

Mapping the Intellectual Landscape of Local Wisdom-Based Learning: A Bibliometric Analysis

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ABSTRACT

This study aimed to systematically map global research trends, intellectual structures, and collaborative dynamics concerning the integration of local wisdom into education for fostering student creativity. A descriptive bibliometric approach combined with qualitative content analysis was employed. A refined dataset of 3,057 peer-reviewed articles published between 2017 and 2025 was retrieved from the Dimensions database following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework. Bibliometric mapping and network visualization were conducted using VOSviewer to examine publication growth, citation patterns, keyword co-occurrence, thematic evolution, and research density. The findings revealed an exponential increase in annual publications and cumulative citations, indicating growing scholarly interest in integrating local wisdom into educational research. Network visualization identified “local wisdom” as the central keyword, strongly connected with science learning, character education, and student creativity. Overlay visualization demonstrated a shift from conceptual discussions toward empirical investigations emphasizing classroom implementation and educational impact. Density mapping further revealed thematic disparities, showing extensive attention to general student contexts, whereas specific learning processes, cognitive mechanisms underlying creativity, and empirical evaluations of instructional effectiveness remain underexplored. This study provides a comprehensive bibliometric baseline that captures the evolution of local wisdom-based education and identifies emerging research opportunities. The findings offer valuable directions for future investigations and support the development of culturally responsive and sustainable educational innovations that strengthen creativity and improve instructional quality across diverse learning contexts.

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Introduction

Over the past two decades, the integration of local wisdom has increasingly occupied a central position within global educational discourse, serving as a strategic framework to develop contextual learning heavily rooted in students' distinct cultural backgrounds (Hajar et al., 2026; Pageh et al., 2025; Saleng & Syatriana, 2025). Recent literature mapping indicates that scholarly publications focusing on embedding indigenous knowledge into education have escalated substantially, particularly in the post-2020 era, driven by the global emphasis on sustainable education paradigms and cultural identity preservation (Arjaya et al., 2024; Fatwa, 2024). Indonesia stands out as a primary contributor to this international literature due to its expansive cultural diversity and contemporary education policies that prioritize character building and national heritage preservation (Ruswinarsih et al., 2025). This trajectory aligns with global perspectives positioning ethnopedagogical integration as a critical component of the Sustainable Development Goals (SDGs) that effectively enriches culture-driven instructional models (Nur'aini & Fariyati, 2026; Ma'ruf et al., 2026; Arjaya et al., 2024; Salim & Aprison, 2024).

On a global scale, localized cultural wisdom is no longer confined to mere heritage conservation efforts; rather, it is recognized as a potent pedagogical asset capable of fostering student innovation, critical thinking skills, and creative thinking. Accumulating evidence demonstrates that when local wisdom-driven learning is paired with modern instructional approaches, such as project-based and problem-based learning which significantly accelerates creative output among learners (Arfida et al., 2024; Salim & Aprison, 2024). This pedagogical shift responds directly to 21st-century competency standards, which emphasize creativity as an indispensable survival skill amidst the pressures of globalization and digital academic transformation (International Commission on the Futures of Education, 2021).

Nevertheless, despite this upward scholarly trend, macro-level bibliometric assessments expose geographical and thematic asymmetries. The current literature remains heavily saturated with studies originating from Asian territories, specifically Southeast Asia, whereas investigations intersecting local wisdom with digital literacies, systematic curriculum design, and macro-level sustainable development remain sparse (Budiantoro & Dewantara, 2025). Such gaps offer an open opportunity for ongoing scholarship to solidify indigenous knowledge as an adaptive, resilient, and inclusive instructional method aligned with the core mandates of global quality education under SDG 4 (International Commission on the Futures of Education, 2021).

Conventionally, contextualizing curricula with native wisdom targets cultural preservation, ethical character reinforcement, and student learning outcome optimization (Arfida et al., 2024). However, current empirical literature remains highly fragmented, primarily concentrating on micro-level classroom implementations or isolated teaching material designs without offering an overarching, systemic evaluation of publication trajectories, thematic fields, and research clusters within this domain. Bibliometric mapping that comprehensively visualizes authorship networks, collaboration dynamics, and thematic shifts remains scarce, especially concerning secondary education structures (Ruswinarsih et al., 2025). Furthermore, while student creativity is repeatedly highlighted as a primary benefit of culture-infused pedagogy, very few broad-scope studies explicitly isolate and target creativity as the central parameter for mapping international literature.

