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A Review: Research Trends on Local Wisdom-Based Empathy Values in Science Learning

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Abstract: The integration of empathy values into science education has gained increasing scholarly attention as part of character education and holistic learning paradigms. In multicultural contexts such as Indonesia, local wisdom offers culturally grounded moral frameworks that can strengthen students' socio-emotional competencies, particularly empathy, within science learning. This study aims to synthesize and map global and national research trends on empathy-based local wisdom in science education through a hybrid review approach, combining a Systematic Literature Review (SLR) and bibliometric analysis. A systematic search was conducted across Scopus-indexed journals and SINTA-accredited Indonesian journals published between 2019 and 2025. Following PRISMA guidelines, 21 articles met the inclusion criteria and were analyzed qualitatively to identify conceptual frameworks, instructional models, learning outcomes, and assessment strategies related to empathy development in science education. The results indicate that embedding local wisdom—such as indigenous environmental ethics, communal values, and cultural narratives—into inquiry-based and project-based science learning significantly enhances students' empathy, environmental awareness, and ethical reasoning. However, empirical studies measuring empathy using validated psychometric instruments remain limited, particularly in experimental and longitudinal designs. Furthermore, international publications predominantly emphasize socio-scientific issues, while Indonesian studies focus more on contextual cultural integration. The findings suggest that future research should strengthen interdisciplinary designs, develop standardized empathy assessment tools, and expand cross-cultural comparative studies to advance globally relevant yet locally rooted science education practices.

Keywords: Bibliometric analysis; Character education; Empathy values; Local wisdom; Science education; Systematic literature review

Introduction

The development of 21st-century education demands learning practices that are not only oriented toward cognitive achievement but also toward strengthening students' affective and social dimensions. One affective value that has received increasing attention in education is empathy. Empathy is defined as an individual's ability to understand, feel, and appropriately respond to the emotional states of others, playing a crucial role in fostering harmonious social interactions, tolerance, and concern for the surrounding environment (Decety & Cowell, 2014). In educational contexts, empathy serves as a fundamental foundation for character formation, particularly in addressing the challenges of globalization, which often promote individualism and a decline in social sensitivity. Science education (Ilmu Pengetahuan Alam/IPA) holds a strategic position in cultivating empathy, as it not only examines natural phenomena scientifically but is also closely related to human life and the environment. Meaningful science learning should integrate cognitive,

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affective, and psychomotor aspects in a balanced manner, enabling students not only to master scientific concepts but also to develop moral and social awareness regarding the impacts of scientific applications in everyday life (Araripe & Zeidler, 2024). However, science learning practices in schools remain largely focused on conceptual memorization and problem-solving, while the integration of empathy and social character values is still limited (Puspita & Fitrisia, 2025; Molyneux & Diamond, 2025).

One approach considered highly relevant for strengthening empathy in science learning is the integration of local wisdom. Local wisdom refers to a set of values, norms, knowledge, and practices that develop within a community and are passed down across generations as guidance for living in harmony with social and natural environments (Banda et al., 2024). In Indonesia, local wisdom is rich in empathy-related values, such as *siri' na pacce* in South Sulawesi, which emphasizes compassion and solidarity, *gotong royong* as an expression of social care, and various local traditions that teach harmony between humans and nature (Kusumawati & Amien, 2025). The integration of local wisdom into science learning provides significant opportunities to create contextual, meaningful, and culturally rooted learning experiences. Studies published in nationally accredited journals indexed by SINTA indicate that science learning based on local wisdom not only enhances conceptual understanding but also fosters students' character development, including care, responsibility, and empathy toward the environment (Kustiarini et al., 2025; Putri & Sari, 2025). Through local contexts, students are encouraged to investigate natural phenomena in their surroundings scientifically while simultaneously understanding the accompanying social and cultural values.

