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Global Trends in Local Wisdom Integration in Education: A Comprehensive Bibliometric Mapping Analysis from 2020 to 2024

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Abstract. The integration of local wisdom into educational processes has garnered significant attention due to its alignment with the Sustainable Development Goals (SDGs) and its ability to enhance culture-based learning. This bibliometric study examines the trends and mapping of local wisdom research in education by analysing publications and citations from Scopus-indexed journals between 2020 and 2024. Based on the inclusion and exclusion criteria from a total of 811 articles, 115 relevant articles were obtained using the Publish or Perish (PoP) software. Furthermore, all selected articles will be further analysed using VOSviewer software. The key metrics analysed include author contributions, keyword distributions, and geographical locations of research activity. Our findings indicate a growing global interest in local wisdom, with Indonesia leading the contributions, followed by significant inputs from the United States and Australia. The study highlights prominent authors and collaborative networks, revealing a central role for Indonesian researchers in advancing this field. The results suggest that integrating local wisdom in education not only supports cultural heritage preservation but also fosters educational relevance and sustainability. Because this research is limited to the Scopus indexed article database only, in the future researchers can use additional reputable indexed journal article databases such as Web of Science to improve this bibliometric research. Educational policies can be designed to use local wisdom as one of the inclusive education programmes for student character development to overcome social and cultural gaps among students.

Keywords: Bibliometric Mapping Study; Culture-Based Learning; Education Trends, Local Wisdom; VOSviewer

1. Introduction

The integration of local wisdom into the educational process has long been a prominent topic in contemporary education. Local wisdom, a component of culture-based learning, has garnered global attention due to its relevance and efficacy in promoting sustainable development-oriented education. This is because local wisdom encompasses the empirical knowledge and practices of specific communities that support sustainable resource development (Maria, 2018; Setyaningsih et al., 2020). Furthermore, local wisdom extends beyond education to encompass areas such as entrepreneurship and environmental conservation, deriving from the good practices, values and beliefs of local communities (Perilla et al., 2021; Shofa et al., 2021). Local wisdom-based learning brings students closer to their cultural heritage, customs and traditions in their surrounding environment. Recognising that education is not a "one-size-fits-all" approach, integrating local wisdom encourages students to appreciate their cultural values and traditions (Asmayawati et al., 2024; Heng et al., 2019). Cultural values and attitudes embedded in local wisdom integrated into learning are crucial to instil from an early age (Grey et al., 2020). Additionally, as a learning context, local wisdom can enhance learning outcomes and foster student attitudes. Local wisdom-based learning is particularly engaging for students in subjects such as physics and biotechnology (Asmayawati et al., 2024; Sumardjoko & Musyiam, 2018). Teaching materials based on local wisdom not only serve as a means of cultural conservation but also equip students with survival skills essential in the modern era (Asrial et al., 2021). Moreover, utilising local wisdom-based teaching materials enhances teachers' abilities to leverage and promote local resources (Nisa et al., 2020).

The significance of local wisdom in education has been extensively discussed, finding that local wisdom-based learning can enrich and build students' perceptions of their own culture (Pamenang, 2021). Each region possesses unique local wisdom that can be integrated into the educational process. Suarmika (2022) found that, although not empirically proven, traditional communities' local wisdom can be categorised into three aspects: beliefs, knowledge and technological engineering in education. Furthermore, Damopolii et al. (2024) demonstrated how integration of local wisdom with a problem-based student book encourage students' conservation attitudes significantly. Studies by Sukmawati and Setiawan, (2020) and Fitrisia et al. (2023) found that the development products of local wisdom possess excellent validity and practicality. Marwany et al. (2022) revealed that integrating local wisdom-based education in early childhood education impacts children's moral development. This integration will encourage student understanding and appreciation of their own cultural values, which also strengthens their cultural identity (Setyaningsih et al., 2020). Moreover, Zidny and Eilks (2020) found the integration of local knowledge in education can prevent the marginalisation of local wisdom and promote SDGs aspects. Therefore, it can be concluded that local wisdom plays a crucial role not only in character development but also in building students' identity, perceptions, knowledge, morals about local culture and promoting SDGs.

Despite numerous studies analysing the effectiveness of local wisdom-based learning, there is still a lack of bibliometric research mapping the research trends

in local wisdom in education. Muhammad (2022) showed that global research trends in local wisdom are increasing, predominantly conducted by Indonesian researchers. However, this research only utilised the keyword "local wisdom" and did not include other synonymous terms like "ethnoscience" and "indigenous science". Furthermore, most of the existing bibliometric research is thematic in nature, that is, in specific fields such as physics education and history education (Rahman et al., 2023; Utami et al., 2024). In the field of physics education, the integration of local wisdom in teaching based on bibliometric research can be divided into three types: content integration, learning materials and learning media (Utami et al., 2024). In the field of history education, there are not many bibliometric studies that discuss the role of local wisdom in shaping the character and personality of the nation (Rahman et al., 2023). Most bibliometric research on local wisdom in the field of education uses a national level scope and is very minimal international or indexed in global databases such as Scopus (Setianingrum et al., 2023).

Considering the rationale from previous bibliometric studies, this research is highly urgent to address the gap in current bibliometric literature on local wisdom in education research. This research holds significant importance in supporting the SDGs and has the potential to promote the implementation of culture-based learning. By mapping global research trends on local wisdom, this study addresses the increasing demand for information and research on local wisdom. Emphasising a multidisciplinary perspective is crucial for fostering global research practices in this area. Furthermore, this study analyses articles published in Scopus based on keywords, author distribution and journal types. The objective is to analyse and map local wisdom research in the field of education indexed in Scopus from 2020 to 2024.

2. Methods

This study falls within the realm of bibliometric research, which analyses publications and citations of scientific articles, encompassing the evaluation of past, present and future research directions (Al Husaeni & Nandiyanto, 2022; Donthu et al., 2021). Furthermore, Khare and Jain (2022) assert that bibliometric research objectively evaluates scientific literature, considering factors such as authors, topics, journals, main themes and other aspects that significantly influence a particular research field. The publication data for this study were sourced from the Scopus database using the Publish or Perish (PoP) software. The Scopus database is widely recognised as the most commonly used source for bibliometric research (Mongeon & Paul-Hus, 2016). Additionally, the bibliometric research process in this study adapts the five stages of research outlined by Tranfield et al. (2003) as illustrated in the figure below.

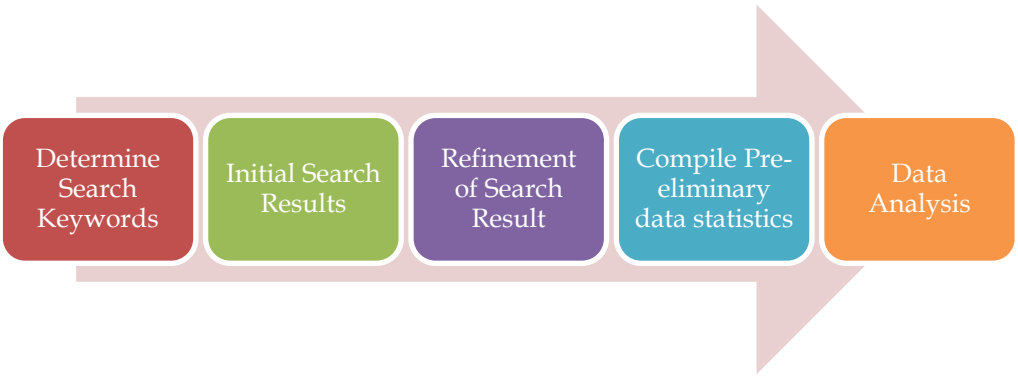

Figure 1: Stages of Bibliometric Analysis according to Tranfield et al. (2003)

2.1 Determine Search Keywords

This study specifically employs three interrelated keywords concerning aspects of local wisdom. The keywords are 'local wisdom in learning', 'ethnoscience in learning' and 'indigenous knowledge in learning'. Scopus, one of the largest and most reliable research databases, was utilised for this purpose.

