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Integrating Local Wisdom and Ethnoscience in Inquiry-Based Science Education with a Focus on Physics: A Systematic Literature Review on Scientific Literacy and Critical Thinking

Rosiyanah[1], I Made Astra[2], Vina Serevina[3]
[1,2,3]Jakarta State University, Indonesia

[1]rosiyanah_1310825004@mhs.unj.ac.id
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Abstract

Indonesian students' science performance remains below international benchmarks: in PISA 2022, Indonesia scored 383 in science, compared with the OECD average of 485 (OECD, 2023). This systematic literature review examines how local wisdom and ethnoscience have been integrated into inquiry-based science education at the K–12 level, with a focus on physics, and how the reviewed studies describe students' scientific literacy and critical thinking. Following a PRISMA-guided process, the review drew on 306 initially identified records from Scopus (n = 106) and Google Scholar (n = 200), of which 51 studies were included in the content analysis in the current manuscript contains 51 studies. A separate bibliometric analysis used the 106 Scopus records to map publication trends, source journals, and keywords; annual output rose from 2 articles in 2015 to 28 in 2024. In the 51-study dataset, Guided Inquiry was the most frequently coded learning model (23.5%), followed by Problem-Based Learning (15.7%) and Project-Based Learning (11.8%). Nineteen studies addressed an identifiable physics topic, mainly simple machines, gravity, and measurement, whereas electricity and optics appeared infrequently and modern physics and thermodynamics were not identified in the current coding. Outcomes were synthesized narratively because study designs, instruments, and reporting formats differed; no cross-study N-gain mean, range, or pooled effect size was calculated. The review recommends developing inquiry-based designs for less-represented physics topics, documenting a wider range of local wisdom, and conducting longitudinal studies to support SDG 4: Quality Education.

Keywords: local wisdom; ethnoscience; inquiry-based learning; physics education; scientific literacy; critical thinking

Introduction

Scientific literacy and critical thinking are essential competencies for 21st-century learners (OECD, 2023; Suprapto et al., 2021). Indonesia, however, continues to perform below international benchmarks. In PISA 2022, Indonesia's science score was 383, well below the OECD average of 485, and the country ranked 67th out of 81 participating countries (OECD, 2023). Previous studies suggest that science instruction in Indonesia, including physics, has not yet fully developed students' scientific literacy (Suprapto et al., 2021; Jufrida et al., 2024). Physics instruction should train students to think critically and understand concepts in depth rather than memorize formulas (Brown, 2017; Zidny et al., 2020).

One frequently cited problem is the weak connection between abstract physics concepts and students' everyday lives (Hariyono et al., 2023; Saminan et al., 2024). When concepts such as force, energy, and motion are presented mainly through textbooks, students may perceive physics as irrelevant, which can reduce motivation (Dewi et al., 2021; Gumbo et al., 2021;

Sanjayanti et al., 2022). At the same time, Indonesia has a rich body of local wisdom and ethnoscience, including traditional knowledge about tools, measurement, and natural phenomena, that may provide meaningful contexts for physics learning (Latip et al., 2024; Saminan et al., 2024; Zidny et al., 2020).

Culturally responsive pedagogy offers one way to connect cognitive development with students' cultural backgrounds by incorporating cultural knowledge and student experiences into the learning process (Brown, 2017; Ogegbo & Ramnarain, 2024). Inquiry-based learning is a promising vehicle for this purpose because inquiry practices, such as developing models, analyzing data, and communicating information, can accommodate culturally situated contexts (Brown, 2017). Whether integrating local wisdom and ethnoscience into inquiry-based instruction is associated with gains in students' scientific literacy and critical thinking is the question that motivates this review.

Scholarly attention to local wisdom, ethnoscience, and indigenous knowledge in science education has grown in recent years. Zidny et al. (2020), in a multi-perspective reflection, argued that indigenous knowledge can offer alternative perspectives on nature and science that enrich science education for sustainability. Latip et al. (2024) systematically reviewed 52 articles and reported that local and indigenous knowledge has been studied in Indonesia, the United States, Canada, Australia, and several African countries. Ogegbo and Ramnarain (2024) identified pedagogical practices for integrating indigenous knowledge systems into science teaching, including argumentative discussions, contextual teaching materials, and collaboration with knowledge holders.

Research on inquiry-based and culturally responsive approaches has reported encouraging outcomes. Brown (2017), in a metasynthesis of 52 articles, found complementarity between culturally responsive and inquiry-based science education. In Indonesia, Jufrida et al. (2024) reported that ethnoscience learning with a discovery model improved junior high school students' scientific literacy on simple machines. Saminan et al. (2024) developed ethnoscience-based physics learning tools from Aceh and reported that they were valid, practical, and effective. Dewi et al. (2021) and Sanjayanti et al. (2022) reported that ethnoscience-based and Balinese local-wisdom-based learning models improved students' scientific literacy (and, in Sanjayanti et al., character).

