (Martawijaya et al., 2023; Parno et al., 2019). Furthermore, problem-solving skills only increased by 40.63% due to a lack of experience with complex problems (Alfianti et al., 2023). Another issue that requires further investigation is the efficacy of vector representation. Studies have shown that students in conventional classes demonstrate superior proficiency in this area compared to those who learn with local wisdom-based learning media (Husna & Kuswanto,

2018). Moreover, not all indicators of understanding of physics concepts demonstrated improvement, particularly with regard to the compare sub-indicator (Hariyono et al., 2023). Additionally, 21.42% of students exhibited low literacy skills, while 4.76% demonstrated deficient literacy skills (Rahmawati et al., 2021). Consequently, local wisdom-based learning strategies and media require further refinement or redevelopment to enhance these suboptimal competencies.

Prior to the development of physics learning strategies and media containing local wisdom, a need analysis should be conducted. A need analysis is a process to identify the needs and conditions of students to ensure that the learning strategies and media designed to meet these needs and conditions appropriately (Azis & Yulkifli, 2021; Risdianto et al., 2021). Furthermore, a need analysis is also conducted to identify the needs of teachers in the context of teaching (Abdurrahman et al., 2020; Putry et al., 2018) and ascertain the responses of teachers and students, particularly the level of interest (Delima et al., 2018; Risdianto et al., 2021). A need analysis enables the identification of the characteristics of strategies and media that are appropriate for implementation in the classroom (Suastra et al., 2017).

In addition, ethnographic research is also required before learning strategies and media with local wisdom can be developed. Ethnographic research examines the relationship between physics concepts and local wisdom (Baquete et al., 2016; Morales, 2017b). This process ensures the validity of the physics concepts contained in local wisdom and facilitates the preparation of physics learning strategies and media that are appropriate to the characteristics of the physics concepts.

Subsequently, developing learning strategies and media with local wisdom must be founded upon learning theories. This learning theory serves as a reference for the design of learning strategies and media that align with the anticipated learning objectives (Gumbo et al., 2021; Morales, 2017a; Moro & Billote, 2019). The implementation of learning strategies and media with local wisdom, grounded in specific learning theories, has demonstrated efficacy in enhancing student competencies (Gumbo et al., 2021; Hariyono et al., 2023; Moro & Billote, 2019).

The variety of competencies that can be developed is more varied when the application of local wisdom-based learning strategies is supported by learning media. This indicates that numerous studies substantiate the implementation of learning strategies incorporating local wisdom, which should be accompanied by the utilisation of media to facilitate the development of cognitive, affective, and psychomotor learners. This is consistent with the intrinsic function of media as a conduit for the delivery of learning content (Nyirahabimana et al., 2022). Furthermore, learning media facilitates students' exploration of material, practice, and testing of skills (Girwidz et al., 2019). Furthermore, media facilitates understanding, encourages enthusiasm for learning, and helps students remember material (Abdulrahaman et al., 2020; Nyirahabimana et al., 2022). Therefore, learning strategies with local wisdom are effective when assisted by learning media.

Conclusion

The results of this study identified 70 articles related to physics learning strategies and media based on Indonesian local wisdom published between 2014 and 2024. The majority of the research was published in 2021 and utilisation samples of high school students. Additionally, local wisdom-based physics learning strategies and media were implemented to enhance student competencies in three domains: cognitive, affective, and psychomotor. Notably, almost all regions in Indonesia possess local wisdom encompassing physics concepts. The linkage of these concepts with local wisdom is then taught in the classroom through models, approaches, and learning methods supported by learning media. Based on this, it can be concluded that in Indonesia, the integration of local wisdom is one of the focuses of education by the demands of the curriculum in this country. This integration is in the form of learning strategies and media. Indonesian local wisdom is a bridge between physics and real life which has been proven to have a positive effect on the development of student competence. Further development and application of local wisdom-based physics learning must consider the inadequate competencies of students, the needs of students and teachers or lecturers, ethnography research, and learning theory.