2.2 Initial Search Results

The article search for this study was conducted within the last five-year interval, from 2020 to 2024. All data obtained from the initial search were compiled in Research Information System (RIS) format. The RIS files contain essential information such as author names, article titles, citation counts, countries of origin and keywords for each article.

2.3 Refinement of Search Results

The search results from Scopus, retrieved using the PoP application, were further refined based on the type of publication. PoP was chosen for its ability to provide citation and metrics data from various Scopus-indexed sources quickly. However, researchers must have an Elsevier account and create an Application Programming Interface (API) key first. Papers from proceedings, magazines, books, book reviews, and book chapters were excluded from this study. This research is inclusive only of articles indexed by Scopus, ensuring that only high-quality articles are used. The refined PoP data were then saved in RIS format. The inclusion and exclusion criteria used in this study can be described as follows.

Table 1: Inclusion and Exclusion Criteria for Searching Research Articles

Inclusion Criteria	Exclusion Criteria
a. Articles related to local wisdom, ethnoscience and indigenous knowledge research in learning b. Scopus-indexed international journal articles c. Articles in English d. Publication of articles in 2020-2024 e. Articles obtained in full text	a. Articles outside the research topics of local wisdom, ethnoscienceand indigenous knowledge in learning b. Articles that are not indexed by Scopus c. Articles not in English d. Publication of articles outside 2020-2024 e. Articles obtained are not in full text

2.4 Compile Preliminary Data Statistics

The metadata for research on local wisdom in learning, stored in RIS format, were then enhanced using Mendeley. The data enhanced include author names, Digital Object Identifier (DOI), publisher and researchers' countries. Once the necessary metadata for bibliographic analysis were complete, the metadata were exported again in RIS format. This final RIS metadata will be analysed using the VOSviewer application.

2.5 Data Analysis

Data analysis in bibliometric research typically utilises numerous research articles as references. The VOSviewer application is highly functional in this research for displaying bibliographic maps in an easily interpretable manner (Donthu et al., 2020; van Eck & Waltman, 2010). Additionally, VOSviewer provides more comprehensive data for bibliometric research (Ejaz et al., 2022). Important features of VOSviewer for bibliometric research include mapping publications, author relationships, co-citation mapping and keyword mapping in the analysis of local wisdom research (Hudha et al., 2020).

The analysis of data using the PoP application was conducted to understand the publication and citation structures of bibliometric research related to local wisdom. The formula of bibliometric analysis is shown in Table 2.

Table 2: The Formula of Bibliometric Analysis

Type of Analysis	Formula	Source
Citations/year:	$citations/year = \frac{\text{Total number of citations}}{\text{Number of years}}$	(Bornmann et al., 2018)
Cites/paper:	$citations/paper = \frac{\text{Total number of citations}}{\text{Number of papers}}$	(Harzing & Alakangas, 2016)
Cites/author	$citations/author = \frac{\text{Total number of citations}}{\text{Number of authors}}$	(Harzing & Alakangas, 2016)
Papers/author	$Papers/author = \frac{\text{Total number of papers}}{\text{Number of authors}}$	(Harzing & Alakangas, 2016)
Authors/paper	$Papers/author = \frac{\text{Total number of papers}}{\text{Number of authors}}$	(Harzing & Alakangas, 2016)
h-index	The h-index is the largest number h such that h papers have at least h citations each	(Harzing & Alakangas, 2016)
g-index	The largest number g such that the top g articles received (together) at least g^2 citations	(Harzing & Alakangas, 2016)
Hl_norm	$Hl\_norm = \frac{h-\text{index}}{\text{average number of authors per paper}}$	(Harzing & Alakangas, 2016)
HI-annual	$\text{HI-annual} = \frac{h-\text{index}}{Number\ of\ years}$	(Harzing & Alakangas, 2016)
ha-index	Variant of the h-index that accounts for the age of the publications.	(Harzing & Alakangas, 2016)

Additionally, data analysis using the VOSviewer application aimed to determine the author and co-author relationship patterns in local wisdom research over the past five years. The data visualisations produced include tissue visualisation, overlay visualisation, and density visualisation.

3. Results

3.1 Publications and Citation Structures

In the initial search, a total of 811 research articles indexed in Scopus were retrieved. Following the refinement stage, 115 research articles on local wisdom indexed in Scopus were selected. Both searches spanned the years 2020 to 2024, using the keywords 'Local Wisdom in Learning', 'Ethnoscience in Learning' and 'Indigenous Science in Learning'. From the 811 articles in the initial search, 3182 citations were obtained, averaging 636.4 citations per year. In contrast, the refined search yielded 460 citations from the 115 selected articles, averaging 92 citations per year. The comparison metrics of this research can be found in Table 3.

Table 3: Comparison Metrics

Metric Citation	Initial Search	Refinement Search
Source	'Local Wisdom in Learning' 'Ethnoscience in Learning' 'Indigenous Science in Learning'	'Local Wisdom in Learning' 'Ethnoscience in Learning' 'Indigenous Science in Learning'
Year Of Publication	2020-2024	2020-2024
Papers	811	115
Citations	3182	460
Citations/year	636.4	92
Cites/paper	3.92	4
Cites/author	4	4.14
Papers/author	1.02	1
Authors/paper	0.98	1
h-index	1	11
g-index	37	16
Hl_norm	0.0013	0.10
HI-annual	0.2	2.2
ha-index	34.68	2.2

The following study seeks to identify the most significant writers and their contributions to the incorporation of indigenous knowledge into the learning process. The top 10 writers will be identified and mapped based on their citations from a pool of 115 papers retrieved using the keywords 'Local Wisdom in Learning', 'Ethnoscience in Learning' and 'Indigenous Science in Learning'. The results are presented in a tabular format in Table 4.

Table 4: Top 10 Cited Articles on Local Wisdom in the Field of Education

Citations	Author	Topic	Years	Journal	Publisher
51	Hidayati et al.	Local wisdom-based character education in higher education students	2020	International Journal of Instruction	Gate Association for Teaching and Education
34	Upadhyay et al.	Sociopolitical consciousness in a high school science class	2020	Journal of Research in Science Teaching	Wiley-Blackwell
20	Fadli and Irwanto	Impact of local wisdom-based ELSII learning model	2020	International Journal of Instruction	Gate Association for Teaching and Education
18	Dewi et al.	Effect of Contextual Collaborative Learning Based Ethnoscience Ability	2021	Journal of Turkish Science Education	Ekip Buro Makineleri A.S.
17	de la Garza	Internationalizing the Curriculum for STEAM (STEM + Arts and Humanities)	2021	Journal of Studies in International Education	SAGE Publications Ltd
16	Sudirman et al.	Local wisdom forms in augmented reality application	2020	International Journal of Interactive Mobile Technologies	International Association of Online Engineering
14	Silva et al.	Technological structure for technology integration in the classroom	2020	Journal of Information Technology Education: Research	Informing Science Institute
14	Bulkani et al.	Development of animation learning media based on local wisdom	2022	International Journal of Instruction	Gate Association for Teaching and Education
14	Sumarmi et al.	Problem-based service learning's effect on environmental concern and ability to write	2020	International Journal of Instruction	Gate Association for Teaching and Education
12	Haynes et al.	Qualitative Research Approaches for Productive Dialogue in the Intercultural Space	2022	International Journal of Environmental Research and Public Health	Multidisciplinary Digital Publishing Institute (MDPI)

Statistically, the number of studies on local wisdom in education over the past five years is illustrated in Figure 2.

