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Mapping the Landscape of Physics Learning Research on Local Wisdom: A Bibliometric Study

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ABSTRACT

Objective: *This study aims to map the research landscape of physics education that integrates local wisdom. It identifies key trends, author collaborations, and thematic clusters in publications, providing insights for future research and curriculum development.* ***Method:*** *A bibliometric analysis approach was employed, collecting articles from Google Scholar using the Publish or Perish software, with a focus on publications from 2018 to 2024. The PRISMA protocol was followed for systematic data screening, resulting in 150 relevant articles. The metadata was analyzed using VOSviewer to generate visualizations of keyword networks, author collaborations, and research clusters.* ***Results:*** *The analysis revealed that "local wisdom" is a central theme connected to ethnoscience, Islamic physics, digital learning tools, and specific cultural contexts, such as Karapan Sapi. Four major research clusters were identified: cultural-based learning, religious integration, digital innovation, and contextual learning. The study also highlights the dominance of Indonesian researchers in this field and the growing interest in integrating local knowledge into physics education.* ***Novelty:*** *This study provides the first comprehensive bibliometric mapping of physics education research on local wisdom, offering an in-depth overview of trends, gaps, and collaborative networks. It emphasizes the role of indigenous knowledge in enhancing science literacy, sustainability education, and 21st-century skills in physics learning.*

INTRODUCTION

Physics education in Indonesia faces the challenge of bridging the gap between abstract scientific concepts and students' daily life contexts (Laos & Tefu, 2020). To make learning more meaningful, a local wisdom-based approach has emerged as an effective strategy to contextualize physics materials according to students' culture and environment. This integration not only enriches the learning experience but also strengthens cultural identity and local values in the educational process (Sholahuddin & Admoko, 2021; Kasim et al., 2023).

Local wisdom encompasses knowledge, values, and practices that evolve within a particular community and are transmitted from one generation to the next (Kasim et al., 2022). In the context of physics education, local wisdom can be integrated through various means, such as the use of traditional games, local musical instruments, or agricultural practices that contain physics concepts. Physics teaching materials developed using an ethnoscience approach based on traditional games have been shown to improve students' critical thinking skills (Fianti & Neratania, 2024).

Integration of local wisdom in physics learning also contributes to improving students' scientific literacy. Ethnoscience-based learning modules are effective in

improving students' understanding of scientific concepts and environmental awareness (Sihombing et al., 2024). This shows that this approach is not only culturally but also pedagogically relevant. Furthermore, the integration of local wisdom in physics education supports the development of 21st-century skills, including scientific communication and problem-solving. A science learning model that integrates local wisdom significantly improves the scientific communication skills of student teachers in ecology learning (Yasir et al., 2020). These findings emphasize the importance of this approach in preparing students to face global challenges.

Although various studies have explored the integration of local wisdom in physics education, there has been no comprehensive mapping that describes the research landscape in this field. Bibliometric analysis can provide insight into research trends, author collaborations, and dominant topics, as well as identify research gaps that need to be filled (Alhusni et al., 2024). Bibliometric analysis enables researchers to understand how a particular topic has evolved, identify key actors in the field, and examine the formation of collaborative networks. Mapping research on local wisdom in physics education can inform future studies and lead to more contextual and inclusive education policies. In addition, understanding the geographic and institutional distribution of this research can reveal how local contexts influence pedagogical approaches. For example, the integration of ethnoscience in physics teaching materials in the Enggros and Tobati communities in Jayapura improved students' science process skills and conceptual mastery (Pieter & Risamasu, 2024).

Thus, this study aims to map the landscape of physics education research that integrates local wisdom through bibliometric analysis. By employing the PRISMA approach for systematic literature review and utilizing analysis tools such as VOSviewer, this study aims to identify trends, collaborations, and key topics in this field. The results of this study are expected to provide significant contributions to understanding how local wisdom is integrated into physics education, as well as assist researchers and educators in developing more relevant and effective learning strategies. In addition, these findings can be the basis for developing educational policies that support the preservation of local culture through science education.

RESEARCH METHOD

This study uses a bibliometric analysis approach to map the landscape of physics education research that integrates local wisdom. Bibliometric analysis was chosen because it enables the identification of research trends, collaborations between authors, and conceptual relationships between topics based on available publication metadata (Donthu et al., 2021; Alhusni et al., 2024). Data collection was conducted using Publish or Perish (PoP) version 8 to access Google Scholar with the keywords "local wisdom in physics education" and "ethnoscience in physics learning." The publication period is focused on the period 2018 to 2024 to ensure that the data is up-to-date and relevant to curriculum developments in Indonesia, such as the Merdeka Curriculum. Data was exported in RIS and CSV formats for analysis in VOSviewer software (van Eck & Waltman, 2010). The data filtering process adheres to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol, as recommended by Page et al. (2021). From the initial search results of 241 articles, filtering was carried out by checking for duplication, relevance to physics topics, and explicit involvement of local wisdom elements in teaching methods or materials. After the selection process, 150 articles remained, which were used as the final data in the bibliometric analysis.