Within Indonesian physics education, earlier work has developed guided-discovery and problem-based designs, for example web-based physics learning media using a guided-discovery approach (Kalatting et al., 2015) and a problem-based e-module on heat and temperature aimed at science process skills (Serevina et al., 2018). These studies did not integrate local wisdom or ethnoscience and are not among the studies included in this review; they are cited as pedagogical background for the instructional models that recur in the reviewed literature.

Nevertheless, three gaps remain. First, research on local wisdom and ethnoscience is fragmented across disciplines, and systematic syntheses focused on physics are scarce (Latip et al., 2024; Ogegbo & Ramnarain, 2024). Second, available studies appear to concentrate on general science or concrete topics such as simple machines, while abstract topics such as electricity, optics, modern physics, and thermodynamics receive less attention (Jufrida et al., 2024; Saminan et al., 2024). Third, to our knowledge, no previous review has examined the integration of local wisdom and ethnoscience in inquiry-based science and physics education while also describing the reported outcomes for scientific literacy and critical thinking. Without such synthesis, it is difficult to determine which learning models and physics topics dominate the field, where evidence is thin, and what recommendations can reasonably be made for culturally responsive physics curricula.

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This review contributes in three ways. First, it focuses on the integration of local wisdom and ethnoscience in inquiry-based science education with an explicit physics lens. Second, it combines a bibliometric mapping of the field (Aria & Cuccurullo, 2017; Zupic & Čater, 2015) with a content analysis of studies selected through a PRISMA-guided procedure. Third, it describes the reported outcomes for two constructs, scientific literacy and critical thinking, while distinguishing evidence reported in primary studies from the authors' interpretation. The review addresses four research questions:

1. How are local wisdom and ethnoscience implemented in inquiry-based science and physics education?
2. What outcomes for scientific literacy and critical thinking do the included primary studies report?
3. Which learning models and physics topics dominate the literature, and where are the gaps?
4. What recommendations for culturally responsive physics pedagogy and future research can be derived from the evidence?

Method

Research Design

This study is a systematic literature review reported in accordance with the PRISMA 2020 statement (Liberati et al., 2009; Page et al., 2021). A systematic review was chosen because it supports transparent and replicable identification, selection, and synthesis of the literature (Gough et al., 2012; Moller & Myles, 2016). The review combines two analyses applied to two related datasets: (a) a bibliometric analysis of all records retrieved from Scopus (n = 106), which maps the broader research field, and (b) a content analysis of the final 51-study corpus, which addresses the research questions on implementation, outcomes, learning models, and topics. The relationship between the datasets is shown in Figure 1.

Search Strategy and Period

Searches were conducted in Scopus and Google Scholar for records published between 2015 and 2024. The retained export files do not preserve a verifiable date for each search run; therefore, the exact search date cannot be reconstructed reliably and is acknowledged as a limitation to replication. Scopus provided bibliographic metadata for the bibliometric analysis, while Google Scholar broadened coverage beyond Scopus-indexed journals.

The search strategy combined five concept groups: "local wisdom", "ethnoscience", "indigenous knowledge", "physics/science education", and "inquiry learning". The search concepts and eligibility parameters are summarized in Table 1. The archived files retain the returned records but not the complete original query history, so the wording in Table 1 is a transparent summary rather than a verbatim platform query.

Table 1. Search Concepts and Eligibility Parameters

Database	Search concepts and fields (summary)	Search/eligibility parameters	Records
Scopus	Concept groups: ("local wisdom" OR ethnoscience OR "indigenous knowledge") AND ("physics education" OR "science education") AND (inquiry OR "inquiry learning"). This is a summary reconstructed from the	Publication window: 2015–2024. English-language, peer-reviewed journal-article eligibility	106

	retained records; the verbatim Scopus query history was not preserved.	was applied during screening.	
Google Scholar	Queries combined terms relating to local wisdom/ethnoscience or Indigenous knowledge, physics/science education, and inquiry. The exact Google Scholar query syntax was not retained.	200 records preserved in the CSV export and screened against the 2015–2024 publication window and eligibility criteria; the ranking snapshot was not retained.	200
Total			306

The retained Google Scholar dataset consists of a CSV export containing 200 records, which was used for screening. The available archive does not reliably preserve the exact query syntax, the date-specific ranking snapshot, or a verifiable record of the export tool. Accordingly, the retrieval procedure is described only to the extent supported by the retained files. This limitation should be considered when interpreting reproducibility.