Limitation

It should be noted that this research is subject to certain limitations. The local wisdom presented in this study is derived exclusively from Indonesia. It is possible that each country possesses local wisdom pertinent to the field of physics, yet this was not the subject of this research. Furthermore, the document search is based on specific keywords, which may result in different documents being retrieved for different keywords. The documents searched are limited to the Scopus database of open-access, English journals, and conference papers. There may be relevant documents in other databases with different types of publications and languages. Therefore, this SLR must be extended to other databases, publication types, and languages used, not only in the Indonesian context, to produce a broader and more comprehensive analysis.

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Appendix

Table A1

The total number of documents obtained based on a combination of three terms

Education Term	Science Term	Local Wisdom Term										Total
		Local Wisdom	Ethnoscience	Indigenous Knowledge	Local Genius	Local Knowledge	Traditional Knowledge	Native Knowledge	Culture	Cultural	Cultural Transmission	
Education	Physics	60	6	9	1	1	1	0	139	115	12	344
	Science	3	2	163	0	8	93	0	1929	2142	185	4525
Learning	Physics	71	20	11	0	1	2	0	145	105	12	367
	Science	68	51	125	0	78	33	1	1221	1295	129	3001
Pedagogical practice	Physics	0	0	0	0	0	0	0	3	2	0	5
	Science	0	0	0	0	0	0	0	17	17	4	38
Student	Physics	61	16	6	0	0	2	0	176	118	10	389
	Science	62	42	40	1	16	19	1	1270	1488	138	3077
Teaching	Physics	2	0	1	0	0	0	0	92	71	3	169
	Science	18	15	37	0	11	5	0	682	737	61	1566
Total	345	152	392	2	115	155	2	5674	6090	554	13481	

Source. Own research.

Table A2

Physics learning strategy and media based on local wisdom

No.	Learning Strategy and Media	Research Results	Author and Year
1.	Active learning model with a worksheet and android media "Boyfis"	The media was valid and had good readability.	Mudjid et al. (2017)
2.	Contextual approach with REACT model (Relating, Experiencing, Applying, Cooperating, and Transferring) supported by ethnoscience-themed picture books embedded in context-based learning (EthCBL) and worksheet	Scientific literacy had increased.	Yuliana et al. (2021)
3.	Cooperative learning model with teacher's book and student's book	The developed book was valid, practical, and able to improve learning outcomes.	Lubis et al. (2021)
4.	Digital learning integrated with local wisdom using E-book and LKPD through Google Classroom	Physics problem-solving skills and digital literacy have improved with a medium category and teachers practically applied each learning phase.	Siswanto et al. (2022)
5.	Discovery learning model with EGEBLM worksheet and teaching materials	Physics understanding and learning motivation have improved.	Hariyono et al. (2023)

No.	Learning Strategy and Media	Research Results	Author and Year
6.	Ethno-STEM approach with smartphone-based E-module	Media was needed in schools.	Azis & Yulkifli (2021)
7.	Ethno-STEM learning assisted by RE-STEM App.	Scientific literacy skills have increased.	Subali et al. (2023)
8.	Ethno-STEM-Project-Based Learning Model with worksheet and module	Average HOTS on all indicators increased with the medium category, and misconceptions decreased	Martawijaya et al. (2023)
9.	Guided inquiry learning model with e-module	Schools needed e-module. The developed e-module was valid so that students can use it.	Kurniawan & Syafriani, (2020), Kurniawan & Syafriani (2021)
10.	Hybrid Ethnoscience Project-Based Learning (E-PjBL) integrated with virtual assistive technology (VAT)	Critical thinking skills have increased.	Wahyudi et al. (2023)
11.	Inquiry-creative learning integrated with ethnoscience with learning modules and worksheets	Critical thinking skills were better than before.	Verawati et al. (2022)
12.	Local Wisdom-Based Learning through LMS (Learning Management System)	Creative thinking skills have developed.	Hikmawati & Suastra (2023)
13.	Experimental method with textbooks	Media was valid, and scientific literacy increased.	Rusilowati et al. (2021)
14.	The practical method with a practical module	The practicum module was valid.	Zainuddin et al. (2021)
15.	I-CLORE (Islamic-Connecting to Local Wisdom, Organizing, Reflecting, and Extending) model with textbook	The developed book was very valid, the effectiveness of learning outcomes in the medium category, and it instills local characters very well.	Fitriah et al. (2021)
16.	Online learning through LMS Moodle and modules	Learning outcomes have increased.	Irfandi et al. (2023)
17.	Problem-Based Learning with Physics Pocketbook Integrating Augmented Reality	Mathematical and graphical representation abilities have increased.	Rahmasari & Kuswanto (2023)
18.	Problem-Based Learning with Textbook	Learning mastery increased.	Fauzana et al. (2019)
19.	Project Based Learning with a portable laboratory	Learning outcomes improved.	Susanto et al. (2023)
20.	Science domain-based learning integrated local wisdom with worksheet	Science process skills and scientific attitude improved.	Dwianto et al. (2017)