Furthermore, the cleaned data was analyzed using VOSviewer to display the visualization of keyword networks (co-occurrence), author collaboration (co-authorship), and inter-document relationships (co-citation and bibliographic coupling). Keyword data was taken from the "author keywords" and "indexed keywords" metadata available in the bibliography file. The analysis was conducted both quantitatively (in terms of the number of documents, word frequency, and author connectivity) and qualitatively (in terms of topic patterns, theme dominance, and institutional connectivity). Interpretation of the visual map identified the main clusters, the most dominant keywords, and potential future research directions in the realm of local wisdom-based physics education.

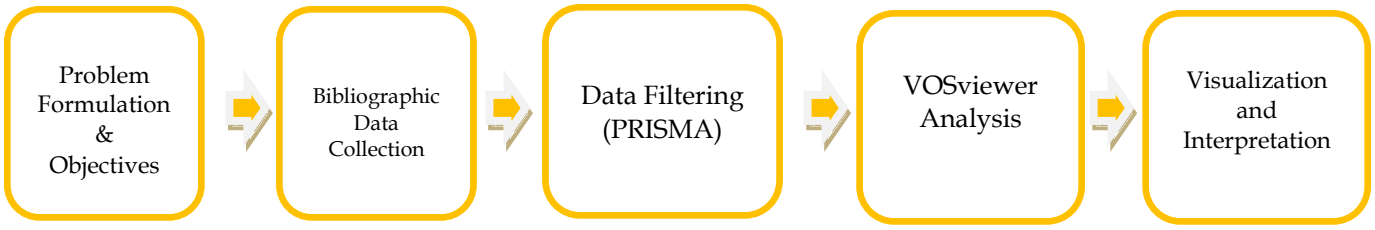

Figure 1. Research flowchart

RESULTS AND DISCUSSION

Results

Publication Trends

The number of documents obtained from the Scopus database from 2017 to 2024 is shown in the bar chart in Figure 2.

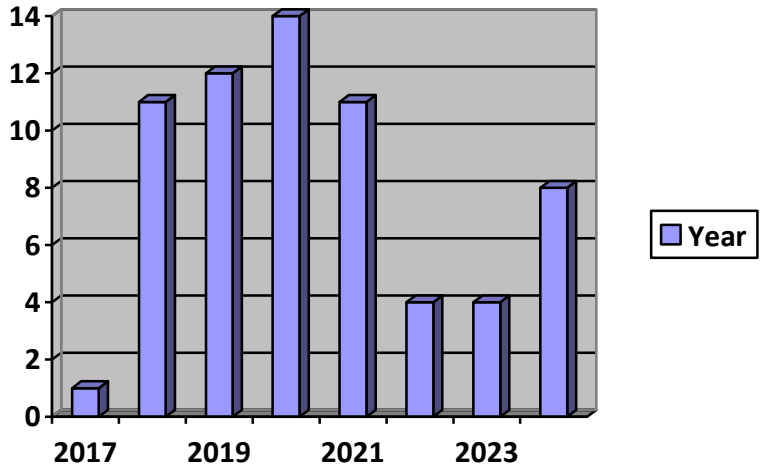

Figure 2. Publication trends

The publication trend of local wisdom-based physics education research shows fluctuations from 2017 to 2024. The number of articles has increased significantly since 2018, peaking in 2020 and 2021, with each year featuring more than 13 articles. This spike reflects attention to the importance of local context-based learning in strengthening science literacy and 21st-century skills (Yasir et al., 2020; Fianti & Neratania, 2024; Sihombing et al., 2024). However, publications decreased in 2022–2023, possibly due to a shift in research focus or limited access to the field. The increase again in 2024 indicates an opportunity for topic development in line with the implementation

of the Merdeka Curriculum. Understanding these trends is crucial for supporting the development of more relevant and sustainable research, as well as for encouraging cross-institutional collaboration. The bibliometric analysis also helps map the dynamics of research topics temporally as a basis for future research planning (Donthu et al., 2021; Alhusni et al., 2024).

Bibliometric Map

Figure 3 presents a visualization of the results derived from the database analysis.