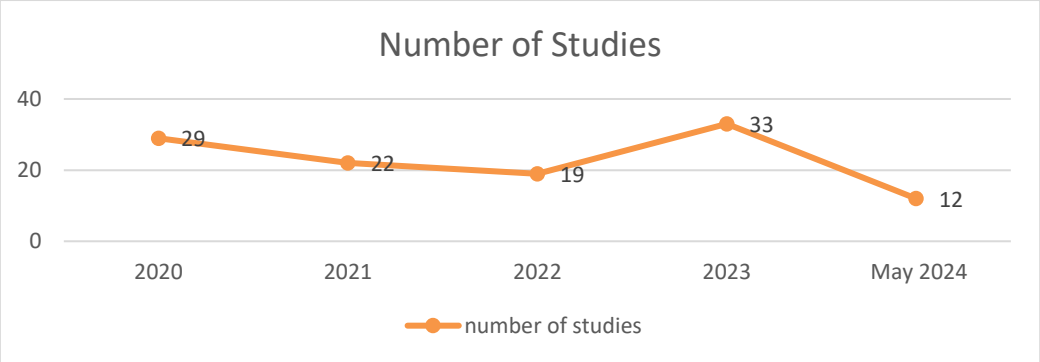

Figure 2: Number of Local Wisdom Studies in Education (2020-2024)

Figure 2 above indicates that the trend of research on local wisdom in education over the past five years has been fluctuating. In 2024, there is a noticeable decline in local wisdom research, likely because it is still early in the year. The data on the top 10 publishers that have accepted manuscripts on local wisdom in learning are detailed in Table 5.

Table 5: Top 10 Publishers Accepting Manuscripts on Local Wisdom in Learning

Publisher	Quantity
Gate Association for Teaching and Education	8
International Association of Online Engineering	8
Birlesik Dunya Yenilik Arastirma ve Yayincilik Merkezi	5
Taylor & Francis	5
Eurasian Society of Educational Research	4
Horizon Research Publishing	4
International Journal of Information and Education Technology	4
North American Business Press	4
SAGE Publications Ltd	4
Ani Publishing	3

The top 10 journals that examine local wisdom in the field of education are detailed in Table 6.

Table 6. Top 10 Journals Examining Local Wisdom in the Field of Education

Name of Journal	Quantity
International Journal of Instruction	8
International Journal of Interactive Mobile Technologies	6
Cypriot Journal of Educational Sciences	5
International Journal of Information and Education Technology	4
Journal of Higher Education Theory and Practice	4
Universal Journal of Educational Research	4
Eurasian Journal of Educational Research	3
European Journal of Educational Research	3
International Journal of Evaluation and Research in Education	3

The network visualisation of local wisdom research, based on articles indexed in Scopus using the keywords 'Local Wisdom in Learning', 'Ethnoscience in Learning' and 'Indigenous Science in Learning' is depicted in Figure 3. The overlay visualisation is shown in Figure 4, and the density visualisation is presented in Figure 5.

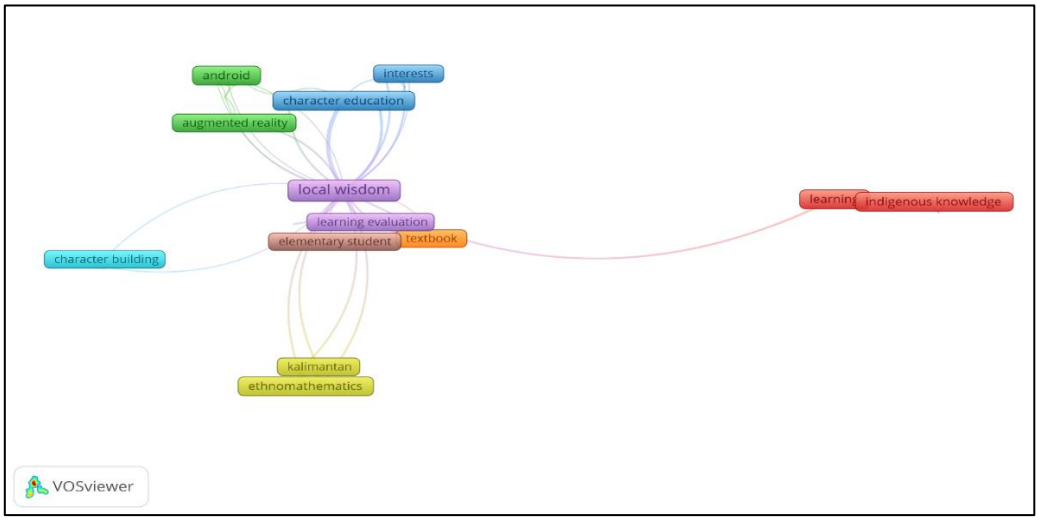

Figure 3: Network Visualisation from the Scopus Database Using VOSviewer

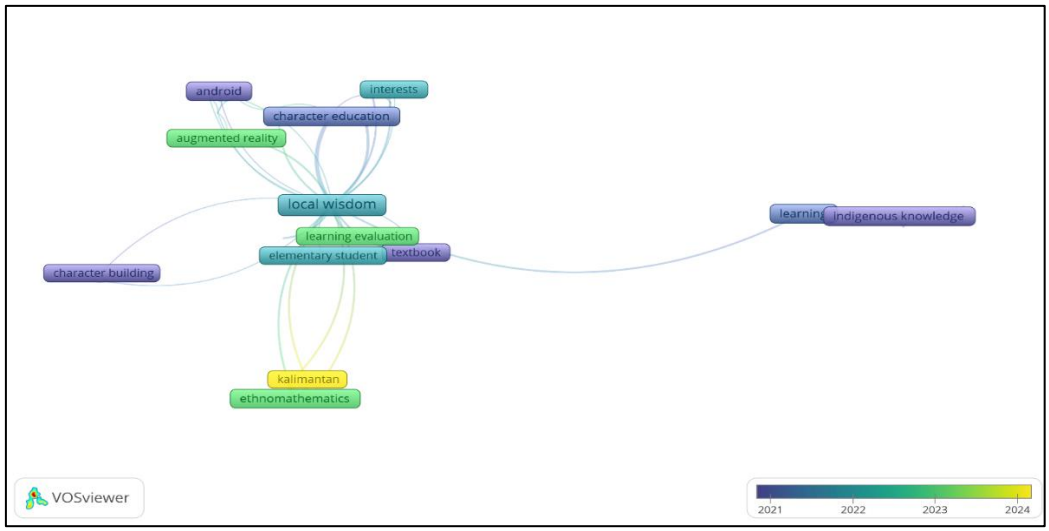

Figure 4: Overlay Visualisation from the Scopus Database Using VOSviewer

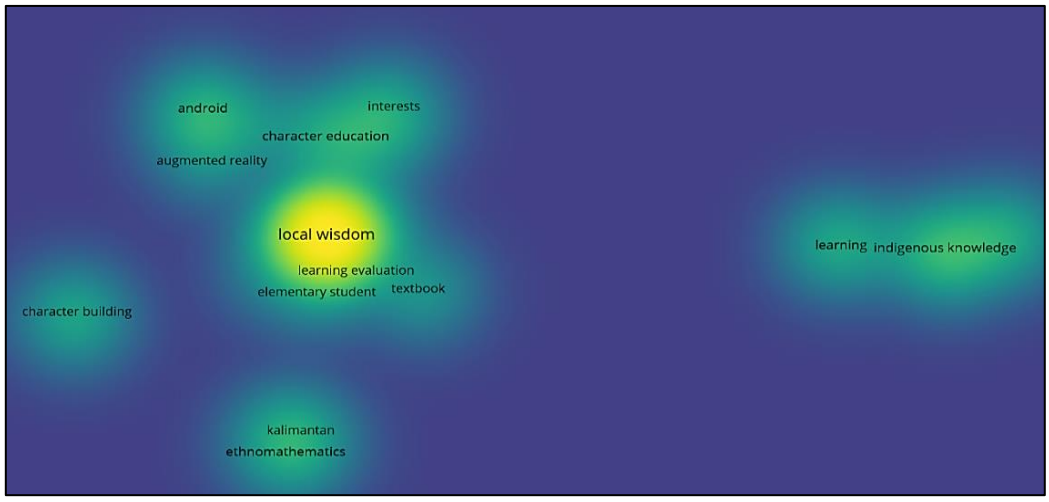

Figure 5: Density Visualisation from the Scopus Database Using VOSviewer

With the minimum number of events set to 2 in the VOSviewer application, the visualisation results were fully calculated and derived from the titles, keywords and abstracts of the research. Approximately 38 items met the established criteria. Based on the VOSviewer analysis, these 38 items were categorized into nine different clusters. The detailed clustering results of the local wisdom research items in learning can be found in Table 7.