Moreover, international studies indexed in Scopus emphasize that culturally based and ethnopedagogical approaches are effective in developing social character traits, including empathy, tolerance, and concern for environmental sustainability (Ardoin et al., 2020; Feng et al., 2024). The integration of local values into science education has been shown to bridge the gap between scientific knowledge and students' socio-cultural realities, making learning more relevant and meaningful. This approach aligns with the paradigm of culturally responsive teaching, which emphasizes local culture as a primary learning resource. In the Indonesian context, strengthening empathy values based on local wisdom in science learning is also aligned with national education policies that emphasize character education and the Profile of Pancasila Students (*Profil Pelajar Pancasila*). Empathy is an integral component of the dimensions of global diversity and mutual cooperation, which require students to demonstrate social sensitivity, collaborative skills, and concern for others (Manke et al., 2025). Therefore, science learning should be designed not only to achieve academic competence but also to instill noble national values through culturally grounded learning contexts. Nevertheless, literature reviews reveal that the integration of empathy values based on local wisdom in science learning still faces various challenges. Several studies report teachers' limited capacity to develop learning tools that explicitly integrate character values, the scarcity of learning resources based on local wisdom, and insufficient support from schools and communities (Kironoratri et al., 2025; Siska et al., 2026). These conditions indicate the need for in-depth studies on the concepts, strategies, and implications of implementing empathy values grounded in local wisdom within science learning (Izudin et al., 2025).

Based on the above discussion, a literature-based examination of empathy values rooted in local wisdom within science education is essential. Such a review is expected to provide a comprehensive overview of theoretical foundations, empirical findings, and best practices related to the integration of empathy in science learning. Consequently, the results of this study can serve as a reference for educators, researchers, and policymakers in designing science education that excels academically while simultaneously contributing to the development of empathetic, culturally grounded, and sustainability-oriented students. Therefore, this research wants to know the research trend on local wisdom-based empathy values in science learning.

Method

Research Design

This study employed a hybrid review method, integrating a Systematic Literature Review (SLR) with bibliometric analysis to comprehensively examine research on empathy values based on local wisdom in science education. The hybrid approach combines the methodological rigor of SLR with the quantitative mapping capabilities of bibliometric analysis, enabling both in-depth qualitative synthesis and objective trend identification (Donthu et al., 2021). The use of a hybrid review is particularly appropriate for emerging interdisciplinary fields, such as culturally grounded science education, where understanding conceptual development and research trajectories is equally important.

Systematic Literature Review Procedure

The SLR followed established guidelines for educational research adapted from Azarian et al. (2023) and the PRISMA 2020 framework. The review process consisted of four stages: identification, screening,

eligibility assessment, and inclusion. he review was guided by the following research questions: How is empathy conceptualized in science education researchs?; What types of local wisdom are integrated into science learning?; What instructional strategies are used to embed empathy-based local wisdom?; What impacts are reported on students' empathy and character development?. Literature was retrieved from Scopus (international peer-reviewed journals) SINTA (nationally accredited Indonesian journals) from google scholar database. The Google Scholar database was chosen as a place to search for documents because Google Scholar applies consistent standards in selecting documents to be included in its index, and Google Scholar displays more documents than the top databases. Others, especially research in the field of education. Search strings included combinations of empathy, character education, local wisdom, indigenous knowledge, ethnopedagogy, and science education. Only journal articles published between 2019 and 2025 in English or Indonesian were included. To see research trends in recent years, app.dimensions.ai is also used to filter data that has been collected via Publish or Perish, researchers used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

Inclusion and Exclusion Criteria

Inclusion criteria include Indexed in Scopus or SINTA, Focused on science education, Explicit discussion of empathy or social values and Integration of local wisdom or cultural contexts. While exclusion criteria include non-journal publications, Studies outside science education and Articles lacking methodological clarity.

Study Selection Results

The PRISMA-guided selection process resulted in: Records identified: 132; Records after duplicates removed: 98; Full-text articles assessed: 42; Studies included in SLR synthesis: 21 articles.

Bibliometric Analysis Procedure

The bibliometric analysis was conducted using the same 21 articles included in the SLR to ensure methodological consistency. Metadata extracted included authorship, publication year, journal source, keywords, abstracts, and country of study. The analysis was designed to be conducted using, following common practices in educational bibliometric studies.