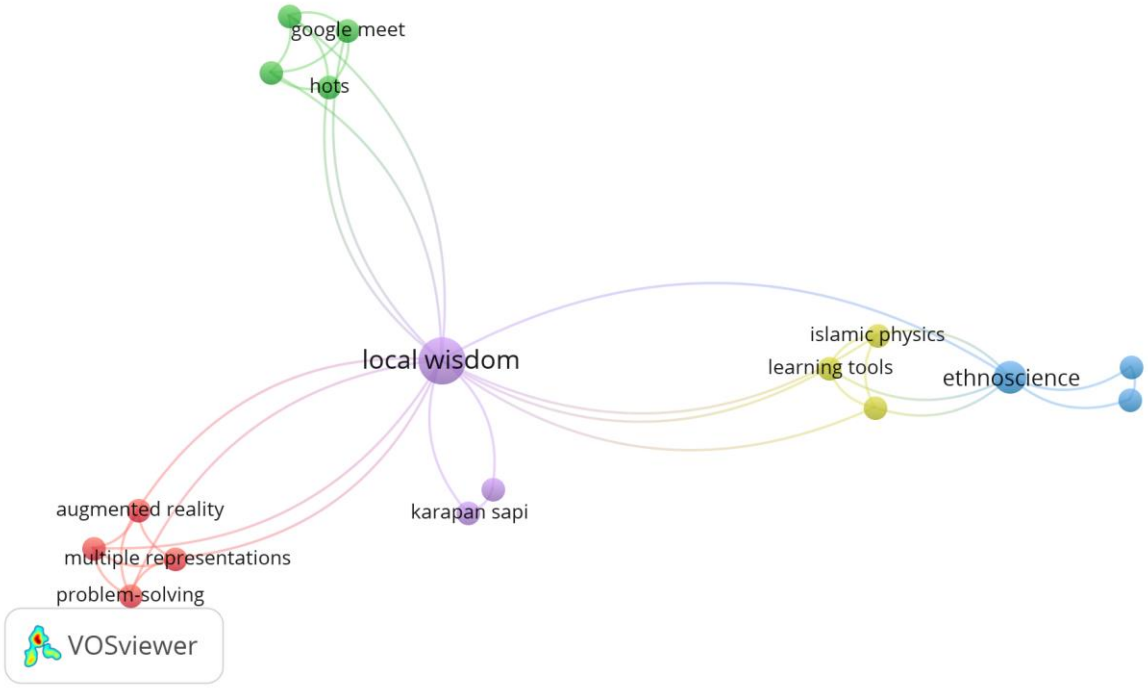

Figure 3. Bibliometric map local wisdom in physics learning

Based on the results of the analysis using VOSviewer, a visualization map of the relationship between keywords relevant to the topic of local wisdom in physics education research was obtained. This visualization illustrates how local wisdom is the central focus (primary node) and is closely related to various other topics that support the integration of local wisdom in physics education.

Keyword Network

Keyword co-occurrence analysis reveals that local wisdom is at the center of the network, closely connected to various other key terms, including ethnoscience, Islamic physics, learning tools, augmented reality, multiple representations, problem-solving, Google Meet, and HOTS. This reflects the diversity of approaches in local wisdom-based physics education research (Khoiriyah et al., 2021; Rizki et al., 2022). For example, ethnoscience is often used as a framework for developing learning materials (Suastra et al., 2020; Sari et al., 2021), while Islamic physics shows the integration of religious values into science (Saphira et al., 2022). The use of technology, such as augmented reality and digital platforms like Google Meet, reflects the adaptation of local physics learning in the digital era (Prahani & Siswanto, 2022; Putri et al., 2023). The relationship

between HOTS and problem-solving demonstrates that this research also aims to support the development of high-level thinking skills (Suastra et al., 2020; Sholahuddin & Admoko, 2021). In a more specific context, topics such as Bull Racing are used as local case studies that represent the concepts of force, motion, and energy in contextual physics learning.

Cluster Tematik

Visualization of keyword maps in bibliometric analysis yields four main thematic clusters. The Green Cluster focuses on the topic of digital technology in learning, with keywords such as Google Meet and HOTS reflecting the integration of online technology in improving critical thinking skills (Putri et al., 2023). The Red Cluster highlights technology-based learning innovations, such as augmented reality, multiple representations, and problem-solving, which serve to strengthen conceptual understanding through visualization and problem-solving strategies (Deta & Eliezanatalie, 2022). The Blue Cluster centers on ethnoscience as a culture-based learning approach, including topics such as Islamic Physics and learning tools (Khoiriyah et al., 2021; Saphira et al., 2022). Finally, the Purple Cluster focuses on a specific topic, namely Karapan Sapi, which shows an in-depth exploration of the local cultural context in science education.