Prior bibliometric investigations predominantly evaluate local wisdom through generalized lenses such as character education, basic cultural literacy, or contextual instruction, failing to build a dedicated conceptual bridge toward student creative development as a required 21st-century capability (Ruswinarsih et al., 2025; International

Commission on the Futures of Education, 2021). Consequently, a substantial literary gap persists, demanding a descriptive bibliometric study to systematically trace local wisdom publication directions while evaluating how this discourse underpins creative student output within global sustainable education. Currently, the instructional content distributed across many schools suffers from uniformity, failing to capture the rich socio-cultural environments in which students live, which ultimately causes a disconnect between formal instruction and local societal realities (Purnama et al., 2025; Santi et al., 2023). While several grassroots innovations such as utilizing traditional games to bridge scientific concepts with local narratives have effectively enhanced student competencies and character traits (Kusuma et al., 2025), these applications remain localized and lack the institutional sustainability required for wide-scale school implementation.

Compounding these curricular disconnects, the unequal availability of culturally responsive learning resources continues to widen educational quality disparities across regions. At the same time, significant challenges remain regarding teacher preparedness and institutional capacity to effectively implement local wisdom-based learning. Previous studies indicate that many educators lack both the pedagogical knowledge and practical skills necessary to systematically develop and integrate culturally relevant instructional materials (Purnama et al., 2025; Supriadi et al., 2025). Although localized modules and thematic learning materials have demonstrated considerable potential in enhancing student engagement and participation, evidence regarding their broader implementation, effectiveness, and policy support remains fragmented. Furthermore, the growing erosion of indigenous languages and cultural values within increasingly pluralistic societies highlights the need for educational approaches that preserve local identities while promoting social cohesion (Gaspersz et al., 2025; Zulkifli et al., 2024).

Despite the increasing scholarly attention to local wisdom-based education, there is still limited comprehensive evidence regarding the global development of this research field, including its intellectual structure, thematic evolution, and emerging research directions. Therefore, this study aims to systematically map and analyze global scientific publications on local wisdom and student creativity development using a bibliometric approach. The primary contribution of this study lies in providing a comprehensive overview of publication trends, collaboration networks, thematic clusters, and research gaps within the field. By identifying underexplored areas and future research opportunities, this study offers a valuable knowledge base for researchers, educators, and policymakers seeking to develop more effective, culturally grounded, and sustainable educational innovations.

Method

This investigation implements a content analysis design, deploying a systematic and objective methodological framework to analytically characterize and quantify targeted research phenomena (Krippendorff, 2018). This approach facilitates the rigorous examination of documentary records, empowering researchers to systematically sort and aggregate textual codes, words, or phrases into macro-level, content-relevant categories (Elo & Kyngäs, 2008). Operatively, a meta-review procedure is incorporated as an essential structural component within a broader systematic review of primary empirical literature (Heal, 2009; Ruddy & House, 2005; Serenko & Bontis, 2004). To complement this framework, a bibliometric analysis is applied to drive intellectual idea organization, visually and textually mapping scholarly outputs while actively identifying shifting thematic trends within the academic landscape. The baseline dataset underpinning this analysis comprises scholarly publications extracted from the Dimensions database, compiled comprehensively in January 2026.

To systematically guide the identification and curation of academic literature addressing local wisdom within education to foster student creativity, this study implements the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework. The initial literature extraction was executed through the Dimensions database by deploying designated search strings associated with local wisdom, instructional settings, and student creative outputs. This search parameters were strictly restricted to documents published from 2017 to 2025, focusing primarily on the title and abstract metadata. Structurally aligned with the PRISMA protocol, the selection workflow progresses through three distinct operational phases: identification, screening, and eligibility evaluation (Page et al., 2021; Rethlefsen & Page, 2022).

During the initial identification phase, a comprehensive database query across Dimensions yielded an initial pool of 21,156 publication records reflecting localized cultural wisdom in educational contexts, all originating from the predefined timeframe. In the subsequent screening phase, strict inclusion criteria regarding document types were applied, filtering the dataset to retain peer-reviewed scientific articles exclusively. Consequently, this process led to the exclusion of 16,807 non-compliant records. In the final eligibility and feasibility assessment phase, the remaining literary works underwent a rigorous qualitative evaluation focused on thematic alignment, baseline research objective relevance, and data integrity. This multi-tiered screening ultimately culminated in a refined sample of 3,057 articles, which served as the core dataset for subsequent bibliometric processing.

The finalized sample was subsequently processed using VOSviewer, a specialized computational tool engineered for the systematic construction and visual mapping of bibliometric networks (Van Eck & Waltman, 2010). This software enables analytical mapping of interconnected configurations among authors, source journals, and high-frequency keywords leveraging co-citation, co-authorship, and keyword co-occurrence parameters. Furthermore, VOSviewer provides multiple analytical interfaces-namely network, overlay, and density visualizations-which were strategically utilized in this study to detect thematic clusters, trace evolution pathways, and map contemporary scholarly shifts over time (Aria & Cuccurullo, 2017; Budiantoro & Dewantara, 2025; Van Eck & Waltman, 2010). The structural progression of this selection methodology is charted in the PRISMA flow diagram presented in **Figure 1**.