No.	Learning Strategy and Media	Research Results	Author and Year
21.	Science learning-based ethnoscience approach with booklet.	Local wisdom can be used as an alternative to science literacy and has the potential to be used as a reference in integrating local wisdom and science.	Novitasari et al. (2017)
22.	Scientific inquiry model with worksheet, student's book, and teacher's guidebook	Media was valid and able to improve science process skills and curiosity.	Nasution et al. (2018)
23	STAD type of cooperative learning model and contextual approach with textbook and Student Activity Sheet (SAS)	The learning tools were valid and could be applied in the field test.	Melyasari et al. (2018)
24	STEM approach with book	The developed book was valid.	Putra et al. (2023)
25.	The online learning using Zoom Cloud Meeting (ZCM), Google Meet (GM), and a combination of GM and learning management system (LMS)	Higher Order Thingking Skill increased.	Hikmawati et al. (2024

Source. Own research.

Table A3

Physics learning strategy based on local wisdom

No.	Learning Strategy	Research Results	Author and Year
1.	Arts-based instruction	Integrating traditional dance with physics learning through video analysis of art performances allowed for the incorporation of art into the learning process.	Handayani et al. (2016)
2.	Direct instruction learning model	The learning model got a positive response from students.	Risdianto et al. (2021)
3.	E-SETSaR approach	Problem-solving, creative thinking, and communication skills have improved.	Winarto et al. (2021)
4.	Ethnopedagogical approach	Scientific literacy skills have accelerated.	Rahmawati et al. (2021)
5.	Ethno pedagogy-integrated STEM learning approach.	There was potential for integrating local potential into STEM learning.	Abdurrahman et al. (2020)
6.	Ethnoscience approach	Physics concepts can be found in traditional games, thus allowing for their integration in learning.	Kasi et al. (2022)
7.	Ethnoscience approach with experimental method	Numerous physics concepts can be explored from the local wisdom of Surabaya City.	Suryanti et al. (2021)
8.	Mandar local wisdom-based learning model	Prospective physics teachers agreed that the learning model applied to physics learning.	Martawijaya (2018)
9.	Practical method with Visual Analyzer software	Physics parameters in traditional musical instruments could be measured effectively, thus allowing for more meaningful learning and alignment with the environmental context.	Afrizon et al. (2020)

No.	Learning Strategy	Research Results	Author and Year
10.	Physics teaching based on local culture-based characters	Local character could be developed in physics teaching through appropriate methods, including inquiry, discussion, and demonstration.	Suastra et al. (2017)
11.	Project Based Learning	Interest and learning outcomes increased.	Mashudi (2017)
12.	Science learning oriented towards science process skills	The reconstruction of indigenous knowledge in making traditional food could be utilised as a scientific basis for mapping competencies in science learning, which could then be applied to train science process skills.	Jufrida et al. (2021)
13.	Scientific approach	Local wisdom can be integrated with science learning.	Suarmika et al. (2020), Hikmawati et al. (2021)
14.	SETS approach	Local wisdom can be integrated with science concepts.	Basuki et al. (2019)
15.	STEM-integrated ethnoscience learning	The scientific concepts derived from the reconstruction can be integrated into science learning through the STEM approach.	Izzah et al. (2020)
16.	T-TRACESS model	The participants demonstrated an enhanced conceptual understanding and cultural knowledge.	Pramuda et al. (2019)

Source. Own research.