Interpretasi Visualisasi

Local wisdom is central to physics education research, indicating that this theme is significant as a link between various learning approaches and technologies (Prasetyo et al., 2021). The focus on ethnoscience and Islamic physics highlights an emphasis on local context, encompassing both culture and religion, which enriches physics learning materials (Rahman & Sari, 2022). Innovations such as Augmented Reality and the use of Multiple Representations help bridge local wisdom with 21st-century learning, enabling students to understand physics concepts more concretely and contextually (Hidayat & Wulandari, 2023). Practical implementations of local wisdom, such as the Karapan Sapi case study, offer real-world examples of physics analysis in everyday life, including force, motion, and energy (Nugroho et al., 2020). In addition, the integration of local wisdom in learning supports the development of higher-order thinking skills (HOTS) and problem-solving, which are very relevant in preparing students to face global challenges.

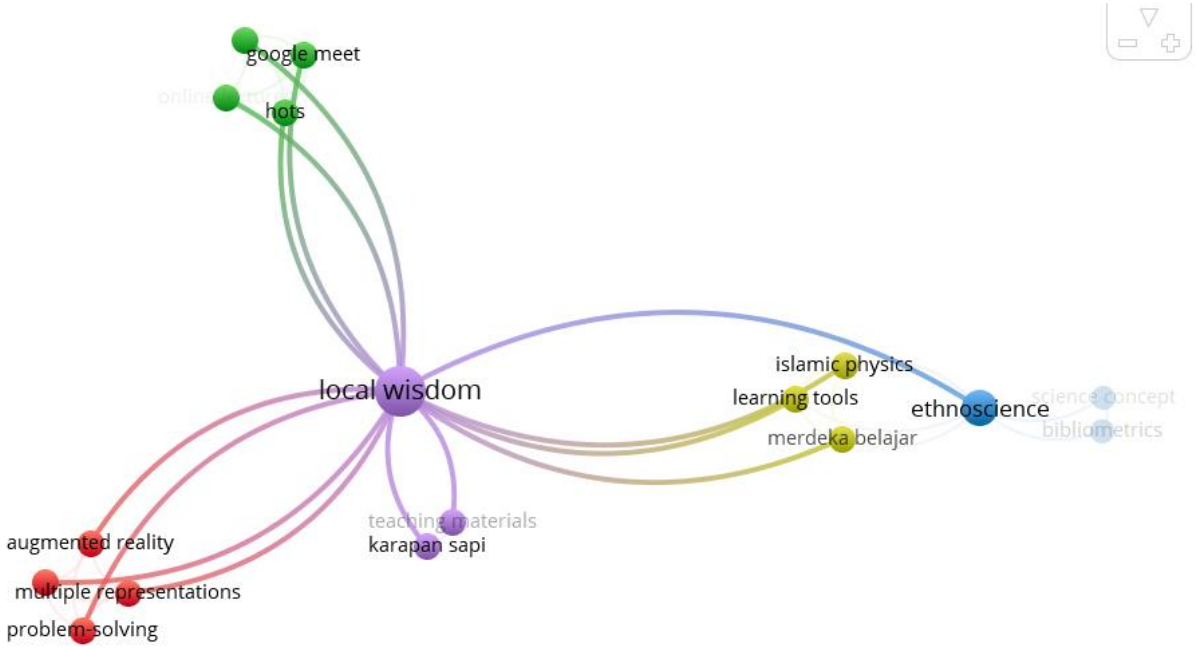

Figure 4. Local Wisdom as a network hub demonstrates the importance of this theme in physics education research, becoming a link between different approaches and technologies

Visualization of keyword networks reveals that local wisdom serves as the primary hub connecting various topics in physics education research (Deta et al., 2024; Tiro et al., 2024; Alhusni et al., 2024). This connection reflects the central role of local wisdom as a link between cultural context and modern learning approaches. Topics such as ethnoscience and Islamic physics are directly connected to local wisdom, demonstrating how local values, both cultural and religious, serve as the basis for developing physics materials (Mukaromah et al., 2022; Setianingrum et al., 2023; Lestari, 2024). In addition, the relationship with keywords such as learning tools and Merdeka bel-ajar shows how local wisdom is incorporated into the design of teaching materials relevant to the educational context in Indonesia (Muhammad et al., 2022; Eliezanatalie & Deta, 2023). Meanwhile, the relationship between local wisdom and Google Meet and HOTS reflects the adaptation of local contexts in technology-based learning and the development of high-level thinking skills (Anasi & Harjunowibowo, 2023; Lestari, 2024). Specific topics, such as Karapan Sapi, strengthen the position of local wisdom as a source of inspiration in contextual physics learning, for example, in the analysis of concepts like force, motion, and energy (Khusyairin et al., 2022). The relationship with augmented reality, multiple representations, and problem-solving demonstrates efforts to integrate local wisdom with innovative learning approaches to support the understanding of concepts visually, creatively, and practically.