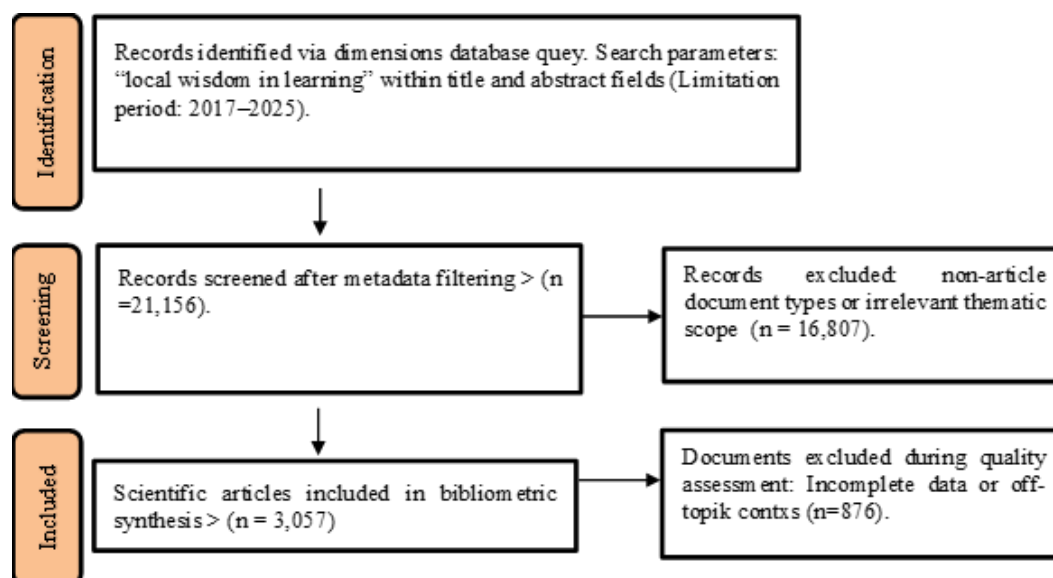


Figure 1. PRISMA flow diagram of the Research

Results and Discussion

This section elucidates the empirical findings derived from the bibliometric mapping of scholarly literature exploring the integration of local wisdom in educational frameworks to augment student creativity. The evaluated dataset spans a nine-year publication window from 2017 to 2025, with records comprehensively retrieved from the Dimensions repository. Fundamentally, bibliometric analysis operates as a specialized macro-level meta-analysis of research documentation, serving to evaluate structural metadata, bibliographic attributes, and systemic citation configurations of peer-reviewed outputs within the scholarly domain (Aria & Cuccurullo, 2017).

The analytical focus within this segment is organized around several primary dimensions: longitudinal publication volumes, cumulative citation trajectories, and the categorization of outputs across thematic fields, source journals, and prolific investigators. Furthermore, it incorporates advanced spatial networks developed via VOSviewer software, comprising network, overlay, and density visualizations (Altay & Balım, 2024; Çolak & Koç, 2023). Ultimately, this multi-faceted evaluation aims to deliver a holistic overview of evolving research trajectories concerning indigenous knowledge systems in pedagogy—specifically their intersection with learner innovation—while uncovering underlying conceptual interconnections and promising gaps for future investigative deployment.

Number of Publications

The comprehensive database interrogation targeting scientific literature at the intersection of educational local wisdom and student creative development over the 2017–2025 period yielded an initial pool of 21,156 publications. The longitudinal distribution of these outputs reveals a distinct and statistically significant upward trajectory year over year, capturing a robust and continuous expansion of academic interest in this specialized domain. This steady growth pattern underscores that embedding localized cultural values into formal learning environments—particularly as a catalyst for student ingenuity—has solidified into a highly relevant, dynamic, and increasingly prominent field of study among contemporary educational researchers. The annual progression of these publication metrics is illustrated in **Figure 2**.