Eligibility Criteria

Studies were eligible if they (a) were peer-reviewed journal articles, (b) were written in English, (c) were published between 2015 and 2024, (d) addressed K–12 education, and (e) examined local wisdom, ethnoscience, or Indigenous knowledge in inquiry-based or inquiry-oriented science teaching. Physics-exclusive content was not a universal inclusion requirement; each study was coded as physics-specific or general/other science, and physics-specific evidence was reported separately. Learning-model labels were coded as reported in the source articles. PBL, PjBL, discovery, and contextual approaches were not treated as synonyms for inquiry; their relevance depended on whether inquiry processes were explicitly described. Outcome type was not an exclusion criterion. Scientific literacy and critical thinking were coded when measured directly, and other reported outcomes (e.g., conceptual understanding, motivation, character) were recorded as reported and are mentioned only descriptively. Commentaries without empirical data and studies focused on higher education were excluded. Reviews and metasyntheses were used for contextual interpretation only and were not counted as primary empirical evidence for outcomes.

Study Selection

Selection followed the four PRISMA 2020 stages (Figure 1):

1. Identification. The searches yielded 306 records (Scopus, n = 106; Google Scholar, n = 200).
2. Screening. After 36 duplicate records were removed, 270 records were screened by title and abstract, and 200 were excluded as irrelevant.
3. Retrieval. Seventy reports were sought for full-text retrieval; two could not be retrieved, leaving 68 reports assessed for eligibility.
4. Eligibility and inclusion. Seventeen of the 68 reports were excluded: not relevant to inquiry learning or ethnoscience (n = 2), no empirical data (n = 1), focus on higher education rather than K–12 (n = 1), and duplicate reports of the same study that were identified only at the full-text stage (n = 13). This left 51 studies for the content analysis.

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Potential duplicate records were checked by comparing titles, author names, publication years, DOI information where available, and article content. Differences in metadata between Scopus and Google Scholar exports meant that some potential matches required manual inspection; records were retained as separate publications when their bibliographic identity and article content showed that they were distinct works. Screening decisions were documented in the working spreadsheet, and ambiguous records were rechecked against the available article or metadata. A percentage-agreement statistic was not calculated because a verified file of independent, paired ratings was not retained; no inter-rater reliability coefficient is therefore reported.

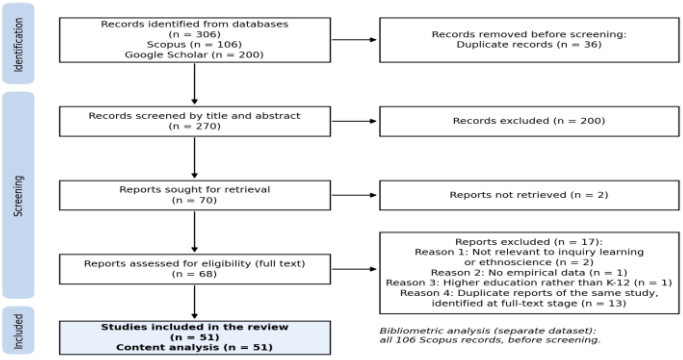


Figure 1. PRISMA 2020 Flow Diagram of the Study Selection Process

Quality Assessment

Methodological limitations were considered narratively during interpretation, with attention to the appropriateness of the study design, description of participants and context, clarity of outcome measures, transparency of analysis, and consistency between results and conclusions. The retained extraction material did not provide a complete, independently verifiable set of numerical quality ratings for every included study. Therefore, no composite quality score or numerical cut-off is reported, and the conclusions are framed cautiously in light of the information available from each study.

Data Extraction and Coding

Data were recorded in a standardized spreadsheet (Table 2). The coding fields covered bibliographic details, publication country, study type, educational level, sample size when reported, research design, learning model, physics topic, and learning outcomes. When a field was not stated clearly in the available article or metadata, it was treated as unreported rather than inferred. Outcome information was recorded as described by the original authors and synthesized narratively. A percentage-agreement statistic for extraction was not calculated because a verified file of independent, paired extraction records was not retained.

Table 2. Data Items and Coding Protocol

Category	Code
Year	2015–2024
Country	Indonesia, South Africa, Australia, Canada, USA, etc.
Study type	Primary empirical study; systematic review or metasynthesis; conceptual paper
Educational level	Primary; junior secondary; senior secondary; K–12 (unspecified)
Method	Quantitative, qualitative, mixed methods, R&D, SLR

Learning model	Model labels coded as reported; inquiry was not assumed equivalent to PBL, PjBL, discovery, or contextual teaching unless inquiry processes were described.
Domain and topic	Physics-specific (e.g., simple machines, gravity, measurement, waves) or general/other science
Outcome	Scientific literacy and/or critical thinking when measured directly; other outcomes (e.g., conceptual understanding, motivation, character) recorded as reported