Result and Discussion

This research aims to describe research trends on local wisdom-based empathy values in science learning. Figure 1 is presented below regarding research trends on the local wisdom-based empathy values in science learning in the las ten years (obtained from app.dimensions.ai). Figure 1 shows that the trend in research on the local wisdom-based empathy values in science learning experiencing increases and decreases. Below are also Table 1 presented research of local wisdom-based empathy values in science learning based on the type of publication.

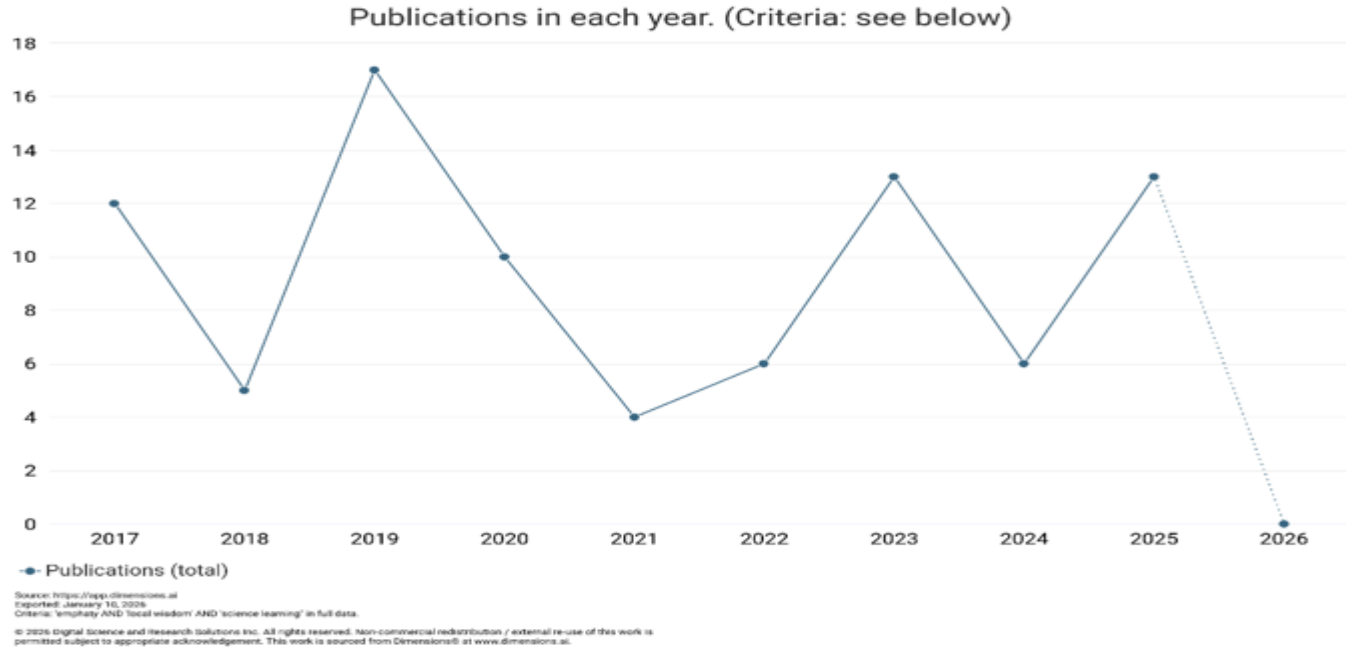

Figure 1. Research trends in local wisdom-based empathy values in science learning (app.dimensions.ai)

Table 1. Trends in local wisdom-based empathy values in science learning Research Based on Publication Types (app.dimensions.ai)

Publication Type	Publications
Edited Book	42
Article	33
Chapter	20
Proceeding	7
Monograph	5
Preprint	1

Based on Table 1, it is known that local wisdom-based empathy values in science learning contained in 6 types of publications. In the form of articles there were 33 documents, chapters as many as 20 documents, proceedings as many as 7 documents, edited books as many as 42 documents, 5 monograph documents and preprint only 1 document. Research trends in article form is the type of publication that contains the most research about local wisdom-based empathy values in science learning compared to other types of publications, except edited book. Meanwhile, the type of publication contains the least amount of research results local wisdom-based empathy values in science learning is preprint. Research conducted by Oltarzhevskyi (2019) states that an article is a complete factual essay of a certain length created for publication in online or print media (via newspapers, magazines or bulletins) and aims to convey ideas and facts that can convince and educate. These articles are usually published in scientific journals both in print and online (Wang et al., 2023). Below are also Figure 2 presented the sources category title trends in research on local wisdom-based empathy values in science learning which are often cited by other researchers related to this matter.