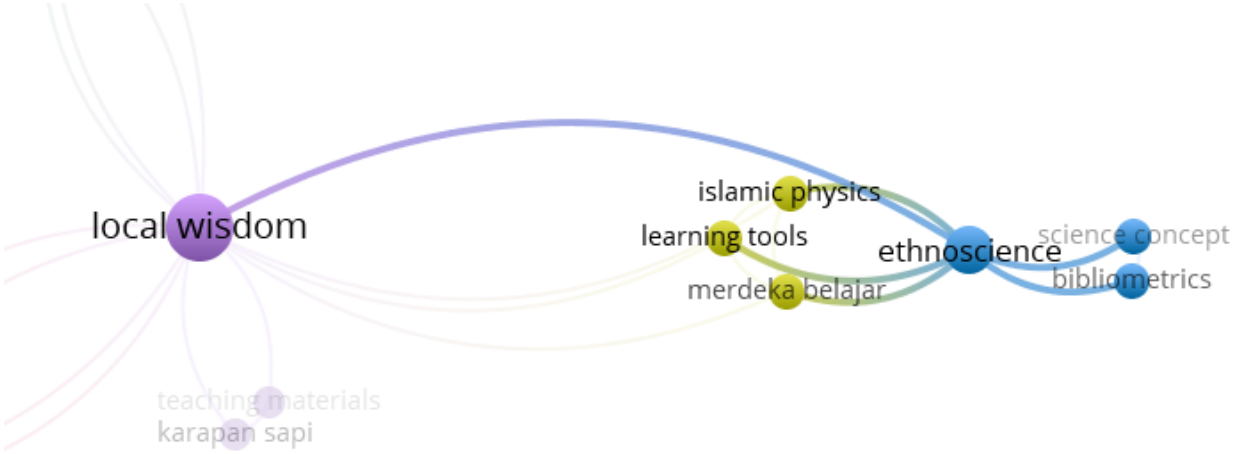

Figure 5. Ethnoscience and Islamic Physics are frequently occurring themes, indicating a focus on local context (religious, cultural) in physics learning

The results of the keyword network visualization show the dominance of ethnoscience and Islamic physics themes in local wisdom-based physics education research (Setianingrum et al., 2023; Deta et al., 2024; Lestari, 2024). The close relationship between local wisdom and the two keywords suggests the focus of the research on integrating cultural and religious values in physics learning. Ethnoscience has emerged as the primary approach that connects the context of local wisdom with physics concepts, utilizing culture, traditional practices, and local knowledge as contextual learning resources (Mukaromah et al., 2022; Fatimah, 2023). Meanwhile, Islamic physics endeavors to integrate physics learning with Islamic values, for example, by understanding the universe as a manifestation of God's greatness or by developing teaching materials based on religious teachings (Setianingrum et al., 2023). This connection reflects a strong orientation towards strengthening local identity and cultural values in the learning process while also addressing the needs of contextual education that are relevant to the characteristics of students.

Figure 6. Augmented Reality and Multiple Representations have emerged as innovative approaches to bridge local wisdom with 21st century learning

The visualization illustrates the relationship between local wisdom and innovative approaches in 21st-century learning, including augmented reality, multiple representations, and problem-solving (Anasi & Harjunowibowo, 2023; Lestari, 2024). The augmented reality approach enables the integration of local cultural elements into immersive and contextual learning experiences, allowing students to understand local wisdom through engaging and interactive visual simulations (Mukaromah et al., 2022; Lestari, 2024). Meanwhile, multiple representations support conceptual understanding through various forms of information presentation, such as text, images, graphics, and digital models, which make local cultural values more straightforward to understand for students with various learning styles (Khusyairin et al., 2022; Muhammad et al., 2022). The integration of this technology and problem-solving approaches creates an environment that fosters learning that is not only cognitively meaningful but also contextually and culturally relevant (Prahani & Neswary, 2022; Lestari, 2024; Deta et al., 2024). Thus, the use of educational technology like this can bridge local wisdom with the demands of 21st-century competencies.

Figure 7. Bull racing as a specific example shows the practical implementation of local wisdom in the context of physics, for example the analysis of force, motion, and energy

This visualization illustrates how Karapan Sapi serves as a concrete example of the application of local wisdom in the context of education, particularly in physics learning (Khusyairin et al., 2022; Deta et al., 2024). As a cultural tradition typical of Madura, Karapan Sapi can be utilized in the development of teaching materials to explain physics concepts such as force, motion, and energy. For example, the speed of the cow, the pushing force exerted by the jockey, and the kinetic energy generated during the race can be analyzed in the form of contextual questions relevant to students' daily lives (Fatimah, 2023; Lestari, 2024). With this approach, learning becomes more meaningful because it links scientific concepts with local culture while strengthening students' cultural identity and increasing their involvement in the learning process.