Data Analysis

The analysis proceeded in two stages. First, the 106 Scopus records were analyzed with Bibliometrix in R (Aria & Cuccurullo, 2017) to map annual publication trends, source journals, and keyword frequencies. VOSviewer was used to visualize keyword co-occurrence, density, and overlay patterns (van Eck & Waltman, 2010, 2014). Second, content analysis of the 51-study dataset identified learning models, physics topics, and reported outcomes. Outcomes were synthesized narratively by construct and study context. Reported N-gain values and effect sizes were not averaged, converted to a common metric, or pooled because the available reports differed in study design, instruments, populations, and reporting formats. The synthesis distinguishes outcomes directly measured in primary empirical studies from contextual claims made in reviews or conceptual papers.

Results

Bibliometric Analysis of the Scopus Dataset (n = 106)

Publication trends. The 106 Scopus records show an overall upward trend between 2015 and 2024, with fluctuations (Figure 2). Annual output increased from 2 articles in 2015 to 12 in 2017, fluctuated between 7 and 13 articles per year from 2018 to 2023, and rose sharply to 28 articles in 2024.

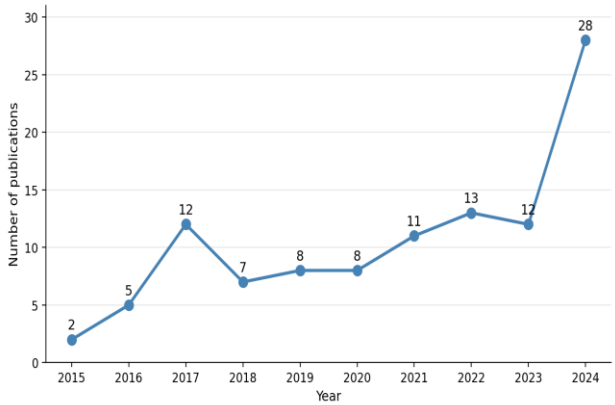


Figure 2. Publication Trends per Year (2015–2024)

The growth is consistent with the increasing attention to indigenous knowledge and local wisdom in science education noted by Zidny et al. (2020) and Latip et al. (2024). The sharp increase in 2024 may partly reflect broader policy interest in culturally responsive education, but the data analyzed here cannot test this explanation.

Journal distribution. The ten most productive sources are listed in Table 3. *Cultural Studies of Science Education* ranked first with 13 articles, followed by the *African Journal of*

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Research in Mathematics, Science and Technology Education and the *International Journal of Evaluation and Research in Education* (5 articles each). *Jurnal Pendidikan IPA Indonesia* contributed 3 articles. The list includes both science education journals and journals from other fields, which reflects the interdisciplinary character of research on indigenous knowledge.

Table 3. Top 10 Source Journals

No	Journal Name	Number of Articles
1	Cultural Studies of Science Education	13
2	African Journal of Research in Mathematics, Science and Technology Education	5
3	International Journal of Evaluation and Research in Education	5
4	Journal of Turkish Science Education	4
5	Jurnal Pendidikan IPA Indonesia	3
6	Revista de Gestão Social e Ambiental	3
7	Journal of Baltic Science Education	2
8	Journal of Research in Science Teaching	2
9	Journal of Science Communication	2
10	London Review of Education	2

Keyword analysis. “Science education” was the most frequent author keyword (25 occurrences), followed by “indigenous knowledge” (24), “local wisdom” (14), and “ethnoscience” (11) (Table 4; Figures 3 and 4). Keywords such as “indigenous knowledge systems,” “indigenous science,” and “western science” indicate that the literature frequently discusses the relationship between indigenous and Western science (Zidny et al., 2020). “Scientific literacy” and “science literacy” appear as separate keywords with four occurrences each, which suggests inconsistent terminology.

Table 4. Top 10 Author Keywords

No	Keyword	Frequency
1	science education	25
2	indigenous knowledge	24
3	local wisdom	14
4	Ethnoscience	11
5	science learning	6
6	indigenous knowledge systems	5
7	Indigenous	4
8	indigenous science	4
9	science literacy	4
10	scientific literacy	4