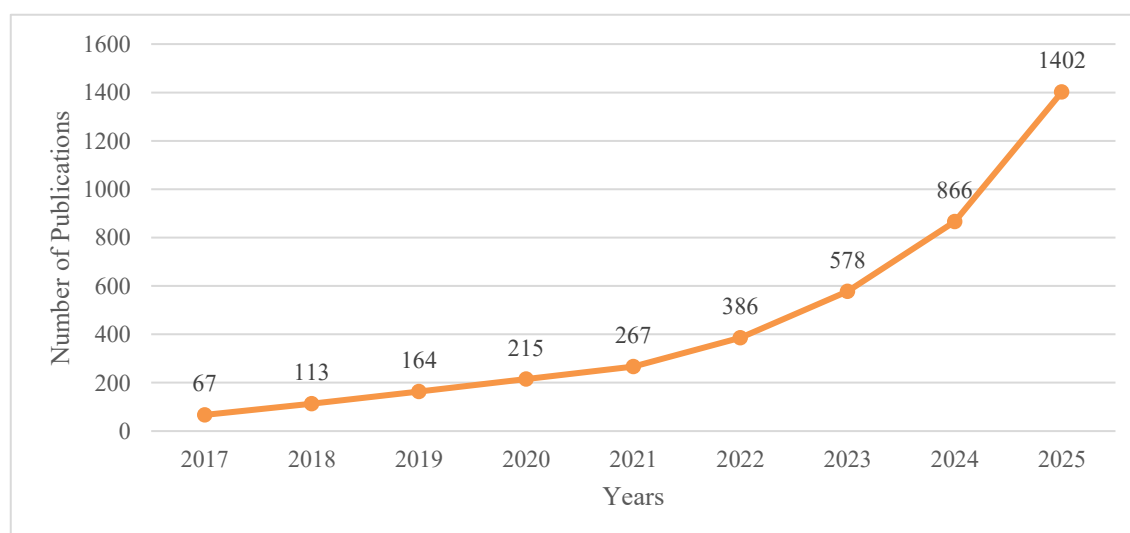


Figure 2. Publication trends and quantitative evolution of culture-infused learning studies across indexed journals (2017–2025)

The quantitative and spatial analyses conducted in this study demonstrate that integrating localized cultural heritage into formal instructional frameworks has evolved from

a niche domain into a mainstream global educational discourse. The substantial longitudinal growth in scholarly output trajectories underscores a growing academic consensus regarding ethnopedagogical approaches as viable mechanisms for fostering contextualized and culturally responsive learning environments. This paradigm shift indicates that local wisdom transcends mere historical preservation, functioning instead as a dynamic pedagogical catalyst that enriches contemporary curriculum design (Baphurah, 2026; Budianto et al., 2026), character formation (Sakti et al., 2024), and 21st-century creative competencies (Milleer, 2026; Anderson, 2024).

Citation Impact and Longitudinal Metrics

Assessing the scientific trajectory of literature bridging educational local wisdom with student creative development reveals a cumulative volume of 121,048 citations generated between 2017 and 2025. At the baseline of this observation window in 2017, scholarly engagement was comparatively minimal, registering a modest 594 citations. Conversely, by 2025, the academic impact peaked significantly, accumulating its highest annual volume of 27,362 citations. This exponential longitudinal growth underscores a compelling upward trend, signaling expanding intellectual recognition and a heightened scientific footprint for this research domain across the global academic community. Within science mapping frameworks, citation metrics offer critical insights regarding the systemic influence and paradigm contributions of specific scholarly works, allowing researchers to evaluate and benchmark structural authority based on cumulative peer reception (Handoyo, 2024). The chronological evolution and annual breakdown of these citation dynamics are graphically modeled in **Figure 3**.

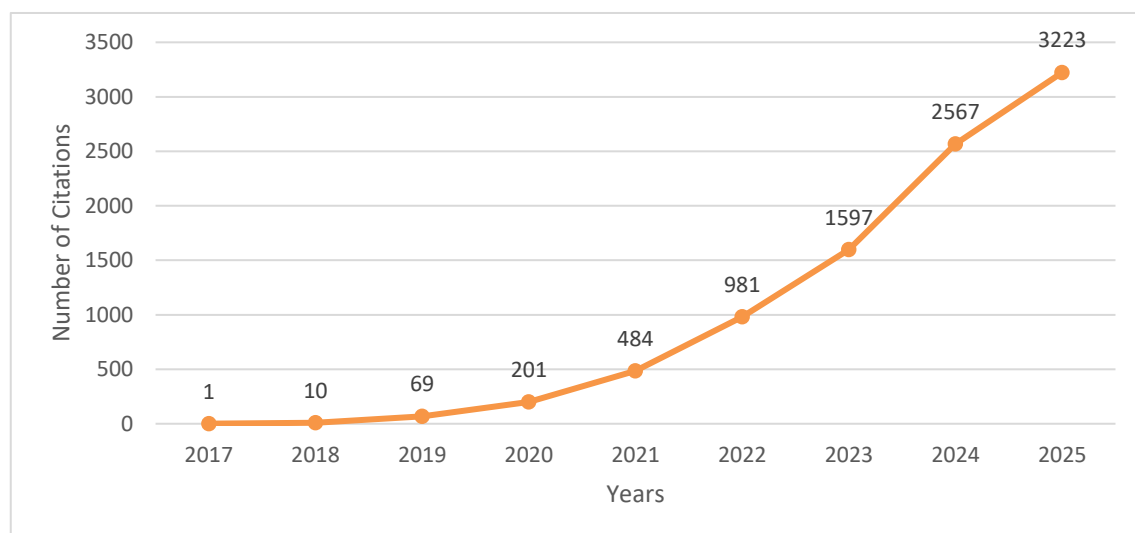


Figure 3. Longitudinal trajectory and scientific impact of local wisdom research in education based on cumulative citation volumes