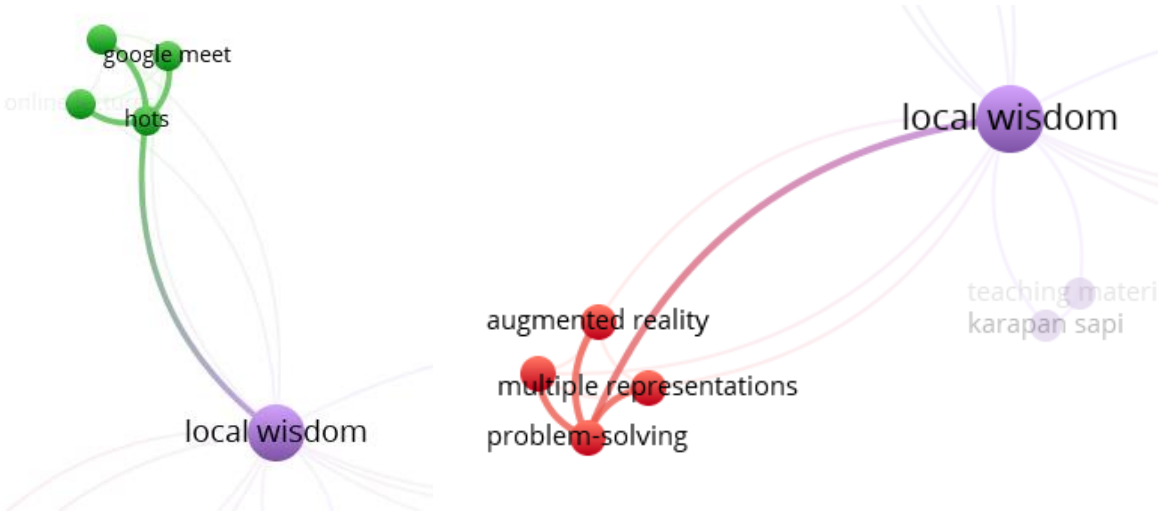

Figure 8. The relationship with HOTS (Higher Order Thinking Skills) and Problem-Solving emphasizes the relevance of local wisdom-based learning in developing critical thinking skills.

This visualization clarifies the close connection between local wisdom and learning approaches that support higher-order thinking Skills (HOTS), such as problem-solving (Anasi & Harjunowibowo, 2023; Deta et al., 2024). This connection demonstrates that local wisdom is not only a cultural heritage but can also serve as an authentic context for developing critical, analytical, and creative thinking skills (Fatimah, 2023; Lestari, 2024). When students are faced with contextual problems rooted in local cultures, such as local traditions or practices, they are encouraged to analyze situations, formulate solutions, and make decisions logically (Khusyairin et al., 2022; Mukaromah et al., 2022). Local wisdom-based learning integrated with the HOTS approach makes the learning process more meaningful and applicable while fostering concern for their social and cultural environment.