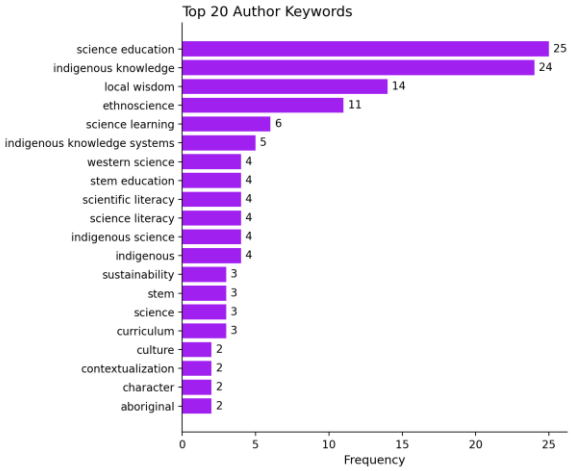


Figure 3. Top 20 Author Keywords

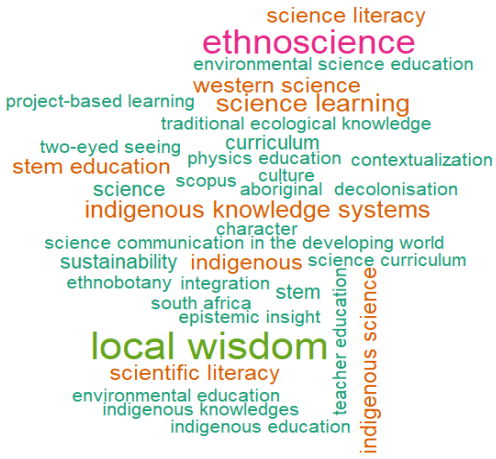


Figure 4. Word Cloud of Keywords

Co-occurrence network. The VOSviewer network in Figure 5 contains four clusters. The red cluster centers on “science education” and “indigenous science”; the green cluster on “local wisdom” and “ethnoscience”; the yellow cluster on “indigenous knowledge systems” and “traditional ecological knowledge”; and the blue cluster on “indigenous knowledge,” “teacher education,” and “science literacy.” Node size reflects keyword frequency, and proximity reflects co-occurrence. “Science education” and “indigenous knowledge” occupy central positions and link the clusters, and “ethnoscience” and “local wisdom” are located close to “science education,” which indicates that these concepts are frequently studied together in the corpus.

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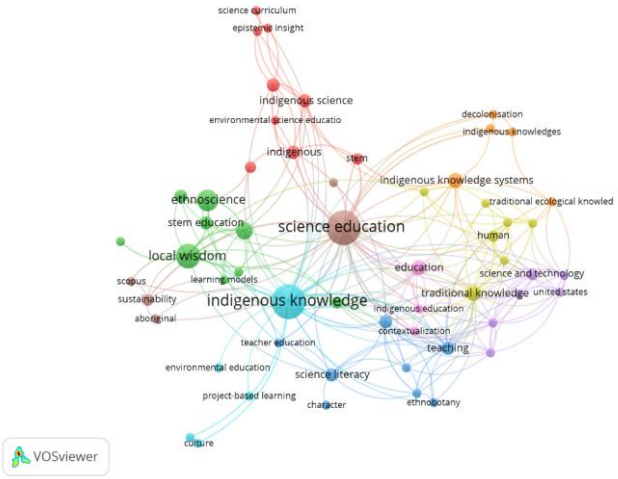


Figure 5. Co-occurrence Network of Author Keywords

Density. In the density visualization (Figure 6), the densest areas correspond to "science education," "indigenous knowledge," "local wisdom," and "ethnoscience," which form the core of the field. Keywords such as "culture," "ethnobotany," and "character" appear in low-density areas, indicating that these themes are comparatively less studied in the Scopus dataset.

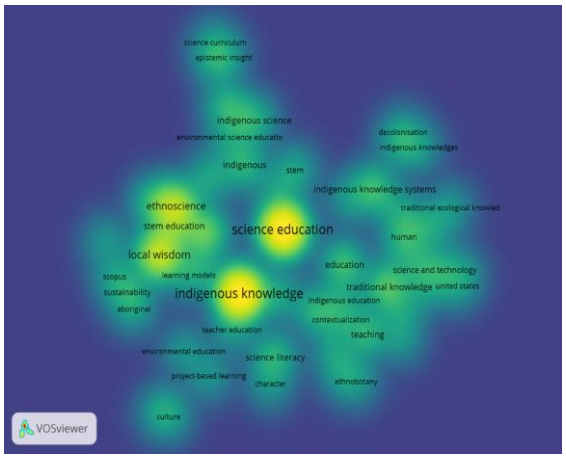


Figure 6. Density Visualization of Keywords

Temporal patterns. In the overlay visualization (Figure 7), node color indicates the average publication year of the articles in which a keyword appears. "Science education," "indigenous knowledge," and "local wisdom" have the earliest average years (around 2019); "ethnoscience," "STEM education," and "indigenous knowledge systems" fall in a transition period (2020–2021); and "culture," "sustainability," and "contextualization" have the most recent average years (2022–2023). This pattern indicates that sustainability- and context-related terms appear more often in recent articles, while the foundational terms have been used throughout the period. It is consistent with the rise in annual output shown in Figure 2.