Figure 2. Top sources title trend of local wisdom-based empathy values in science learning research

Figure 2 shows the most published sources for research trend of local wisdom-based empathy values in science learning, namely in the criteris of education, with 18 publications. The most publishers are Advances in Social Science, Education and Humanities Research. The proceedings series Advances in Social Science, Education and Humanities Research aims to publish proceedings from conferences on the theories and methods in fields of social sciences, education and humanities. All proceedings in this series are open access, i.e. the articles published in them are immediately and permanently free to read, download, copy & distribute. The online publication of each proceeding is sponsored by the conference organizers and hence no additional publication fees are required. In the articles researched and written by these researchers, there are many terms related to of local wisdom-based empathy values in science learning. Below are presented five popular keywords related to of local wisdom-based empathy values in science learning. Table 2 shows that the keywords that often appear related to research on the local wisdom-based empathy values in science learning are character education 9 times with a level of 2.13. Table 2 also shows that ethnoscience is also a keyword that appears frequently in research trends on local wisdom-

based empathy values in science learning, namely 6 times with a relevance of 1.13.

Table 2. Keywords on trend of local wisdom-based empathy values in science learning

Terms	Occurrences	Relevance
Indonesia	6	3.23
Elementary school student	6	2.42
Character education	9	2.13
Ethnoscience	6	1.13
Environment	6	0.62

Below is the visualization is accomplished by generating a landscape map, which offers a visual representation of subjects related to scientific studies. The outcomes of bibliometric mapping for the co-word network in articles related to the topic local wisdom-based empathy values in science learning are illustrated in Figure 3. Figure 3 shows the results of bibliometric keyword mapping on research trends on the local wisdom-based empathy values in science learning. In Figure 3 there are 24 keyword items that are often used in research on the local wisdom-based empathy values in science learning. Figure 3 also contains 4 clusters, where the first cluster is colored red and consists of 9 keyword items, namely elementary school, ethnoscience, etc. The second cluster in green consists of 7 keyword items, namely character education, indonesia, etc. The third cluster in blue consists of 6 keyword items, namely education, social science, etc. The fourth yellow cluster only consists of 2 keyword items, namely mutual cooperation and study.