Table 7: Clustering Results of Local Wisdom Research Items in Learning

Cluster Name	Item (key words)
Cluster 1	Indigenous, Indigenous Knowledge, indigenous knowledge systems learning, local culture, multiculturalism, reconciliation, science education, traditional knowledge.
Cluster 2	Android, augmented reality, critical thinking, development, mathematical representation, mobile learning
Cluster 3	Character education, elementary school, interest, process skills, traditional games
Cluster 4	Batik motifs, dayak tribe, ethnomathematics, Kalimantan
Cluster 5	Indonesian language, learning evaluation, local wisdom, multicultural education
Cluster 6	Character building, Covid-19, integration
Cluster 7	Textbook , thematic learning,
Cluster 8	Elementary student,
Cluster 9	Teaching material

3.2 Authors and Co-authorship Network

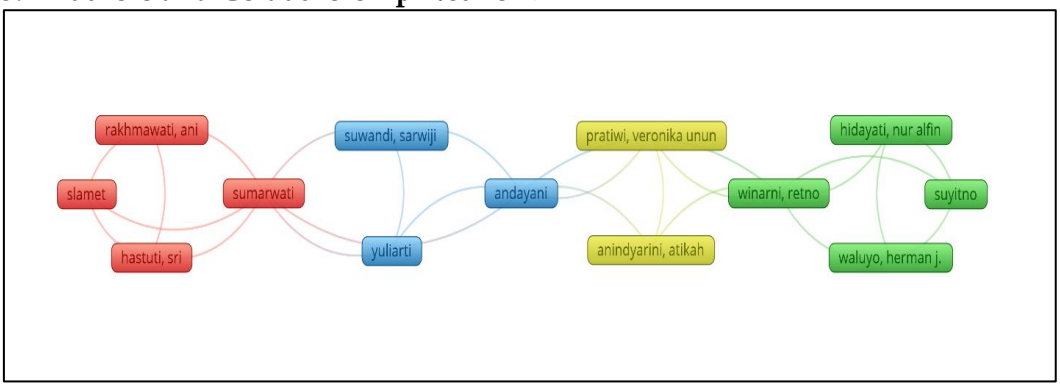

Figure 6: Network Visualisation of Author and Co-Author in Local Wisdom Research in Education Based on the Scopus Database Using VOSviewer

The relationships or network of authors and co-authors in local wisdom research are depicted in the visualisation in Figure 6. This visualisation reveals that there are four clusters (red, blue, yellow and green) of authors and co-authors in the field of local wisdom in education. The key contributors in this research are Sumarwati, Andayani and Winarni. Additionally, from an interdisciplinary contribution perspective, Andayani is an author involved in various clusters, indicating extensive collaboration and a greater impact. Furthermore, the overlay visualisation of authors and co-authors in the research can be seen in Figure 7.

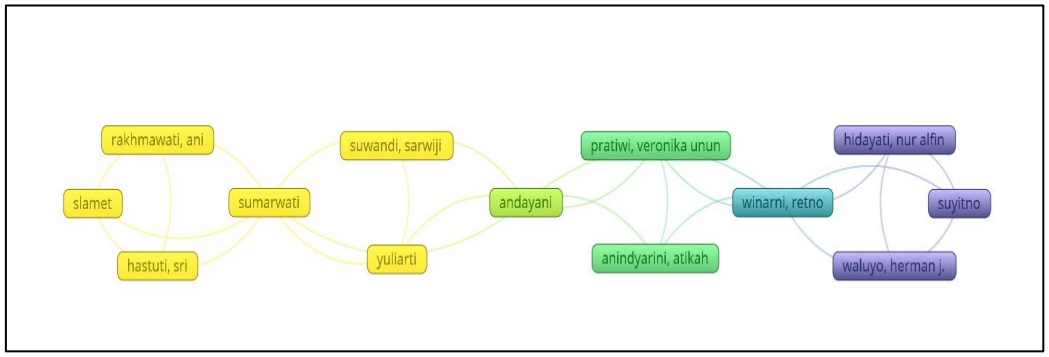

Figure 7: Overlay Visualisation of Authors and Co-Authors in Local Wisdom Research in Education Using VOSviewer

Figure 7 shows the temporal distribution of authors and co-authors in the research. Purple nodes indicate research conducted in 2020, blue-green nodes indicate research conducted in 2021, and yellow nodes indicate research conducted in 2023. There is not yet sufficient relevant data in network form for research in 2024, so its nodes have not appeared. Next, the density visualisation of authors and co-authors is displayed in Figure 8.

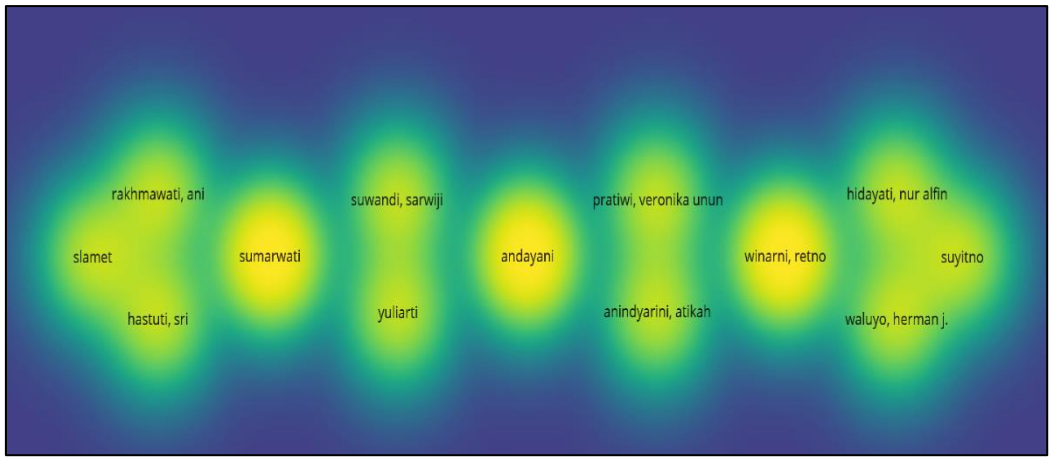

Figure 8: Density Visualisation of Authors and Co-Authors Using VOSviewer

The colour gradient in the density visualisation in Figure 8 ranges from blue (low density) to green to yellow (high density).

3.3 Author Country Mapping

The Mendeley metadata in RIS format will be visually mapped using tableau application. The distribution of countries of the contributing authors in local wisdom research in education is illustrated in Figure 9.

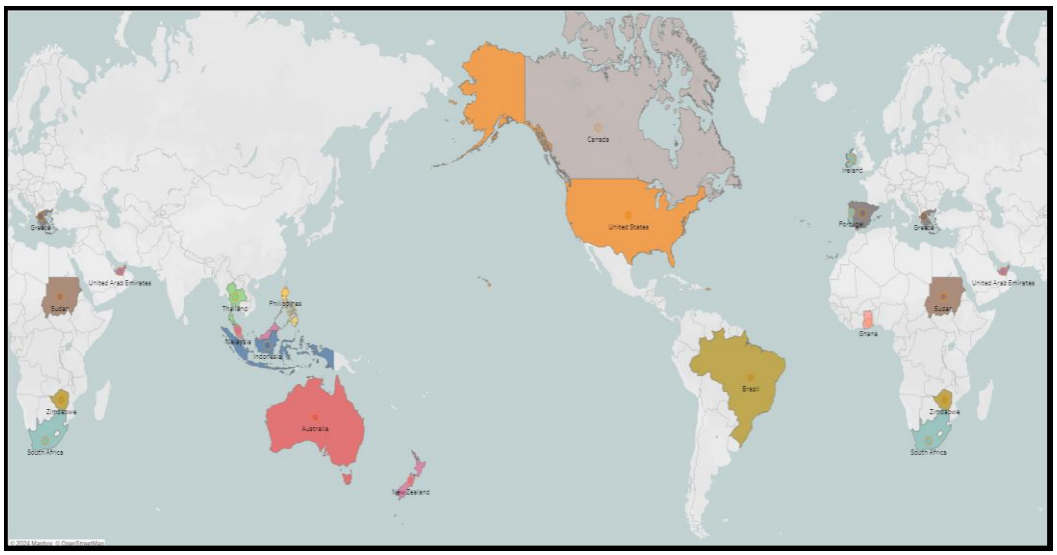

Figure 9: Country Distribution of Contributing Authors in Local Wisdom Research in Education Using Tableau Application

The top 5 distributions of contributing authors in local wisdom research in education are dominated by researchers from Indonesia (68.03%), followed by the United States (6.56%), Australia (5.74%), Malaysia (2.46%), and New Zealand (2.46%).