Table A4

Physics learning media based on local wisdom

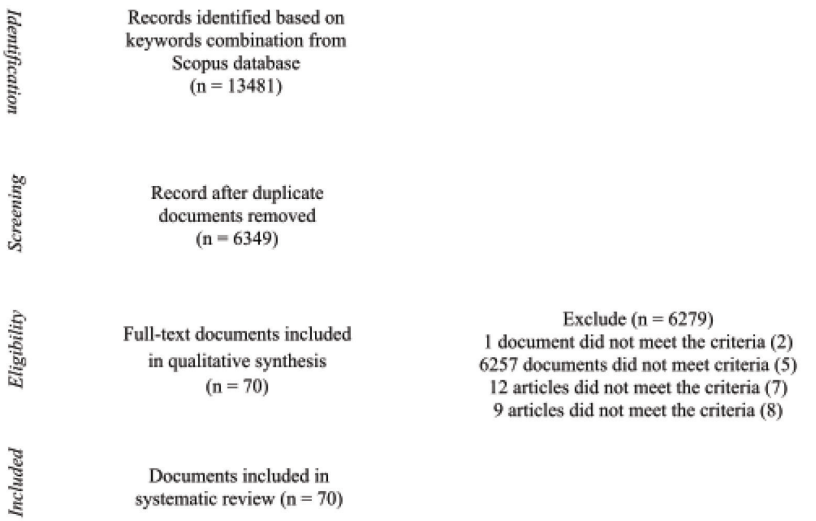
No.	Learning Strategy and Media	Research Results	Author and Year
1.	Android-assisted physics learning media	The learning media, vector representation, and diagram representation abilities have all been improved.	Husna & Kuswanto (2018)
2.	Android-based physics e-book	The media was valid and appropriate for the learning process.	Wardani & Mundilarto (2021)
3.	Augmented reality-assisted physics e-module	Mathematical communication and critical thinking abilities have also been enhanced.	Dewi & Kuswanto (2023)
4.	Direct current electricity-augmented reality (DICTY-AR) media	The media developed is highly valid and has excellent readability, which improves representation and problem-solving skills.	Alfianti et al. (2023)
5.	Electronic comic	The media has been designed by the principles of physics.	Ramadhan et al. (2019)
		The developed media was valid.	Sari et al. (2019)
		Media was feasible to use in physics learning.	Haroky et al. (2020)
		Mathematical representation ability and creative thinking skills increased.	Sari et al. (2020)
		Learning outcomes were very good.	Ntobuo et al. (2018)
		Verbal representation and critical thinking abilities improved.	Damayanti & Kuswanto (2021)