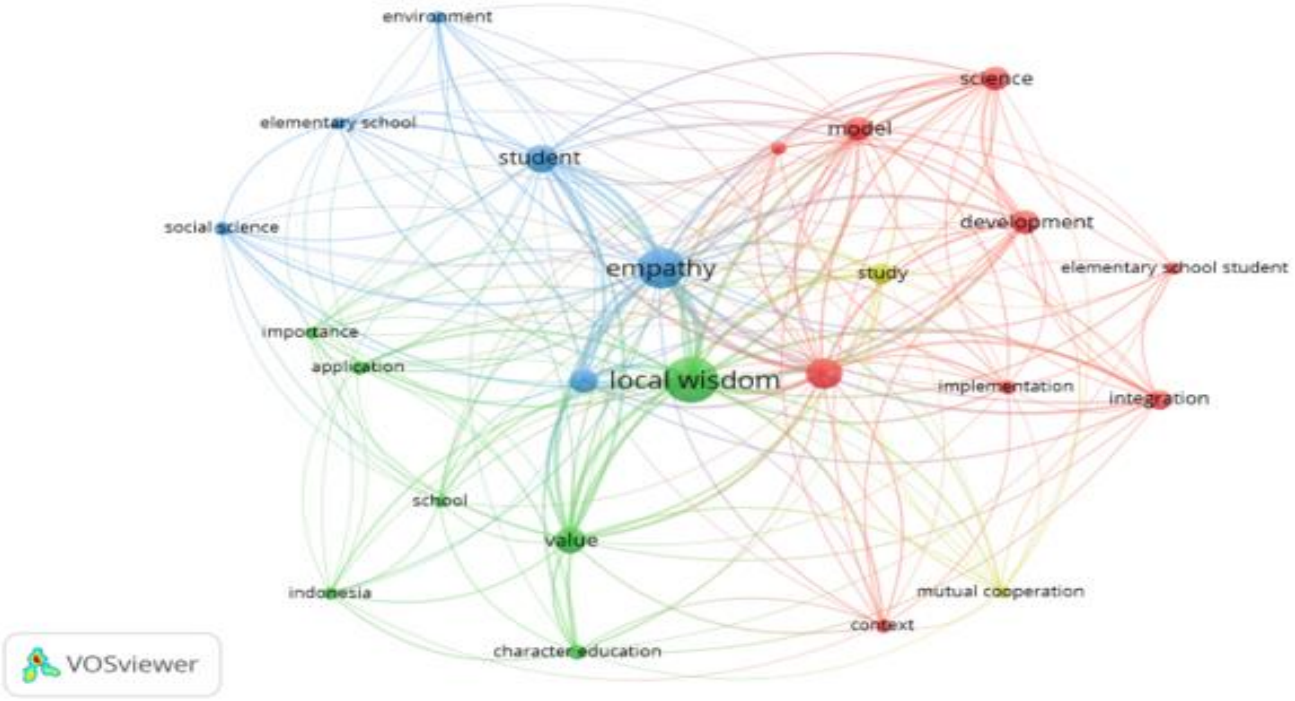

Figure 3. Network visualization on trend local wisdom-based empathy values in science learning research

Figure 3 above also shows that network visualization shows the network between the terms being visualized. Keywords classified into four clusters are arranged in a color chart showing the divisions that are connected to each other. The results of this analysis can be used to determine keyword research trends in the last year. This analysis shows several keywords that are often used in research on the local wisdom-based empathy values in science learning. The more keywords that appear, the wider the visualization displayed. Below are also presented keywords regarding the local wisdom-based empathy values in science learning based on overlay visualization. Figure 4 shows the trend of keywords related to research on local wisdom-based empathy values in science learning in Google Scholar indexed journals. Trends in the themes of writing articles related to the local wisdom-based empathy values in science learning from the oldest to the newest year are marked with purple, blue themes, turquoise, dark green, light green and yellow. In the picture below you can see that the environment, implementation, school, etc. This shows that these keywords were widely used by researchers in 2023. In 2024, the keywords that frequently appeared were character education, elementary school, etc.