4. Discussion

Citation count is a key parameter for assessing the relevance of research. Hidayati is identified as the most relevant author on the topic of local wisdom in education. Her article, discussing the implementation of local wisdom-based character education at the higher education level, has been cited 51 times. Additionally, two publishers play significant roles in promoting local wisdom research from 2020 to 2024: the Gate Association for Teaching and Education and the International Association of Online Engineering, each with eight articles. This indicates a high level of involvement in disseminating local wisdom research in education. Both publishers are highly active and have specific journals relevant to the topic. Other significant publishers include Birlesik Dunya Yenilik Arastirma ve Yayincilik Merkezi and Taylor & Francis, each with five articles, and the Eurasian Society of Educational Research with four articles.

The journal with the most publications on local wisdom in education is the International Journal of Instruction, with eight articles, followed by the International Journal of Interactive Mobile Technologies with six articles. The frequency of local wisdom research in education has fluctuated over the years. The indexed Scopus research on local wisdom from 2020 to 2024 indicates global research priorities. From 2020 to 2022, the number of local wisdom studies decreased but increased again in 2023, with a decline in early 2024. However, it is premature to conclude a decrease in local wisdom research for 2024 as the literature available is only up to May 2024. Nevertheless, the number of innovations in local wisdom or culture-based education research remains limited (Garcia, 2023). Educational researchers have not yet agreed on the

characteristics of cultural innovations that can be implemented in learning (Fuad et al., 2022).

Based on VOSviewer results, 38 items met the criteria for further keyword analysis, divided into nine clusters. From the network visualisation, "learning evaluation" is the keyword or variable most closely related to local wisdom. The network visualisation from the Scopus database allows researchers to map the intellectual structure, identify main authors, institutions and countries contributing to local wisdom, and uncover collaborative patterns and trends over time (van Eck & Waltman, 2010). In the initial phase (2020-2021), research on local wisdom focused on developing local wisdom in learning. The dominant keywords used included "android", "character education", "indigenous knowledge", "character building" and "textbook". Subsequently, in the mid phase (2022-2023), there was a shift in the trend of local wisdom in the field of education, with a greater focus on thematic implementation and practical learning. The keywords used during this phase were "elementary education" ,"local wisdom" and "interests". In the final or current phase (2023-2024), the research trend on local wisdom has focused on the utilisation of technology in learning evaluation. The keywords used are "augmented reality", "learning evaluation" and "ethnomathematics". Similar to the network visualisation, the density visualisation shows that "learning evaluation" is a highly active research keyword or one that researchers are particularly interested in (van Eck & Waltman, 2014).

Author and co-authorship networks are valuable tools for comprehending collaborative patterns, temporal trends and the influence of localised knowledge in educational research cooperation. The network visualisation findings indicate that Sumarwati, Andayani and Winarni play a pivotal role in fostering collaboration among researchers, having six author and co-authorship networks. This has a significant effect on the enhanced productivity of indigenous knowledge research in the field of education. Although they all have six networks, Andayani has the largest interdisciplinary influence as an author. Since she collaborates with writers from many clusters. Andayani acts more as a co-author with the focus of her research which is more directed towards the utilisation of local wisdom-based inquiry models in writing activities to support students' critical and creative thinking skills (Pratiwi et al., 2022; Yuliarti et al., 2023). The same thing also happened to Sumarwati and Winarni who acted more as co-authors with a research focus on developing a local wisdom-based inquiry model to improve students' critical thinking skills in the aspect of writing (Hastuti et al., 2023; Yuliarti et al., 2023). This indicates that there are still few authors who consistently write local wisdom topics in the field of education in Scopus indexed journals from 2020 to 2024.

Author metrics offer an alternative viewpoint on an individual's involvement in collaborative research (Baas et al., 2020). The overlay representation of authors and co-authorship depicts the chronological spread of research. Hidayati, Waluyo and Suyitno are researchers who have conducted current studies on indigenous knowledge in the field of education. Their primary research predominantly focuses on character development based on local wisdom at the secondary and higher education level. Futhermore, Hidayati's (2020) study

suggests that strategies for character development based on local wisdom can be implemented through habituation, value role modelling, value internalisation, value integration in learning, and cultural values. The integration of local wisdom values in learning is very important to shape students' identity and promote local wisdom (Laili, 2017). The density visualisation of authors and co-authors in local wisdom research is shown by the intensity of the heatmap. Sumarwati, Andayani and Winarni are the authors who have the highest cooperation density, which suggests that the groups of authors connected to these important individuals are actively involved in several cooperative research endeavours.

Indonesia now has the highest number of writers who contribute to research on local wisdom in education, accounting for 68.03% of the total. Indonesia's scholars demonstrate a significant inclination towards doing study on indigenous knowledge in the field of education. In community life, indigenous knowledge is developed continuously, which includes spiritual and cultural elements in addition to multigenerational observations and skills (Mbah et al., 2021). The concept of SDGs especially in Indonesia, can be well-integrated and promoted through intercultural learning (Zidny & Eilks, 2020). Incorporating indigenous knowledge into education is essential to prevent the marginalisation of a country's native wisdom and to promote sustainable development (Mbah et al., 2021; Zidny et al., 2020). The United States holds the second position with a percentage of 6.56%, followed by Australia with 5.74%, Malaysia with 2.46%, and New Zealand with 2.46%. Additionally, Taiwan, Canada, Thailand, South Africa, Spain, Zimbabwe, United Arab Emirates, Portugal, Brazil, Philippines, Ireland, Greece, Ghana and Sudan have expressed interest in local wisdom research, with each country's level of interest falling below 2%. While the percentages remain relatively low, this suggests that research on local knowledge in education is slowly gaining worldwide recognition.

In classroom teaching practices, the integration of local wisdom in education is capable of developing students' character and identity (Parwati et al., 2018) Students will possess a strong sense of identity and belonging due to learning within the context of local culture. The local cultural context is the closest to students' daily lives (Kurnia et al., 2022). Through the integration of local wisdom in learning, students will be brought closer to their local culture and encouraged to directly practise it in their surroundings (Gularso et al., 2023). Ultimately, this supports the practice of SDGs with a more relevant context in education (Lubis et al., 2022; Parwati et al., 2018). The incorporation of local wisdom into science education has been empirically demonstrated to significantly enhance students' science process skills (Orab et al., 2023), character building (Siska et al., 2021), learning outcomes (Rakhmawati & Wulandari, 2023), critical thinking (Ramdani et al., 2021), creative thinking (Sumarni & Kadarwati, 2020), and problem solving skills (Parwati et al., 2018). In the field of social education, the integration of local wisdom is mostly aimed at increasing students' understanding of their culture, developing students' critical thinking skills (Uge et al., 2019), encouraging SDGs (Ulul et al., 2019), and developing student character Thus it can be concluded that the integration of local wisdom in both science and social fields not only builds competence but also student character and personality.

It is important to use technological approaches in education to spread and maintain local cultural values for young generations. Digital multimedia archives such as videos, audio recordings and digital texts can help teachers to transform knowledge in an easily accessible format (Hausknecht et al., 2021). Platforms such as e-learning and mobile applications with the context of local wisdom can provide a different experience by encouraging students to do interactive quizzes, virtual reality experiences, and in making traditional knowledge accessible globally. Similarly, the existence of Augmented Reality (AR) and Virtual Reality (VR) can provide immersive experiences of how cultural practices are carried out (Chatsiopoulou & Michailidis, 2023; Chong et al., 2022).