The quantitative and spatial mappings mapped in this study demonstrate that integrating localized cultural heritage into formal instructional frameworks is transitioning from a localized, niche topic into a prominent global educational discourse. The substantial longitudinal growth in publication volumes and citation indexes underscores that the academic community increasingly values ethnopedagogical approaches as viable strategies for creating contextual, culturally responsive learning environments. This paradigm shift suggests that local wisdom is no longer confined to mere historical preservation; rather, it operates as an active pedagogical tool that enhances contemporary curriculum design, character orientation, and creative capabilities among 21st-century learners (Baphurah, 2026; Milleer, 2026; Anderson, 2024). The rising citation trajectories further validate the

expanding intellectual footprint and systemic influence of this domain, positioning indigenous knowledge systems as essential foundations for sustainable educational innovations.

Dissemination Outlets and Core Source Journals

Evaluating the distribution of literature across various publishing channels reveals five primary journals driving the scholarly output on integrating localized cultural wisdom to foster student creativity. Leading this cohort as the most prolific dissemination source is *Advances in Social Science, Education and Humanities Research*, which accounts for 88 articles. This is closely followed by the *Journal of Science Education Research*, which contributes 73 publications to the domain. The quantitative dominance of the former publication outlet strongly indicates an aligned editorial scope and a dedicated thematic focus on indigenous knowledge systems, pedagogical strategies, and innovative learner development. Consequently, this specific venue serves as a foundational baseline reference and a critical repository for contemporary investigators operating within the ethnopedagogical research landscape. The institutional and thematic breakdown of these prominent publishing channels is visually represented in **Figure 4**.

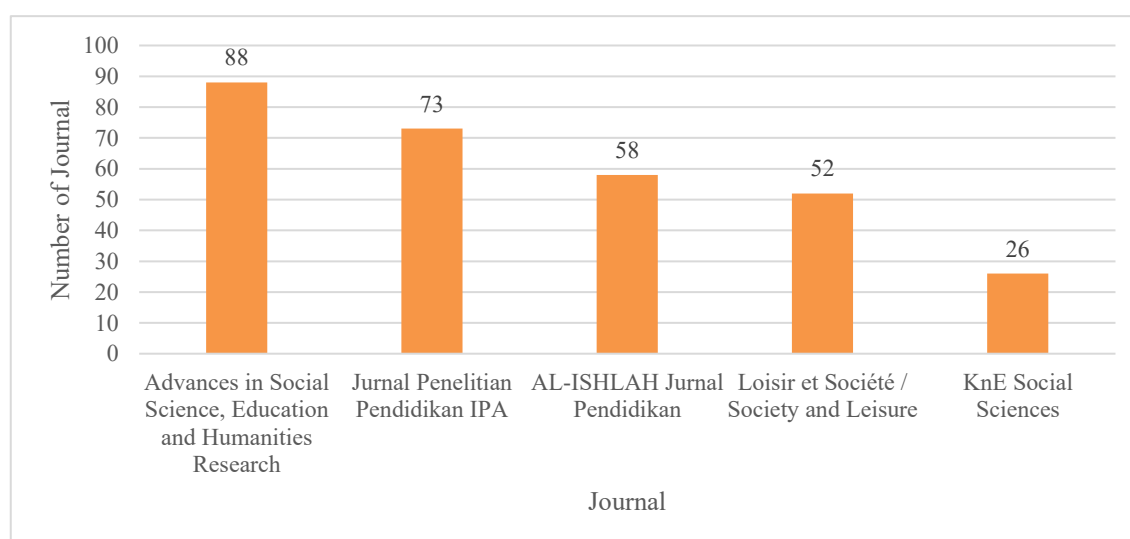


Figure 4. Comparative distribution of leading scholarly journals publishing research on local wisdom in instructional designs (2017–2025)

Prominent Contributors and Investigator Productivity

Investigating the scholarly output driven by individual authors highlights five core researchers who have shaped the literature on integrating local wisdom into educational frameworks to advance student creativity. Key scholars making substantial contributions to local wisdom-integrated learning for student creativity significantly advance the field of education, thereby positioning this domain as a pivotal driver of pedagogical innovation (Kim et al., 2025). Leading this cohort as the most prolific investigator is Insih Wilujeng, who has authored three specialized publications. This contribution is closely supported by Dwi Agnes Setianingrum, Sri Yaminah, Ketang Wiyono, and Jumadi Jumadi, with each investigator contributing two articles to the existing body of knowledge. These metrics demonstrate that these specific scholars have driven the thematic expansion of ethnopedagogical inquiries, particularly through research designs aimed at fostering innovative learner capabilities. Consequently, within the boundaries of this bibliometric dataset, Insih Wilujeng stands out as the vanguard researcher spearheading this academic

subfield. The comparative productivity patterns and distribution among these leading authors are modeled visually in **Figure 5**.