No.	Learning Strategy and Media	Research Results	Author and Year
6.	Electronic module	The effectiveness of learning outcomes was in the high category, and the response to the media was excellent. E-modules are needed.	Matsun et al. (2019) Haspen & Syafriani (2020)
7.	Interactive multimedia	The developed media was valid and practical to use. It could be employed to enhance learning outcomes in a medium category.	Wiyono et al. (2020)
8.	JEMASIK (Jemparingan Applied Physics) Android Assisted Learning Media	The developed media was also valid and could be utilised to improve graphic and vector representation abilities.	Raras & Kuswanto (2019)
9.	Learning video	Science literacy was in the moderate category.	Martawijaya et al. (2024)
10.	Module	The developed module was valid and practical and could enhance learning outcomes while instilling local character.	Hartini et al. (2017), Hartini, Firdausi et al. (2018), Hartini, Isnanda et al. (2018), Mastuang et al. (2019), Wati et al. (2020)
11.	Multimedia learning modules	The media was necessary for students. The developed media was valid and could enhance students' abilities to represent diagrams.	Putry et al. (2018) Warsono et al. (2020)
12.	Multimedia learning modules based on seven characteristics	Media was needed by teachers and students	Delima et al. (2018)
13.	Physics enrichment book	The developed media was valid	Alatas et al. (2023)
14.	Physics Mobile (Android) Learning Media	The developed media was valid and could improve learning outcomes	Saputra & Kuswanto (2018)
15.	Physics teaching material Newton's law based on local wisdom	The teaching materials developed were valid and could be used in learning	Husin et al. (2022)
16.	Worksheet	Worksheets contributed to increase motivation and problem-solving skills	Nisa et al. (2024)

Source. Own research.

Figure A1

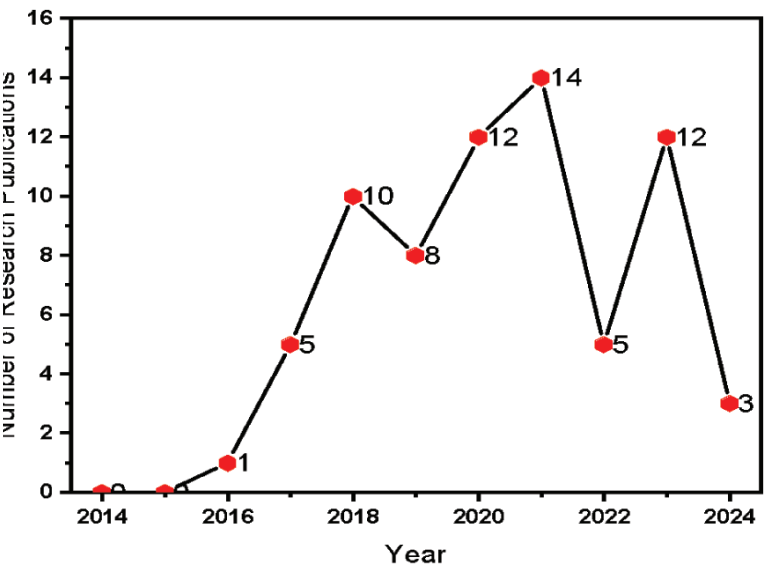
The stages of PRISMA



Source. Own research.

Figure A2

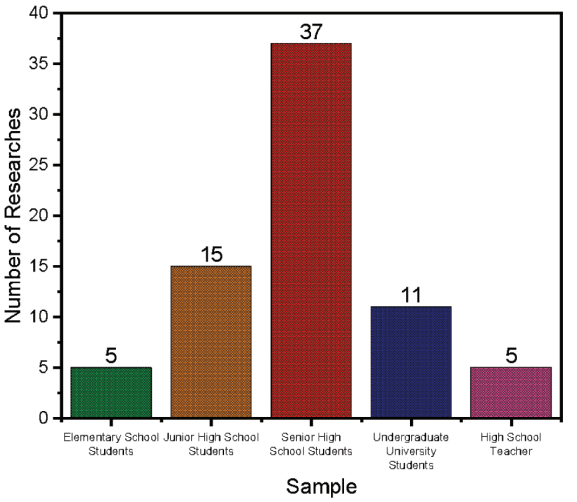
Progression of research publication



Source. Own research.