To advance research on local wisdom in education, it is crucial to foster robust international collaborations, advocating for the integration of local wisdom into national and international educational policies. The mechanisms that can be implemented include joint research projects, conferences, workshops, exchange programs, longitudinal studies and interdisciplinary research. For example, international joint research grants can be used as a way to develop the integration of local wisdom in the education system globally (Zhang et al., 2022). Furthermore, international workshops and conferences can be used to exchange ideas on strategies, methods, media and policies that can be used to develop the integration of local wisdom in education (Kreber, 2008). In addition, academic exchange programmes for students can be carried out to get to know the culture of each country and encourage respect and deeper understanding and practice (de Wit & Altbach, 2021).

Embedding local wisdom principles into educational curricula through collaboration with policymakers will preserve cultural heritage and enhance educational relevance. Educational policies can be designed to use local wisdom as one of the inclusive education programs for student character development to overcome social and cultural gaps among students (Nasrah & Siraj, 2023). To increase the effectiveness of local wisdom-based learning integration, the government can provide support in the form of training and adequate resources (Laili, 2017).

This study has limitations, particularly in the scope of article searches which were conducted solely using the Scopus database. This is due to the authors' limited access to reputable international journal sources indexed in Web of Science. Relying on a single database source can restrict the variety and scope of the data obtained, potentially resulting in research findings that do not fully reflect the entire spectrum of studies (Cooper et al., 2018). Additionally, there is a possibility that some significant studies published in journals not indexed by Scopus, such as those indexed by Web of Science or other databases, were not included in this analysis. This limitation can affect the results of the bibliometric mapping, particularly in identifying global trends and research contributions from various countries and disciplines.

5. Conclusion

This study presents a thorough bibliometric analysis of local wisdom research in education, offering insights into publication and citation structures, authorship patterns and geographical distribution. The analysis underscores the significant contributions of Hidayati, whose work is highly cited, highlighting her prominence in this field. Key publishers, such as the Gate Association for Teaching and Education and the International Association of Online Engineering, have played critical roles in disseminating research, each contributing eight articles.

The publication trends from 2020 to early 2024 exhibit fluctuations, with a notable peak in 2023, followed by a slight decline in 2024. However, it is premature to deduce a downward trend given the incomplete data for 2024. The relatively low overall volume of research in this domain underscores the need for continued scholarly attention and innovation. Authorship analysis using VOSviewer revealed 38 significant keywords organised into nine clusters, with "learning evaluation" being the most frequently associated with local wisdom. Key contributors, including Sumarwati, Andayani and Winarni, play pivotal roles in fostering collaborative research networks. Andayani, in particular, demonstrates high interdisciplinary impact, reflecting her extensive interactions across various clusters. These collaborative networks are essential for enhancing research productivity and fostering innovation in local wisdom education.

Geographically, Indonesia leads in contributions to local wisdom research in education, reflecting strong national interest and engagement. Other countries contribute smaller percentages, indicating a growing global interest in integrating local wisdom into educational research. This widespread geographic participation highlights the potential for international collaboration and the global relevance of local wisdom in supporting sustainable development goals.

In conclusion, this study provides a comprehensive overview of the current landscape of local wisdom research in education. Because this research is limited to the Scopus indexed article database only, in the future researchers can use additional reputable indexed journal article databases such as Web of Science to improve this bibliometric research. Educational policies can be designed to use local wisdom as one of the inclusive education programmes for student character development to overcome social and cultural gaps among students

6. References

Al Husaeni, D. F., & Nandiyanto, A. B. D. (2022). Bibliometric using VOSviewer with Publish or Perish (using Google Scholar data): From step-by-step processing for users to practical examples in the analysis of digital learning articles in pre and post COVID-19 pandemic. *ASEAN Journal of Science and Engineering*, *2*(1), 19–46. https://doi.org/10.17509/ajse.v2i1.37368

Asmayawati, Yufiarti, & Yetti, E. (2024). Pedagogical innovation and curricular adaptation in enhancing digital literacy: A local wisdom approach for sustainable development in the Indonesian context. *Journal of Open Innovation: Technology, Market, and Complexity*, *10*(1), 100233. https://doi.org/10.1016/j.joitmc.2024.100233

Asrial, A., Syahrial, S., Maison, M., Kurniawan, D. A., & Nugroho, M. T. (2021). Integration of local wisdom mangrove ecotourism in class IV learning in elementary school. *Jurnal Iqra' : Kajian Ilmu Pendidikan*, *6*(2), 61–70. https://doi.org/10.25217/ji.v6i2.1142

Baas, J., Schotten, M., Plume, A., Côté, G., & Karimi, R. (2020). Scopus as a curated, high-quality bibliometric data source for academic research in quantitative science studies. *The MIT Press Journals*, *1*(1), 377–386. https://doi.org/10.1162/QSS_A_00019

Bornmann, L., Haunschild, R., & Leydesdorff, L. (2018). Reference Publication Year Spectroscopy (RPYS) for analyzing and visualizing the historical roots of research fields. *Journal of Informetrics*, *12*(3), 750–764. https://doi.org/10.1016/j.joi.2018.06.005

Bulkani, Fatchurahman, M., Adella, H., & Andi Setiawan, M. (2022). Development of animation learning media based on local wisdom to improve student learning outcomes in elementary schools. *International Journal of Instruction*, *15*(1), 55–72. https://doi.org/10.29333/iji.2022.1514a

Chatsiopoulou, A., & Michailidis, P. (2023). Cultural heritage applications based on augmented reality: A literature review. In L. T. De Paolis, P. Arpaia, & M. Sacco (Eds.), *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics): Vol. 14219 LNCS* (pp. 194–209). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-43404-4_13

Chong, H. T., Lim, C. K., Rafi, A., Tan, K. L., & Mokhtar, M. (2022). Comprehensive systematic review on virtual reality for cultural heritage practices: coherent taxonomy and motivations. *Multimedia Systems*, *28*(3), 711–726. https://doi.org/10.1007/s00530-021-00869-4

Cooper, C., Booth, A., Varley-Campbell, J., Britten, N., & Garside, R. (2018). Defining the process to literature searching in systematic reviews: A literature review of guidance and supporting studies. *BMC Medical Research Methodology*, *18*(1), 85. https://doi.org/10.1186/s12874-018-0545-3

Damopolii, I., Nunaki, J. H., Jeni, J., Rampheri, M. B., & Ambusaidi, A. (2024). An integration of local wisdom into a problem-based student book to empower students' conservation attitudes. *Participatory Educational Research*, *11*(1), 158–177. https://doi.org/10.17275/per.24.10.11.1

de la Garza, A. (2021). Internationalizing the curriculum for STEAM (STEM + Arts and Humanities): From intercultural competence to cultural humility. *Journal of Studies in International Education*, *25*(2), 123–135. https://doi.org/10.1177/1028315319888468

de Wit, H., & Altbach, P. G. (2021). Internationalization in higher education: global trends and recommendations for its future. *Policy Reviews in Higher Education*, *5*(1), 28–46. https://doi.org/10.1080/23322969.2020.1820898

Dewi, C. A., Erna, M., Martini, Haris, I., & Kundera, I. N. (2021). Effect of contextual collaborative learning based ethnoscience to increase students' scientific literacy ability. *Journal of Turkish Science Education*, *18*(3), 525–541. https://doi.org/10.36681/tused.2021.88

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, *133*, 285–296. https://doi.org/10.1016/j.jbusres.2021.04.070

Donthu, N., Kumar, S., & Pattnaik, D. (2020). Forty-five years of Journal of Business Research: A bibliometric analysis. *Journal of Business Research*, *109*, 1–14. https://doi.org/10.1016/j.jbusres.2019.10.039

Ejaz, H., Zeeshan, H. M., Ahmad, F., Bukhari, S. N. A., Anwar, N., Alanazi, A., Sadiq, A., Junaid, K., Atif, M., Abosalif, K. O. A., Iqbal, A., Hamza, M. A., & Younas, S. (2022). Bibliometric analysis of publications on the Omicron variant from 2020 to 2022 in the Scopus database using R and VOSviewer. *International Journal of Environmental Research and Public Health*, *19*(19). https://doi.org/10.3390/ijerph191912407

Fadli, A., & Irwanto. (2020). The effect of local wisdom-based ELSII learning model on the problem solving and communication skills of pre-service islamic teachers.