Author on Local Wisdom in Physics Learning

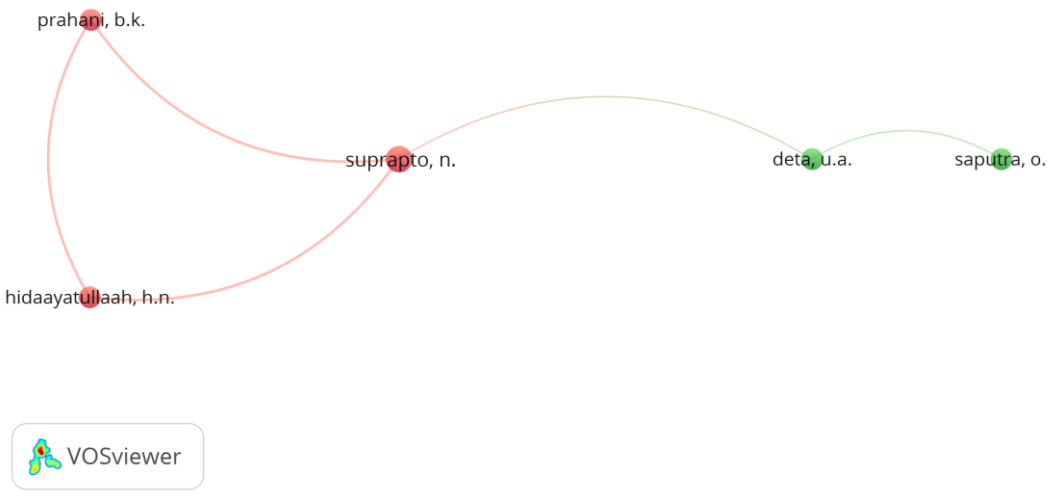

Figure 9. Author on Local Wisdom in Physics Learning

Based on the results of the VOSviewer visualization of the research data "Physics Education Research on Local Wisdom," it can be seen that Suprapto, N., plays a central role in the inter-author collaboration network (Deta et al., 2024). Suprapto, N. has strong connectivity with several other researchers, such as Prahani, B.K. and Hidayatullah, H.N., and is indirectly connected to Deta, U.A. This central position highlights the significant role of Suprapto, N. in establishing a research network and fostering scientific collaboration in the field of physics education grounded in local wisdom (Khusyairin et al., 2022; Tiro et al., 2024; Alhusni et al., 2024). The results of the VOSviewer visualization also reveal two main collaboration clusters in the "Physics Education Research on Local Wisdom" research. The Red Cluster is led by Suprapto, N., who collaborates closely with Prahani, B.K., and Hidayatullah, H.N. This cluster reflects an active group of researchers from Surabaya State University, focusing on the integration of local wisdom in physics learning (Deta et al., 2024). Meanwhile, the Green Cluster comprises Deta, U.A., and Saputra, O., forming a smaller and more specific, yet still relevant, collaborative network within the same research theme (Tiro et al., 2024; Lestari, 2024). Interestingly, Suprapto, N. acts as a liaison between the two clusters, demonstrating his significant contribution to bridging cross-group collaboration among researchers in this field.

Co-authorship analysis using VOSviewer shows that research on local wisdom in physics education in Indonesia is dominated by several key authors, with Suprapto, N. as the center of the collaboration network connecting the central cluster and new research groups such as Deta, U.A., and Saputra, O. (Deta et al., 2024; Tiro et al., 2024). This finding reflects the strength of collaboration within institutions while also indicating the emergence of a new generation of researchers (Fatimah, 2023; Lestari, 2024). This network structure also presents significant opportunities to expand collaboration, both within and across institutions, as well as across fields such as digital technology and STEM education, to enrich perspectives and diversify research.

Discussion

The integration of local wisdom in physics education has emerged as a crucial approach to contextualizing abstract scientific concepts and promoting meaningful learning. The findings of this bibliometric study reveal that local wisdom serves as a central theme connecting various subtopics, including ethnoscience, Islamic physics, augmented reality, and Karapan Sapi. This result aligns with prior research highlighting the significance of cultural context in physics learning, where indigenous knowledge enriches the learning experience by providing relevant and familiar examples (Saphira et al., 2022; Fatimah, 2023; Setianingrum et al., 2023). Local traditions, such as Karapan Sapi, offer a concrete case for exploring physics concepts like force, motion, and energy (Nugroho et al., 2020; Amiruddin, 2021). This cultural integration not only fosters student engagement but also helps develop critical thinking, problem-solving, and scientific literacy skills.

The bibliometric analysis reveals a growing trend in research on local wisdom in physics education, particularly over the last five years. This rise correlates with the implementation of Merdeka Belajar and global calls for contextual and inclusive science education (Khusyairin et al., 2022; Muhammad et al., 2022). However, the analysis also reveals that the field is still predominantly driven by Indonesian scholars, with limited international collaboration (Deta et al., 2024; Tiro et al., 2024). This suggests the need to expand research partnerships across countries to promote diverse perspectives on local

wisdom and to facilitate the global recognition of indigenous knowledge as a valuable resource in physics education (Donthu et al., 2021; Lestari, 2024). Additionally, the emphasis on Islamic physics indicates an emerging trend in integrating religious values into physics learning, which reflects the cultural and spiritual dimensions of the Indonesian context.

The network visualization also highlights the integration of local wisdom with technological innovations such as augmented reality and multiple representations, showing efforts to bridge cultural heritage with 21st-century learning tools (Hidayat & Wulandari, 2023; Putri et al., 2023). The use of augmented reality allows learners to explore traditional practices through immersive digital simulations, making abstract physics concepts more tangible (Mukaromah et al., 2022; Lestari, 2024). Moreover, multiple representations—such as diagrams, animations, and interactive models—facilitate a deeper understanding of physics by presenting information in various formats suited to different learning styles (Khusyairin et al., 2022; Muhammad et al., 2022). These technological integrations align with global educational trends that emphasize creativity, critical thinking, and problem-solving in science learning.