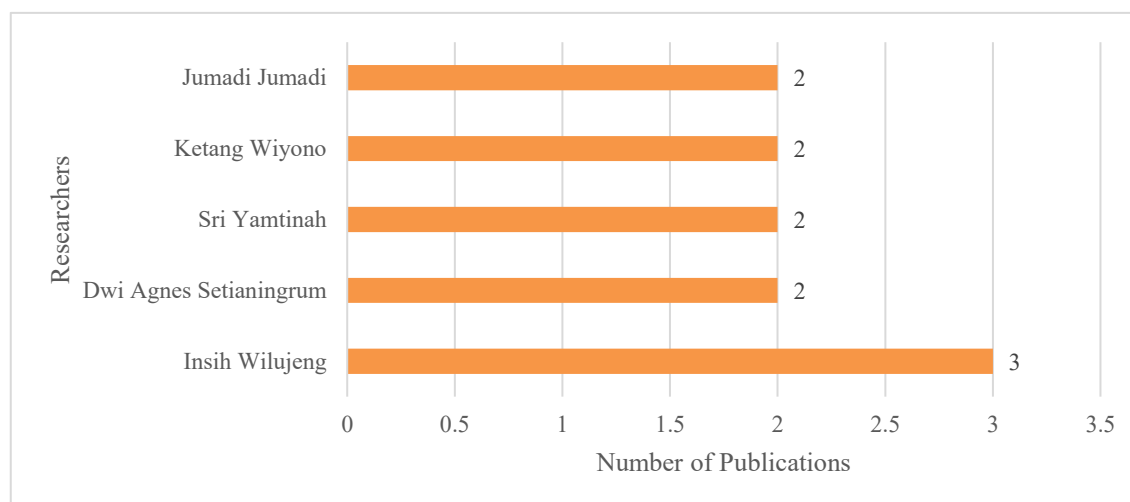


Figure 5. Prolific authors and productivity distribution within the scholarly domain of culture-infused educational frameworks (2017–2025)

Macro-Level Structural Mapping: Keyword Co-occurrence Network

To map the underlying conceptual architecture and trace the interconnections among diverse research topics within the domain of educational local wisdom, a keyword co-occurrence network was constructed. This spatial visualization was modeled using VOSviewer, an analytical software where individual nodes represent high-frequency keywords, and the connecting links illustrate the co-occurrence occurrences of these terms within identical documents. Mechanically, the physical volume of each node corresponds directly to the appearance frequency of the keyword, whereas the distance separating the nodes and the relative thickness of the linking lines visually quantify the structural strength of the relationships between distinct concepts (Altay & Balım, 2024; Çolak & Koç, 2023; Van Eck & Waltman, 2010).

The analytical layout reveals that the descriptor "local wisdom" occupies the absolute central node of the network, showing an expansive degree of interconnectedness with adjacent clusters such as science learning, students, character, and creativity. This highly centralized topology underscores that indigenous knowledge serves as the core conceptual anchor integrating multiple instructional approaches within contemporary pedagogical frameworks. These spatial dynamics corroborate the methodological assertions of Klarin. (2024), who demonstrate that systematic co-occurrence networks are highly effective in uncovering the underlying intellectual structure and thematic intersections governing an active research field.

Furthermore, the topological clustering algorithm identified several distinct thematic subfields representing specialized research directions. The primary cluster focuses deeply on instructional design and learner ingenuity, illustrating how local cultural resources directly stimulate student creative capacities. A separate, closely aligned cluster underscores the intersection of localized heritage with character education frameworks, indicating that embedding ethnopedagogical values drives not only cognitive skill acquisition but also forms systemic attitudinal traits and ethical frameworks in learners. Taken together, this co-occurrence network visualizes local wisdom research as a highly multidimensional, collaborative domain, providing an empirical baseline of inter-topic dynamics that can be strategically exploited to isolate hidden gaps and guide future investigative trajectories (Aria & Cuccurullo, 2017). This structural map is presented in **Figure 6**.