International Journal of Instruction, *13*(1), 731–746. https://doi.org/10.29333/iji.2020.13147a

Fitrisia, A., Ningsih, T. Z., & Mulyani, F. F. (2023). Development of online local history learning media based on virtual field trips to enhance the use of primary source evidence. *European Journal of Educational Research*, *12*(2). https://doi.org/https://dx.doi.org/10.12973/eu-jer.12.2.775

Fuad, D. R. S. M., Musa, K., & Hashim, Z. (2022). Innovation culture in education: A systematic review of the literature. *Management in Education*, *36*(3), 135–149. https://doi.org/10.1177/0892020620959760

Garcia, M. B. (2023). Fostering an innovation culture in the education sector: A scoping review and bibliometric analysis of hackathon research. *Innovative Higher Education*, *48*(4), 739–762. https://doi.org/10.1007/s10755-023-09651-y

Grey, M. S., Masunungure, C., & Manyani, A. (2020). Integrating local indigenous knowledge to enhance risk reduction and adaptation strategies to drought and climate variability: The plight of smallholder farmers in Chirumhanzu district, Zimbabwe. *Jamba: Journal of Disaster Risk Studies*, *12*(1), 1–10. https://doi.org/10.4102/JAMBA.V12I1.924

Gularso, P. R. Y., Sujatmiko, W. I. P., & Ingtias, F. A. N., D. (2023). Developing a local genius-based pocket book for character strengthening elementary school students. *Pegem Journal of Education and Instruction*, *13*(3), 304–313. https://doi.org/https://doi.org/10.47750/pegegog.13.03.31

Harzing, A.-W., & Alakangas, S. (2016). Google Scholar, Scopus and the Web of Science: A longitudinal and cross-disciplinary comparison. *Scientometrics*, *106*(2), 787–804. https://doi.org/10.1007/s11192-015-1798-9

Hastuti, S., Slamet, Sumarwati, & Rakhmawati, A. (2023). Short story writing learning based on local wisdom with digital book media for university students. *International Journal of Instruction*, *16*(1), 821–832. https://doi.org/10.29333/iji.2023.16146a

Hausknecht, S., Freeman, S., Martin, J., Nash, C., & Skinner, K. (2021). Sharing indigenous knowledge through intergenerational digital storytelling: Design of a workshop engaging Elders and youth. *Educational Gerontology*, *47*(7), 285–296. https://doi.org/10.1080/03601277.2021.1927484

Haynes, E., Marawili, M., Mitchell, A., Walker, R., Katzenellenbogen, J., & Bessarab, D. (2022). "Weaving a mat that we can all sit on": Qualitative research approaches for productive dialogue in the intercultural space. *International Journal of Environmental Research and Public Health*, *19*(6). https://doi.org/10.3390/ijerph19063654

Heng, L., Quinlivan, K., & du Plessis, R. (2019). Exploring the creation of a new initial teacher education (ITE) programme underpinned by inclusion. *International Journal of Inclusive Education*, *23*(10), 1017–1031. https://doi.org/10.1080/13603116.2019.1625454

Hidayati, N. A., Waluyo, H. J., Winarni, R., & Suyitno. (2020). Exploring the implementation of local wisdom-based character education among Indonesian higher education students. *International Journal of Instruction*, *13*(2), 179–198. https://doi.org/10.29333/iji.2020.13213a

Hudha, M. N., Hamidah, I., Permanasari, A., Abdullah, A. G., Rachman, I., & Matsumoto, T. (2020). Low carbon education: A review and bibliometric analysis. *European Journal of Educational Research*, *9*(1), 319–329. https://doi.org/10.12973/eu-jer.9.1.319

Khare, A., & Jain, R. (2022). Mapping the conceptual and intellectual structure of the consumer vulnerability field: A bibliometric analysis. *Journal of Business Research*, *150*, 567–584. https://doi.org/10.1016/j.jbusres.2022.06.039

Kreber, C. (2008). The university and its disciplines: Teaching and learning within and beyond disciplinary boundaries. *The University and Its Disciplines: Teaching and*

Learning Within and Beyond Disciplinary Boundaries, 1–246. https://doi.org/10.4324/9780203892596

Kurnia, G., Setiawan, I., Tridakusumah, A. C., Jaelani, G., Heryanto, M. A., & Nugraha, A., G. (2022). Local wisdom for ensuring agriculture sustainability: A case from Indonesia. *Sustainability (Switzerland)*, *14*(14). https://doi.org/https://doi.org/10.3390/su14148823

Laili, M. (2017). Integrating character education and local wisdom in developing English teaching material. *Education and Human Development Journal*, *2*(2). https://doi.org/10.33086/ehdj.v2i2.1383

Lubis, S. P. W., Suryadarma, I. G. P., Paidi, & Yanto, B. E. (2022). The effectiveness of problem-based learning with local wisdom oriented to socio-scientific issues. *International Journal of Instruction*, *15*(2), 455–472. https://doi.org/10.29333/iji.2022.15225a

Maria. (2018). Local wisdom of indigenous society in managing their customary land: A comparative study on tribes in Indonesia. *E3S Web of Conferences*, *52*. https://doi.org/10.1051/e3sconf/20185200023

Marwany, M., Ali, M., Nofianti, F. R., Nurbaiti, A., Rahamwati, N. 'Aini, & Azizah, F. N. (2022, November 7). Implementation of early childhood education in families based on local wisdom and its implications for children's moral development. *Proceedings of the 1st International Conference of Humanities and Social Science, ICHSS 2021, 8 December 2021, Surakarta, Centr*. https://doi.org/10.4108/EAI.8-12-2021.2322588

Mbah, M., Ajaps, S., & Molthan-Hill, P. (2021). A systematic review of the deployment of indigenous knowledge systems towards climate change adaptation in developing world contexts: Implications for climate change education. *Sustainability (Switzerland)*, *13*(9), 4811. https://doi.org/10.3390/SU13094811/S1

Mongeon, P., & Paul-Hus, A. (2016). The journal coverage of Web of Science and Scopus: A comparative analysis. *Scientometrics*, *106*(1), 213–228. https://doi.org/10.1007/S11192-015-1765-5/METRICS

Muhammad, U. A., Fuad, M., Ariyani, F., & Suyanto, E. (2022). Bibliometric analysis of local wisdom-based learning: Direction for future history education research. *International Journal of Evaluation and Research in Education*, *11*(4), 2209–2222. https://doi.org/10.11591/ijere.v11i4.23547

Nasrah, S., & Siraj. (2023). Local wisdom-based school culture model design in realizing character education. *Proceedings of International Conference on Social Science, Political Science, and Humanities (ICoSPOLHUM)*, *3*, 00017. https://doi.org/10.29103/icospolhum.v3i.157

Nisa, A. N. S., Hermanto, F., Ginanjar, A., & Putri, N. A. (2020, August 17). To increase professional competence of social sciences teachers (in utilizing local wisdom-based learning resources through history trips in Batang Regency). *Proceedings of the International Conference on Social Studies, Globalisation and Technology (ICSSGT 2019)*. https://doi.org/10.2991/ASSEHR.K.200803.004

Orab, N., Odja, A. H., Supartin, S., & Abdjul, T. (2023). The effect of local wisdom based learning media on science process skills in straight motion material. *SEJ (Science Education Journal)*, *7*(1), 73–97. https://doi.org/10.21070/sej.v7i1.1639

Pamenang, F. D. N. (2021). Local wisdom in learning as an effort to increase cultural knowledge: Students' perception as prospective teachers. *IJIET (International Journal of Indonesian Education and Teaching)*, *5*(1), 93–101. https://doi.org/10.24071/ijiet.v5i1.3050