Despite these advancements, the study reveals several gaps that need further exploration. First, while there is considerable research on the use of ethnoscience and Islamic physics, the development of localized physics learning models using advanced technology remains limited (Prasetyo et al., 2021; Deta & Eliezanatalie, 2022). Additionally, most studies focus on primary and secondary education, with less attention to tertiary-level physics education and teacher training programs (Yasir et al., 2020; Khusyairin et al., 2022). Future research should investigate how local wisdom can be systematically embedded in pre-service teacher education and higher education curricula, as well as how it can be adapted for interdisciplinary learning across STEM fields (Sihombing et al., 2024; Pieter & Risamasu, 2024). Furthermore, a critical analysis of assessment tools that effectively evaluate students' understanding of physics concepts within local contexts is necessary.

Lastly, this study reinforces the role of local wisdom as both a pedagogical resource and a means of preserving cultural identity. Integrating local traditions into physics learning not only enhances engagement and understanding but also promotes cultural pride and sustainability values among students (Suastra et al., 2020; Kasim et al., 2022). It highlights the potential of local wisdom to contribute to broader educational goals, such as the Sustainable Development Goals (SDGs), by fostering environmental awareness and appreciation for indigenous knowledge systems (Sihombing et al., 2024; Lestari, 2024). Therefore, leveraging local wisdom in physics education can serve as a transformative strategy that bridges scientific knowledge, cultural heritage, and global competencies in the 21st century.

Implications Local Wisdom in Physics Learning

The results of this study have significant implications for the development of physics education grounded in local wisdom. First, these findings confirm that integrating local cultural values, such as ethnoscience and Islamic physics, can enrich physics learning by providing contexts relevant to students' lives (Saphira et al., 2022; Setianingrum et al., 2023; Lestari, 2024). This approach supports the formation of students' cultural identity and character while improving scientific literacy and 21st-century skills such as critical thinking and problem-solving (Suastra et al., 2020; Mukaromah et al., 2022; Fatimah, 2023). Second, visualization of author collaboration and keyword mapping

shows that researchers in Indonesia still dominate local wisdom-based physics education research (Deta et al., 2024; Tiro et al., 2024), so it needs to be carried out in an international context so that local perspectives can be recognized globally (Donthu et al., 2021). Third, the results of this study encourage the development of physics teaching materials that utilize innovative technologies such as augmented reality and multiple representations to bridge abstract physics concepts with local wisdom in the form of contextual and engaging learning experiences (Mukaromah et al., 2022; Hidayat & Wulandari, 2023; Lestari, 2024). Finally, the use of local wisdom in physics education is not only an effort to preserve culture but also a relevant pedagogical strategy to foster a love for national culture and awareness of the importance of tourism.

Recommendations

Based on the findings of this study, it is recommended that the development of a national physics curriculum strengthen the integration of local wisdom as part of efforts to contextualize science materials by the principles of Merdeka Belajar (Muhammad et al., 2022; Khusyairin et al., 2022). Further research is also needed to explore local wisdom-based physics learning models that utilize innovative technologies, such as augmented reality, virtual reality, and project-based learning so that physics materials are more interesting and relevant to students' needs (Deta & Eliezanatalie, 2022; Mukaromah et al., 2022; Anasi & Harjunowibowo, 2023). In addition, teacher and lecturer training needs to focus on developing local wisdom-based teaching materials to increase their capacity, thereby making classroom implementation more effective (Yasir et al., 2020; Fianti & Neratania, 2024). Collaboration between researchers across various fields, including physicists, cultural experts, anthropologists, and technology developers, is also crucial for producing inclusive and globally relevant physics learning innovations (Donthu et al., 2021; Lestari, 2024). Finally, this study recommends that education stakeholders provide policy support to recognize local wisdom as a valuable pedagogical resource in developing contextual, adaptive, and meaningful science learning.

CONCLUSION

Fundamental Finding: This study has mapped the research trends on integrating local wisdom in physics education, showing its growing relevance in the past five years. The findings highlight that local wisdom serves as a core theme in physics education research, connecting topics such as ethnoscience, contextual learning, and critical thinking. **Implication:** The results underscore the importance of incorporating local wisdom into physics education to enhance cultural relevance, promote critical thinking, and preserve cultural identity. This approach supports meaningful learning aligned with 21st-century education goals. **Limitation:** This study is limited by its reliance on a single database and lacks an in-depth analysis of the learning outcomes resulting from integrating local wisdom into physics education. **Future Research:** Future research should utilize broader data sources, investigate the impact of local wisdom-based learning on student outcomes, and assess its long-term effectiveness in enhancing physics education.

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