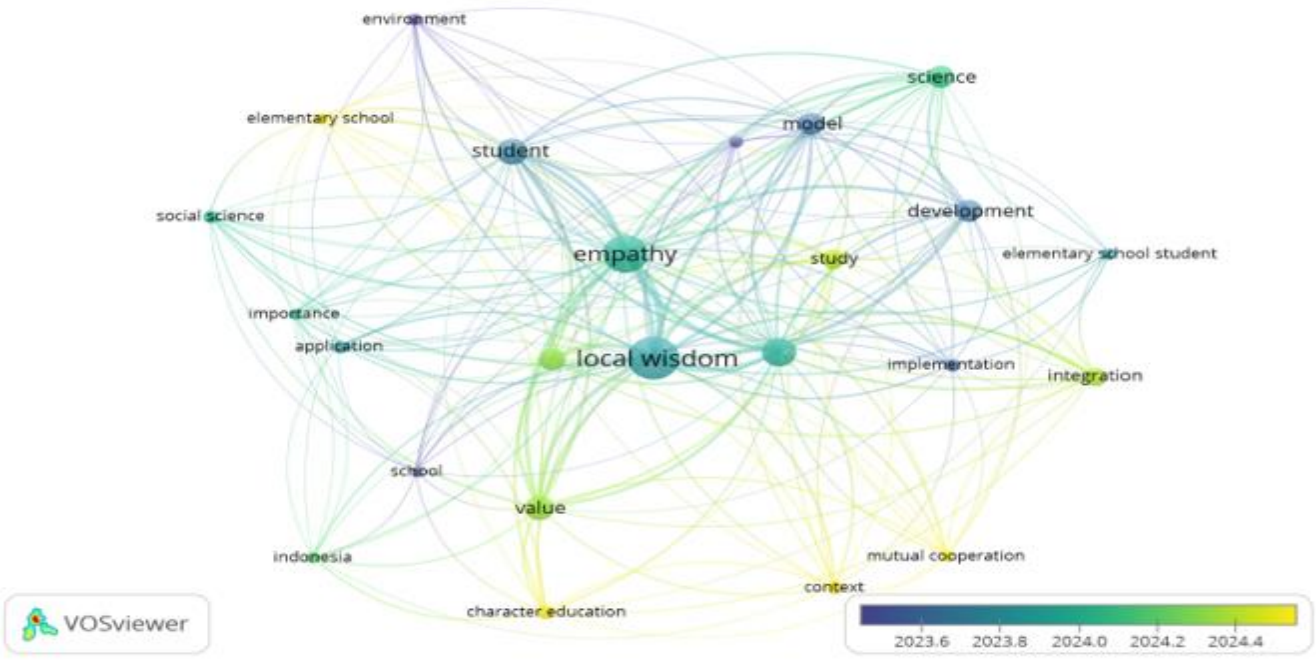

Figure 4. Overlay visualization on trend local wisdom-based empathy values in science learning research

Research on local wisdom-based empathy values in science learning is one area of research that has developed rapidly in recent years. The following also presents keywords for local wisdom-based empathy values in science learning research based on density visualization. Figure 5 shows density visualization. The density of research themes is shown in bright yellow. The brighter the colors of a theme, the more research is done. The fainter the color means the theme is rarely researched (Yanti et al., 2022; Yani et al., 2025). Faintly colored themes such as character education and ethnoscience are dimly colored keywords. This shows that these keywords can be used as a reference for further research. While yellow indicates keywords that are currently and frequently used in research (Doyan et al., 2024).