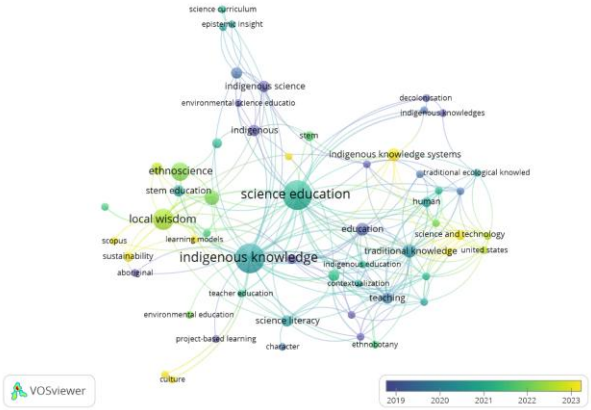


Figure 7. Overlay Visualization of Keyword Trends (2019–2023)

Content Analysis of the Included Studies (n = 51)

Characteristics of the included studies. The 51-study dataset covered primary empirical research and contextual literature on local wisdom or ethnoscience in K–12 science education. The extraction form recorded country, educational level, study type, and method. However, the retained materials did not support a complete, independently verified count for every study-type category; therefore, category-specific frequencies are not reported. Nineteen studies addressed an identifiable physics topic (Table 6). The remaining 32 were coded as general/other science or as studies for which a specific physics topic was not identifiable in the available extraction. The outcome synthesis focuses on findings reported by primary empirical studies, whereas review and conceptual publications provide contextual evidence rather than primary outcome data.

Implementation of local wisdom and ethnoscience. In the primary studies examined, local wisdom or ethnoscience typically provided the context for investigation rather than separate content. Jufrida et al. (2024) combined ethnoscience with a discovery model for simple machines in junior high school; Hariyono et al. (2023) developed learning material based on the traditional Engklek game; Saminan et al. (2024) developed physics learning tools based on Acehnese ethnoscience; Dewi et al. (2021) examined contextual collaborative learning based on ethnoscience; Sanjayanti et al. (2022) tested a science learning model containing Balinese local wisdom; and Gumbo et al. (2021) combined Western science with African indigenous knowledge systems to measure gravitational acceleration. In these examples, a game, tool, practice, or traditional knowledge system served as the object of inquiry, while the instructional structure was provided by discovery, contextual, collaborative, or inquiry-oriented models. This pattern is consistent with the pedagogical practices that Ogegbo and Ramnarain (2024) identified, such as contextual teaching materials and collaboration with knowledge holders.

Learning models. Guided Inquiry was the most frequent coded learning model (12 studies, 23.5%), followed by Problem-Based Learning (8 studies, 15.7%), Project-Based Learning (6 studies, 11.8%), and Discovery and Contextual Teaching (6 studies, 11.8%) (Table 5). The remaining 19 studies (37.3%) used other models or integrated approaches, as described by the original authors. These categories describe reported model labels and should not be interpreted as evidence that the models are equivalent or that one model is more effective than another.

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Table 5. Distribution of Learning Models in the 51 Included Studies

Model	Number	Percentage
Guided Inquiry Learning	12	23.5%
Problem-Based Learning (PBL)	8	15.7%
Project-Based Learning (PjBL)	6	11.8%
Discovery and Contextual Teaching	6	11.8%
Others	19	37.3%
Total	51	100%

Physics topics. Among the 19 studies with an identifiable physics topic, simple machines were most frequent (5 studies), followed by gravity (3) and measurement (3); waves, fluid statics, and heat were each addressed in 2 studies, electricity and optics in 1 study each, and modern physics and thermodynamics in none (Table 6).

Table 6. Distribution of Physics Topics

Topic	Number of Studies
Simple machines	5
Gravity	3
Measurement	3
Waves	2
Fluid statics	2
Heat	2
Electricity	1
Optics	1
Modern physics	0
Thermodynamics	0
Subtotal (physics-specific studies)	19
General or other science / not specified	32
Total	51

Table 7 summarizes illustrative primary studies for which the outcome focus and reported direction are stated in the source articles. Jufrida et al. (2024), Dewi et al. (2021), and Sanjayanti et al. (2022) reported improved scientific literacy following ethnoscience- or local-wisdom-based instruction, and Sanjayanti et al. (2022) also addressed character. Saminan et al. (2024) reported that the developed learning tools were valid, practical, and effective, and Hariyono et al. (2023) targeted conceptual understanding and learning motivation. None of the studies in Table 7 reports critical thinking as a measured outcome; evidence on critical thinking is therefore limited in the examples summarized here, and this review does not draw conclusions about it beyond that observation.