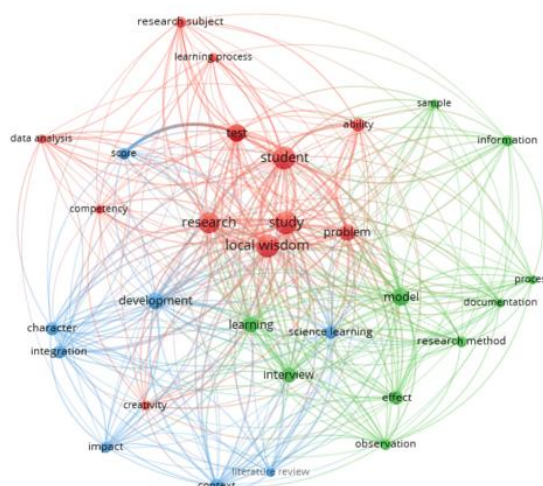


Figure 6. VOSviewer network visualization modeling high-frequency keyword co-occurrences and core thematic clusters in local wisdom literature

Through the lens of network co-occurrence, the absolute centrality of the "local wisdom" node underscores its role as a cross-disciplinary anchor connecting diverse pedagogical parameters, including science education, student character formation, and creativity development. This structural layout confirms that ethnopedagogical research is inherently multidimensional, bridging cognitive domain optimization with effective socio-cultural values (Mohd Hashim et al., 2026; Abbas et al., 2025). However, the presence of weaker links to certain peripheral concepts indicates that while the framework is widely accepted in theory, systematic operational pathways connecting specific indigenous modules to measurable innovation indexes remain highly fragmented. This fragmentation highlights an immediate necessity for deeper interdisciplinary research to formulate standardized tools capable of transforming localized practices into scalable learning models.

Evolving Research Trajectories: Temporal Overlay Visualization

Beyond structural clustering, a temporal analysis was conducted using the overlay visualization interface to trace the chronological evolution and shifting trends within the local wisdom literature from 2017 to 2025. Graphically modeled in Figure 7, this distribution maps the keyword co-occurrence parameters onto a chronological timeline. While the physical scale of individual nodes continues to represent cumulative keyword appearance frequencies, the color spectrum introduces a temporal matrix to reflect the specific eras in which these concepts emerged. Specifically, deep blue gradients capture baseline topics established during the earlier phases of the observation window, whereas transitions from green to vibrant yellow highlight emerging nodes and contemporary research fronts. A detailed evaluation of this temporal layout shows that newer nodes, such as "data analysis" and "impact," have gravitated toward influential positions, connecting seamlessly with broader educational themes. This temporal distribution offers a comprehensive overview of the macro-level evolution of research priorities, effectively plotting the developmental direction of ethno-pedagogical scholarship with an increasing emphasis on practical and empirical outcomes (Altay & Balım, 2024; Çolak & Koç, 2023; Van Eck & Waltman, 2010). This chronological mapping is illustrated in Figure 7.

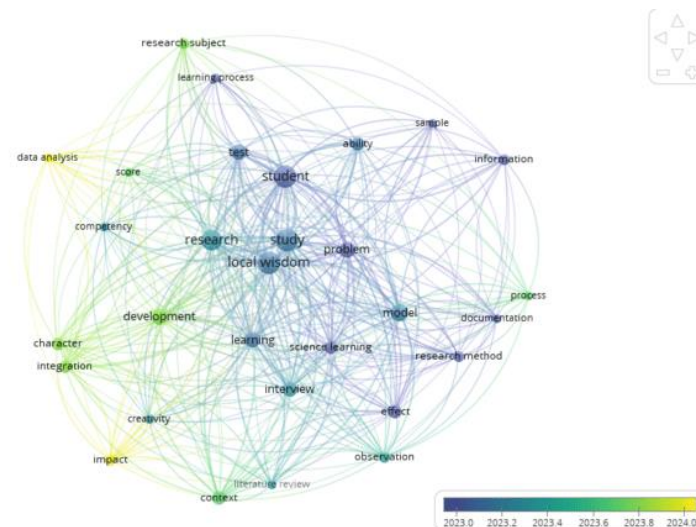


Figure 7. Overlay Visualization on Local Wisdom in Learning

Furthermore, the temporal shifts captured via overlay and density visualizations reflect a critical evolution in research priorities. The movement of contemporary research fronts toward "data analysis" and "impact" indicates that scholarship is moving away from purely conceptual or descriptive explorations. Instead, researchers are focusing on empirical, data-driven verifications of how culture-based learning affects practical classroom outputs. Concurrently, the high-density saturation surrounding generalized nodes like "students" and "learning" contrasts sharply with the low-density frontiers of "the learning process," "creativity," and "impact". This structural imbalance uncovers clear research gaps. It indicates that while general student participation is widely documented, the exact cognitive mechanisms through which local wisdom triggers creative thinking and measurable instructional impact are under-researched (Ifrianti et al., 2025; Anwar et al., 2024). Consequently, these low-density areas offer fertile ground for future researchers to design targeted, sustainable instructional innovations that protect regional identity while cultivating essential 21st-century creative competencies.