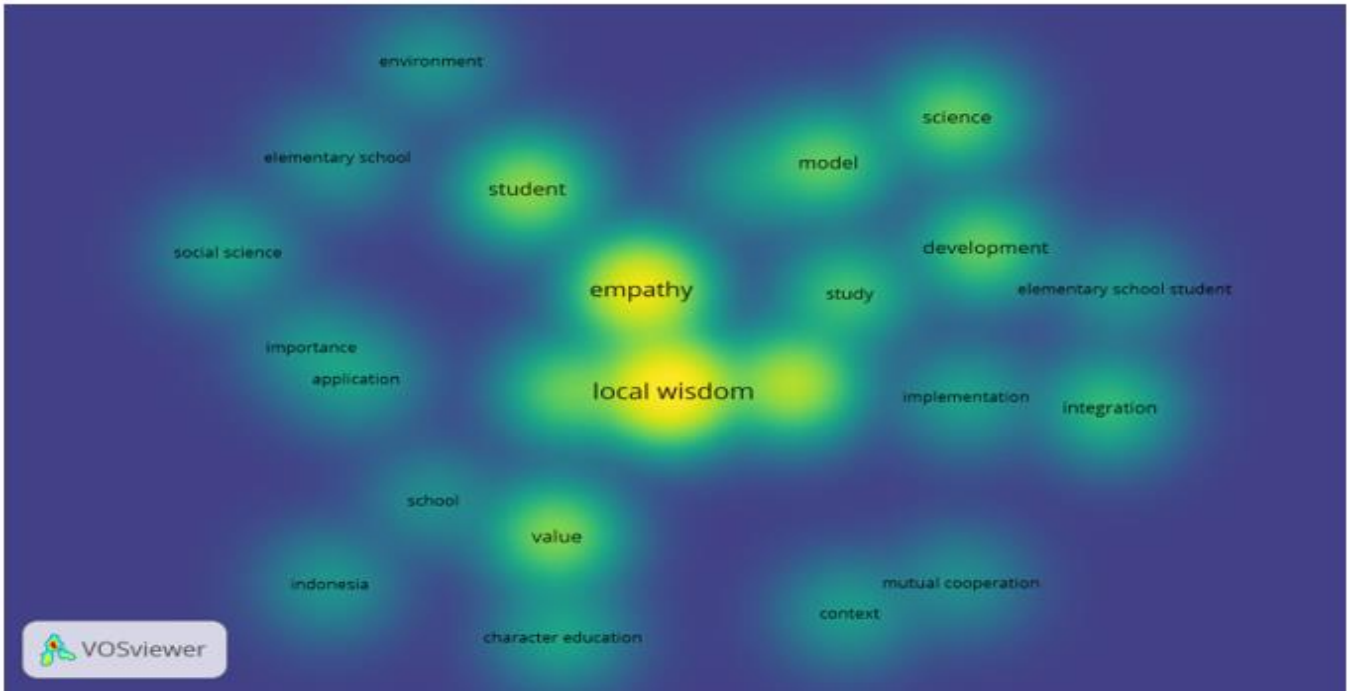

Figure 5. Density visualization on trend local wisdom-based empathy values in science learning research

Overview of Included Studies

The hybrid review identified 21 peer-reviewed journal articles published between 2019 and 2025 and indexed in Scopus and SINTA that explicitly examined empathy values, local wisdom, and science education. This finding indicates that research on empathy-based culturally grounded science learning is still emerging but demonstrates a growing scholarly interest in recent years. Similar patterns have been reported in reviews of character-oriented science education, which emphasize the affective domain as an underexplored yet critical component of science learning (Rezkita et al., 2025). Methodologically, most studies employed qualitative (38%) and mixed-methods designs (33%), while quantitative experimental or quasi-experimental approaches (29%) were less frequent. This methodological distribution reflects the exploratory and context-dependent nature of research involving local wisdom and empathy, as also noted by Mahadew (2025) in environmental and culturally responsive education research.

Publication Trends and Research Growth

Bibliometric analysis revealed a steady increase in publications, particularly after 2021, with a peak during 2023–2025. This trend aligns with the global rise of educational discourses emphasizing character education, sustainability, and socio-cultural relevance in science learning (Nussbaum & Bekerman, 2025). The increasing attention to empathy within science education reflects a paradigm shift from purely cognitive outcomes toward holistic educational goals that integrate moral and social responsibility.

Conceptualization of Empathy in Science Education

Across the reviewed studies, empathy was consistently conceptualized as a multidimensional construct, encompassing cognitive, affective, and behavioral components. Cognitive empathy involves understanding diverse perspectives in socio-scientific contexts, affective empathy relates to emotional engagement with social and environmental issues, and behavioral empathy is reflected in prosocial actions and ethical decision-making (Eisenberg et al., 2015). Several studies emphasized that empathy development in science education is strongly facilitated through engagement with socio-scientific issues (SSI), where students confront real-world dilemmas that require both scientific reasoning and moral judgment (Sadler, 2011). This reinforces the view that empathy is not merely an affective by-product but a core learning outcome in science education.

Forms of Local Wisdom Integrated into Science Learning

The SLR synthesis revealed that local wisdom was integrated into science learning through diverse cultural and ecological contexts. In Indonesian studies, communal values such as *gotong royong*, harmony with nature, and traditional ecological knowledge were frequently embedded in science learning activities (Annam et al., 2024). These values function as cultural mediators that connect abstract scientific concepts to students' lived experiences (Annam et al., 2024). International literature similarly highlights indigenous knowledge systems as legitimate epistemological resources that enhance students' sense of belonging and social responsibility in science learning (Ramli et al., 2025). Bibliometric keyword co-occurrence analysis confirmed local wisdom, indigenous knowledge, and ethnopedagogy as central thematic nodes, indicating their strong conceptual relevance across studies (Dyson et al., 2022).