Because designs, instruments, intervention duration, and educational levels differ, outcomes were synthesized narratively. No N-gain range, mean, or pooled effect size was calculated, and the findings should not be interpreted as proof of uniform effectiveness. Reviews and conceptual papers were used for context only.

Table 7. Illustrative Primary Studies and Reported Outcomes

Study	Local wisdom/ethnoscience element	Instructional approach	Outcome focus	Reported direction
Jufrida et al. (2024)	Ethnoscience; simple machines	Discovery model	Scientific literacy	Improved
Dewi et al. (2021)	Ethnoscience	Contextual collaborative learning	Scientific literacy	Improved
Sanjayanti et al. (2022)	Balinese local wisdom	Science learning model containing local wisdom	Scientific literacy; character	Improved
Hariyono et al. (2023)	Engklek game	Ethnoscience-based learning material	Conceptual understanding; motivation	Targeted improvement
Saminan et al. (2024)	Acehnese ethnoscience	Physics learning tools	Validity, practicality, effectiveness	Valid, practical, effective

Discussion

Summary of Evidence

Across the 51-study dataset, research on local wisdom and ethnoscience in inquiry-oriented science teaching spans different models, topics, and learning outcomes. The primary studies summarized in Table 7 report improved scientific literacy following ethnoscience- or local-wisdom-based instruction (Dewi et al., 2021; Jufrida et al., 2024; Sanjayanti et al., 2022), as well as outcomes related to conceptual understanding and motivation (Hariyono et al., 2023). These examples illustrate the range of outcomes discussed in the field; they should not be interpreted as a common effect estimate or as evidence that every cited intervention used the same learning model. Because the reviewed studies differ in design, instruments, populations, and the extent to which inquiry is implemented, the findings are interpreted narratively and do not establish uniform effectiveness across contexts.

The evidence base is uneven across the two target outcomes. Scientific literacy was the outcome most clearly reported in the studies summarized in Table 7, whereas critical thinking was not reported as a measured outcome in those studies. The outcomes were measured with different instruments and reported in different formats, so this review does not provide a cross-study numerical summary. N-gain and standardized effect sizes are different metrics and should not be compared directly; no conclusion about the relative magnitude of the two outcomes is drawn.

Learning Models

Guided Inquiry was the most frequently used learning model (23.5% of the included studies), followed by PBL and PjBL. This is a finding about the frequency of use, not about relative effectiveness; the review did not compare outcomes across models. We interpret the prominence of Guided Inquiry as plausibly related to its balance between teacher guidance and student exploration, which may suit contexts in which students are also learning to relate cultural

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practices to scientific concepts. This explanation is the authors' interpretation and was not tested in the included studies. The prominence of guided and problem-based designs is also consistent with earlier physics-education development work in Indonesia (Kalatting et al., 2015; Serevina et al., 2018). Those studies addressed learning media and science process skills rather than local wisdom, so they are cited only as context for the model labels observed here, not as evidence for the effects of culturally responsive instruction.

Illustrative Examples

The following examples are offered as illustrations of how cultural practices might be linked to physics concepts, and they should not be read as findings of this review unless stated. Hariyono et al. (2023), one of the included studies, used the traditional Engklek game as the context for learning material; a teacher might, for instance, guide students to analyze the throw and hop in terms of force and projectile motion. Measurement of zakat fitrah, the obligatory almsgiving in Ramadan, could similarly be used to discuss volume and mass measurement. This second example was not examined in the included studies and is the authors' suggestion only.

Bibliometric Patterns

The bibliometric analysis, based on the 106 Scopus records, shows a growing publication volume with a pronounced increase in 2024 and a keyword structure centered on science education, indigenous knowledge, local wisdom, and ethnoscience. The more recent average publication years of "sustainability," "contextualization," and "culture" suggest that researchers have recently linked indigenous knowledge to sustainability and contextual teaching (Zidny et al., 2020). The low density of keywords such as "ethnobotany" and "character" indicates themes that are less developed in this dataset. These patterns describe the structure of the Scopus corpus and do not, by themselves, show that the approach is effective or that it directly supports SDG 4.

Gaps in Physics Topics

Among the 19 studies with an identifiable physics topic, concrete topics such as simple machines (5 studies), gravity (3), and measurement (3) predominated, while electricity (1), optics (1), modern physics (0), and thermodynamics (0) were rare or absent. In addition, 32 of the 51 studies did not address an identifiable physics topic, which means that evidence specific to physics is considerably smaller than the evidence on science education in general. A likely explanation is that concrete topics have visible counterparts in traditional tools, games, and measurement practices, whereas abstract topics are harder to connect to local wisdom, and teachers may lack suitable materials and training (Ogegbo & Ramnarain, 2024). This explanation is an interpretation consistent with the pattern observed here; the included studies did not test it directly.