Identification of Research Gaps: Density Visualization Landscape

To complement the structural and temporal mappings, a density visualization was generated to identify saturated research domains alongside under-explored conceptual areas within the literature. The cloud-like distribution uses a specific color intensity gradient to represent the density and relative weight of co-occurring keywords. Areas surrounding the bright yellow saturation points signify high-density nodes, indicating that these themes have been extensively investigated in previous studies, with a strong focus on concepts like "students" and "learning" itself. Conversely, items situated within the dim blue or green peripheral zones represent low-density clusters, indicating that these specific areas have received minimal academic attention. Prominent examples of these under-utilized themes include "the learning process," "creativity," and "impact". Consequently, to establish strong thematic novelty and address current literary blind spots, future research trajectories are highly recommended to prioritize these low-density categories. The strategic distribution of these density metrics is modeled in **Figure 8**.

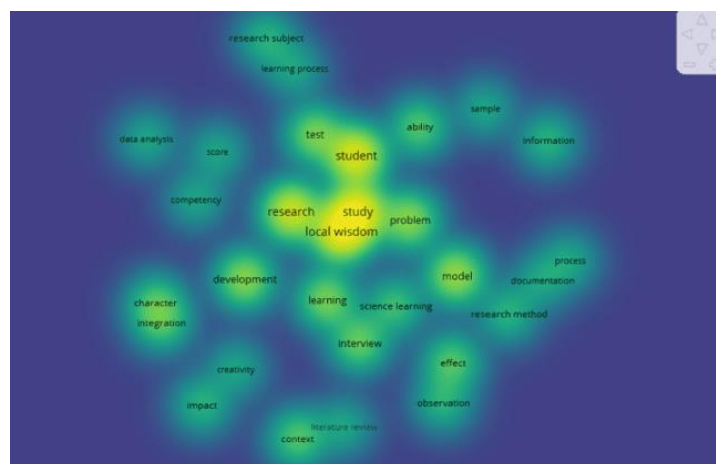


Figure 8. VOSviewer density visualization identifying saturated research domains and latent thematic gaps in local wisdom studies

The visualization illustrates the thematic structure of the literature, delineating both saturated research domains and critical latent thematic gaps in local wisdom studies (Ulupui et al., 2023; McAllister et al., 2022). The high-density cluster represented by the bright yellow regions, dominated by keywords such as local wisdom, study, student, research, test, and problem, indicates that prevailing scholarship remains heavily concentrated on descriptive pedagogical evaluations and basic cognitive testing (Sadri & Temaja, 2025; Utari et al., 2023; Widodo & Priyanto, 2022; Rohmah et al., 2022; Sumarmi et al., 2016). Conversely, low-density peripheral keywords such as creativity, character integration, science learning, impact, and context expose vital yet underexplored empirical frontiers (Paais et al., 2026; Jovanda et al., 2026; Arjaya et al., 2024). These findings underscore an urgent paradigm shift in ethnopedagogical research, moving from conventional assessment-driven paradigms toward active, culturally responsive interventions that directly foster higher-order creativity and character formation among learners (Aprilliawati et al., 2026; Suryanti et al., 2026; Budhiarti & Allolinggi, 2026).

This study has several limitations. The analysis was limited to publications indexed in the Dimensions database and focused on bibliometric patterns rather than directly measuring the educational impact of local wisdom-based learning. Therefore, the findings should be interpreted as an overview of research developments rather than evidence of learning effectiveness. Nevertheless, the results highlight the important role of local wisdom in fostering 21st-century creative competencies. By connecting cultural knowledge with real-world problem-solving, local wisdom-based learning can support creativity, critical thinking, collaboration, and innovation while strengthening students' cultural identity. Future studies should further examine the extent to which these competencies can be developed and measured through specific local wisdom-oriented educational practices.

Conclusion

This study systematically mapped global research trends, intellectual structures, and thematic developments related to the integration of local wisdom in fostering student creativity between 2017 and 2025. The findings reveal a consistent increase in publication and citation growth, indicating the rising importance of local wisdom-based education within contemporary educational research. Bibliometric mapping identified local wisdom as a central research theme closely connected to character education, culture-based learning, and creativity development, while overlay and density analyses highlighted a shift toward empirical investigations and classroom impact studies. The study also identified several underexplored areas, particularly concerning learning processes, creativity-enhancing

mechanisms, and measurable educational outcomes. Future research should move beyond descriptive and conceptual discussions by conducting empirical studies that examine how local wisdom-based pedagogical models influence creativity and other 21st-century competencies across diverse educational contexts. Such investigations will contribute to the development of evidence-based, culturally responsive, and sustainable educational practices.

Author Contributions

Conceptualization was contributed by YU, TYP, M, and SRH; methodology by TYP and M; and formal analysis by YU, TYP, and SRH. Investigation was conducted by YU, SRH, and M, with the original draft written by YU and TYP. Review and editing were performed by YU, TYP, and M, while supervision was provided by TYP, M, and SRH.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Use of Artificial Intelligence

Generative AI tools (ChatGPT 5.6, Gemini 3.5) were used to assist in organizing literature and summarizing references. The authors independently verified all cited sources and interpretations.

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