Instructional Strategies Supporting Empathy Development

Both the systematic synthesis and bibliometric mapping identified several dominant instructional strategies, including project-based learning (PjBL), contextual and problem-based learning, ethnopedagogical approaches, and SSI-based instruction. Project-based learning grounded in local environmental or social issues was particularly effective in fostering empathy, as it encourages students to collaboratively investigate authentic problems and reflect on their social implications (Bell, 2010). Ethnopedagogical approaches further strengthen empathy by positioning local culture as an integral component of the learning process rather than a supplementary context (Sain & Laval, 2024). The strong linkage between these pedagogical strategies and empathy-related keywords in the bibliometric network suggests a high level of methodological coherence within the field.

Impact on Students' Empathy and Character Outcomes

Empirical evidence consistently demonstrated that integrating local wisdom into science learning positively impacts students' empathy, environmental awareness, collaboration skills, and ethical reasoning (Lähteenkorva et al., 2025; Wibowo et al., 2024). Students exposed to culturally grounded science instruction showed increased sensitivity toward social and environmental issues and greater responsibility in scientific decision-making. However, many studies relied on self-reported questionnaires or qualitative observations, echoing concerns raised by Lima & Osório (2021) and Tan et al. (2025) regarding the need for more robust and validated empathy measurement instruments in educational research. The integration of SLR and bibliometric analysis revealed strong convergence between qualitative insights and quantitative publication patterns. The increasing volume of publications and the

emergence of well-defined thematic clusters confirm that empathy-based local wisdom integration has gained scholarly legitimacy within science education research (Agung et al., 2024; Zairul, 2025).

This convergence supports the reliability of the hybrid review approach and demonstrates that the field is transitioning from conceptual advocacy toward empirical validation. The findings strongly support constructivist and socio-cultural learning theories, which conceptualize learning as a socially situated and culturally mediated process (Shabani, 2016). Empathy emerges as a central educational outcome that bridges scientific understanding with moral and social responsibility, aligning with theories of prosocial and moral development (Nistor et al., 2024; Liao, 2025). By integrating local wisdom, science education moves beyond value-neutral instruction and embraces a more holistic epistemological stance that acknowledges cultural knowledge systems as integral to scientific learning (Tikly, 2025; Soysal, 2025), the findings suggest that science teachers should intentionally design learning experiences that integrate local wisdom and empathy outcomes through contextualized projects, community-based investigations, and reflective discussions (Tinenti et al., 2025; Yusuf et al., 2024). Methodologically, the dominance of qualitative and short-term studies indicates the need for more rigorous experimental and longitudinal designs to strengthen causal claims (Miller et al., 2020; Grosz et al., 2020).

Despite promising developments, several gaps remain, including limited use of standardized empathy assessment tools, minimal integration of digital learning environments, and a lack of cross-cultural comparative studies. Future research should adopt mixed-methods and longitudinal designs, integrate technology-enhanced learning grounded in local wisdom, and expand international collaboration to enhance generalizability (Rutkowski et al., 2024; Yuliantoro et al., 2025). Overall, the hybrid review demonstrates that empathy values grounded in local wisdom play a critical role in shaping socially responsible and culturally responsive science education. The integration of systematic qualitative synthesis and bibliometric evidence provides a robust foundation for advancing theory, practice, and policy in science education (Lim et al., 2024; Aransyah et al., 2025).

Conclusion

In conclusion, this study affirms that integrating empathy values rooted in local wisdom is not merely an additive component of science education but a foundational strategy for cultivating culturally responsive, ethically grounded, and socially engaged learners. The hybrid review offers valuable theoretical insights, empirical evidence, and methodological guidance for educators, researchers, and policymakers seeking to design science learning experiences that are both academically rigorous and socially meaningful. Future research is expected to develop and validate standardized empathy assessment instruments to provide more objective quantitative measurements in science education. Furthermore, longitudinal studies are needed to monitor the persistence of empathy values in students over the long term after exposure to local wisdom-based learning.

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Author Contributions
Conceptualization, writing—reviewing and editing, M.I.; methodology, visualization, I.I.; formal analysis, supervision, J.A.; investigation, project administration, M.L.; resources, F.M.Y.; writing—preparation of original draft, A.S.K.; obtaining funding, F.M.Y. and A.S.K. All authors have read and approved the published version of the manuscript.

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