Parwati, N. N., Sudiarta, I. G. P., Mariawan, I. M., & Widiana, I. W. (2018). Local wisdom-oriented problem-solving learning model to improve mathematical problem-solving ability. *Journal of Technology and Science Education*, *8*(4), 310–320. https://doi.org/10.3926/jotse.401

Perilla, V. M. L., Magalhaes, L., Perez, D. K. C., Olivero, M. M. A., Cortes, B. D. M.,

Montero, Y. R., Arias, V. S. A., & Arias, D. R. A. (2021). "The bug, that little guy" in the Colombian indigenous territories: Weaving dialogues with the Kankuama community in pandemic times. *Brazilian Journal of Occupational Therapy*, *29*. https://doi.org/10.1590/2526-8910.CTOAO2146

Pratiwi, V. U., Andayani, Winarni, R., & Anindyarini, A. (2022). Digital Storybook to Transform Character Education of Local Wisdom Figures for Elementary School Students. *Journal of Social Studies Education Research*, *13*(4), 250–264. https://api.elsevier.com/content/abstract/scopus_id/85145059625

Rahman, E. Y., Pelealu, A. E., Terry, H., Burdam, Y., Tamon, M., Najoan, M., Imbar, M., Dasfordate, A., & Ramaino, A. S. (2023). Trends research on local wisdom in history learning: A bibliometric analysis. *Technium Social Sciences Journal*. https://api.semanticscholar.org/CorpusID:264532334

Rakhmawati, A. D., & Wulandari, F. E. (2023). The influence of science textbooks on simple machines based on local wisdom on students' learning outcomes. *Indonesian Journal of Education Methods Development*, *21*(4). https://doi.org/10.21070/ijemd.v21i4.794

Ramdani, A., Jufri, A. W., Gunawan, Fahrurrozi, M., & Yustiqvar, M. (2021). Analysis of students' critical thinking skills in terms of gender using science teaching materials based on the 5e learning cycle integrated with local wisdom. *Jurnal Pendidikan IPA Indonesia*, *10*(2), 187–199. https://doi.org/10.15294/jpii.v10i2.29956

Setianingrum, D. A., Jumadi, J., Suyanta, S., Nurohman, S., Astuti, S. R. D., & Fikri, I. N. (2023). Bibliometric analysis: Trends research on local wisdom in science learning and its implications for strengthening love local culture. *Journal of Science and Science Education*. https://api.semanticscholar.org/CorpusID:260559995

Setyaningsih, W., Suharini, E., & Yuliawati, Y. (2020, January 9). Environmental conservation based on local wisdoms in Kendal Ngisor, Banyubiru. *Proceedings of the Proceedings of the 1st International Conference on Environment and Sustainability Issues, ICESI 2019, 18-19*. https://doi.org/10.4108/eai.18-7-2019.2290406

Shofa, A., Su'Ad, & Murtono. (2021). Development of learning media technology based on natural science local wisdom materials. *Journal of Physics: Conference Series*, *1823*(1). https://doi.org/10.1088/1742-6596/1823/1/012080

Silva, J. B., Silva, I. N., & Bilessimo, S. (2020). Technological structure for technology integration in the classroom, inspired by the maker culture. *Journal of Information Technology Education: Research*, *19*, 167–204. https://doi.org/10.28945/4532

Siska, F., Sapriya, S., & Febriani, T. (2021). Local wisdom-based character building through social science learning in elementary schools. *Jurnal Ilmu Sosial Mamangan*, *10*(1), 54–59. https://doi.org/10.22202/mamangan.v10i1.4887

Suarmika, P. E., Putu Arnyana, I. B., Suastra, I. W., & Margunayasa, I. G. (2022). Reconstruction of disaster education: The role of indigenous disaster mitigation for learning in Indonesian elementary schools. *International Journal of Disaster Risk Reduction*, *72*, 102874. https://doi.org/10.1016/j.ijdrr.2022.102874

Sudirman, Mellawaty, Yaniwati, R. P., & Indrawan, R. (2020). Integrating local wisdom forms in augmented reality application: Impact attitudes, motivations and understanding of geometry of pre-service mathematics teachers. *International Journal of Interactive Mobile Technologies*, *14*(11), 91–106. https://doi.org/10.3991/ijim.v14i11.12183

Sukmawati, A., & Setiawan, T. (2020). Developing assessment of higher order thinking skills in physics learning based on local wisdom. *Journal of Physics: Conference Series*, *1567*(4), 42045. https://doi.org/https://dx.doi.org/10.1088/1742-6596/1567/4/042045

Sumardjoko, B., & Musyiam, M. (2018). Model of civic education learning based on the local wisdom for revitalizing values of Pancasila (Bahasa Indonesia). *Cakrawala Pendidikan*, *37*(2), 201–211. https://doi.org/10.21831/CP.V37I2.18037

Sumarmi, Bachri, S., Baidowi, A., & Aliman, M. (2020). Problem-based service learning's effect on environmental concern and ability to write scientific papers. *International Journal of Instruction*, *13*(4), 161–176. https://doi.org/10.29333/iji.2020.13411a

Sumarni, W., & Kadarwati, S. (2020). Ethno-stem project-based learning: Its impact to critical and creative thinking skills. *Jurnal Pendidikan IPA Indonesia*, *9*(1), 11–21. https://doi.org/10.15294/jpii.v9i1.21754

Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *British Journal of Management*, *14*(3), 207–222. https://doi.org/10.1111/1467-8551.00375

Uge, S., Neolaka, A., & Yasin, M. (2019). Development of social studies learning model based on local wisdom in improving students' knowledge and social attitude. *International Journal of Instruction*, *12*(3), 375–388. https://doi.org/10.29333/iji.2019.12323a

Ulul, M., Sutimin, L., & Sudiyanto, S. (2019). Local wisdom for sustainable education: The sakura traditional art to improve students' social solidarity. *Proceedings of the 1st Seminar and Workshop on Research Design, for Education, Social Science, Arts, and Humanities, SEWORD FRESSH 2019, April 27 2019, Surakarta, Central Java, Indonesia*. https://doi.org/10.4108/eai.27-4-2019.2286932

Upadhyay, B., Atwood, E., & Tharu, B. (2020). Actions for sociopolitical consciousness in a high school science class: A case study of ninth grade class with predominantly indigenous students. *Journal of Research in Science Teaching*, *57*(7), 1119–1147. https://doi.org/10.1002/tea.21626

Utami, P. L., Suprapto, N., Hidaayatullaah, H. N., Prahani, B. K., Hariyono, E., Wibowo, F. C., & Sanjaya, L. A. (2024). Bibliometric analysis of implementation Indonesian local wisdom in physics learning during 1986-2023. *AIP Conference Proceedings*, *3116*(1). https://doi.org/10.1063/5.0210761

van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, *84*(2), 523–538. https://doi.org/10.1007/s11192-009-0146-3

van Eck, N. J., & Waltman, L. (2014). Visualizing bibliometric networks. *Measuring Scholarly Impact*, 285–320. https://doi.org/10.1007/978-3-319-10377-8_13

Yuliarti, Suwandi, S., Andayani, & Sumarwati. (2023). Learning model inquiry-based local wisdom dilemmas stories and their effects on critical thinking and scientific writing abilities. *International Journal of Learning, Teaching and Educational Research*, *22*(5), 538–557. https://doi.org/10.26803/ijlter.22.5.27

Zhang, D., Ding, W., Wang, Y., & Liu, S. (2022). Exploring the role of international research collaboration in building China's world-class universities. In *Sustainability (Switzerland)* (Vol. 14, Issue 6). https://doi.org/10.3390/su14063487

Zidny, R., & Eilks, I. (2020). Integrating perspectives from indigenous knowledge and Western science in secondary and higher chemistry learning to contribute to sustainability education. *Sustainable Chemistry and Pharmacy*, *16*(February), 100229. https://doi.org/10.1016/j.scp.2020.100229

Zidny, R., Sjöström, J., & Eilks, I. (2020). A multi-perspective reflection on how indigenous knowledge and related ideas can improve science education for sustainability. *Science & Education 2021 29:1*, *29*(1), 145–185. https://doi.org/10.1007/S11191-019-00100-X