Figure A3

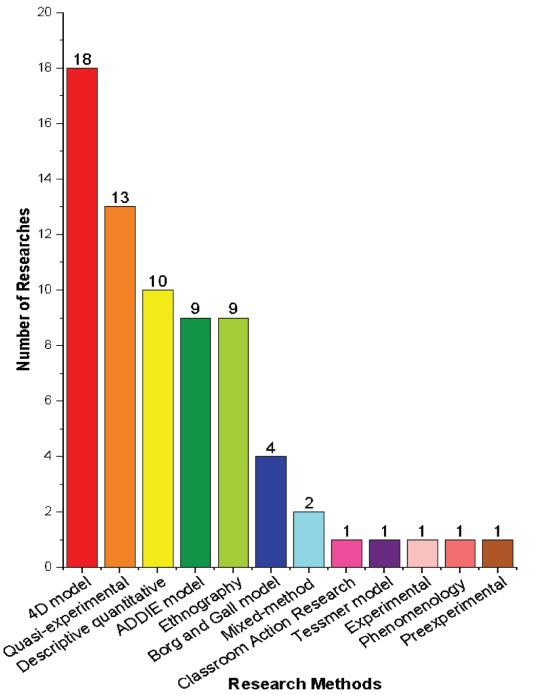
Research sample



Source. Own research.

Figure A4

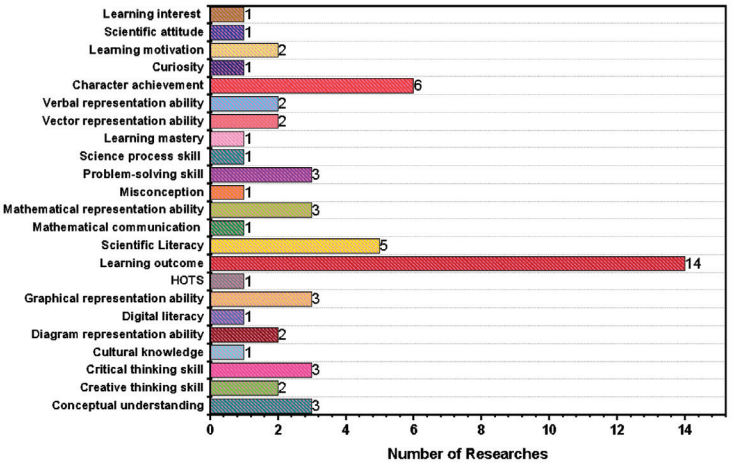
Research methods



Source. Own research.

Figure A5

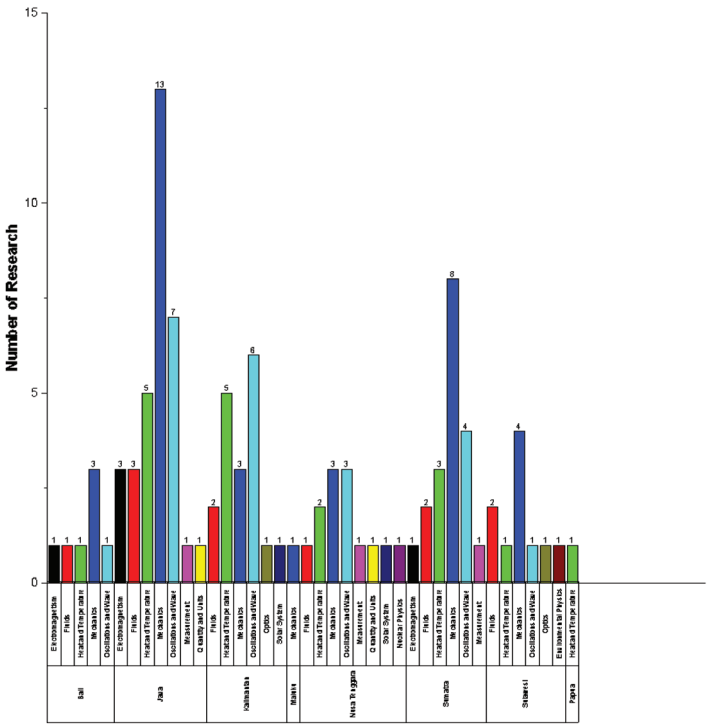
Competencies developed



Source. Own research.

Figure A6

Physics concepts and the origin of the local wisdom



Source. Own research.

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