Implications

For research, the review identifies a need for primary studies that integrate local wisdom into abstract physics topics and report transparent outcome data (sample size, instrument, and effect size), so that future syntheses can pool results quantitatively. For practice, the studies reviewed suggest that teachers and curriculum developers may consider guided inquiry as one feasible structure for incorporating local wisdom into physics lessons and may need teaching materials for abstract topics. These implications follow from the descriptive evidence and should be tested in rigorous designs. Supporting SDG 4: Quality Education is a potential benefit of culturally responsive pedagogy rather than a result demonstrated by this review.

Limitations

This review has several limitations. First, only Scopus and Google Scholar were searched, and only English-language publications were considered, so relevant studies in other languages or databases may have been missed. Second, the bibliometric analysis used the 106

Scopus records, whereas the content analysis used the 51-study dataset; these analyses therefore differ in coverage and purpose. Third, 19 studies addressed identifiable physics topics, while 32 were coded as general/other science or had no identifiable physics topic, which limits conclusions specific to physics. Fourth, outcome findings were synthesized narratively; no meta-analysis, publication-bias assessment, sample-size weighting, or cross-study effect calculation was performed. Fifth, the retained files did not preserve the exact search execution dates and full platform-specific query histories, which limits exact replication. Finally, outcome data were taken from the information reported in the original publications and could not be independently recalculated in a common format.

Recommendations for Future Research

Future research could (a) develop and test inquiry-based designs that integrate local wisdom into physics topics that were rare or absent in this dataset, including electricity, optics, modern physics, and thermodynamics; (b) document local wisdom from a broader range of communities and regions, guided by transparent mapping of which contexts are currently represented; (c) conduct longitudinal studies of learning outcomes; (d) develop and validate instruments that measure scientific literacy and critical thinking in culturally responsive contexts; and (e) report sample characteristics, instruments, analysis procedures, and outcome data transparently so that future reviews can assess comparability and, where justified, conduct a meta-analysis.

Conclusion

This systematic review of the 51-study content-analysis dataset, supported by a separate bibliometric analysis of 106 Scopus records, leads to three main conclusions. First, the Scopus corpus shows increased publication output in 2024, and Guided Inquiry is the most frequently coded learning model in the content-analysis dataset, followed by Problem-Based Learning and Project-Based Learning. Second, the reviewed literature reports outcomes related to scientific literacy and critical thinking, but differences in designs, instruments, and reporting prevented a reliable cross-study numerical synthesis; the findings therefore suggest areas of promise rather than establish uniform effectiveness. Third, the identifiable physics-specific evidence is concentrated on simple machines, gravity, and measurement, while electricity and optics appear infrequently and modern physics and thermodynamics were not identified in the current coding.

These conclusions are limited by the use of two sources, the restriction to English-language publications, the incomplete preservation of search-history metadata, and the descriptive nature of the outcome synthesis. Future studies should develop inquiry-based designs for less-represented physics topics, report outcomes transparently, document a wider range of local knowledge systems, and use longitudinal or otherwise rigorous designs to strengthen the evidence base for culturally responsive physics education.

References

Aria, M., & Cuccurullo, C. (2017). bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics, 11*(4), 959–975. https://doi.org/10.1016/j.joi.2017.08.007

Brown, J. C. (2017). A metasynthesis of the complementarity of culturally responsive and inquiry-based science education in K-12 settings: Implications for advancing equitable science teaching and learning. *Journal of Research in Science Teaching, 54*(9), 1143–1173. https://doi.org/10.1002/tea.21401

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

Gough, D., Oliver, S., & Thomas, J. (2012). *An introduction to systematic reviews*. SAGE Publications.

Gumbo, M. T., Nnadi, F. O., & Anamezie, R. C. (2021). Amalgamating western science and African indigenous knowledge systems in the measurement of gravitational acceleration. *Journal of Baltic Science Education, 20*(5), 729–739. https://doi.org/10.33225/JBSE/21.20.729

Hariyono, E., Rizki, I. A., Lestari, D. A., Citra, N. F., Islamiyah, A. N., & Agusty, A. I. (2023). Engklek game ethnoscience-based learning material (EGEBLM) to improve students' conceptual understanding and learning motivation. *Jurnal Pendidikan IPA Indonesia, 12*(4), 635–647. https://doi.org/10.15294/jpii.v12i4.43941

Jufrida, Kurniawan, W., & Basuki, F. R. (2024). Ethnoscience learning: How do teacher implementing to increase scientific literacy in junior high school. *International Journal of Evaluation and Research in Education, 13*(3), 1719–1730. https://doi.org/10.11591/ijere.v13i3.26180

Kalatting, S., Serevina, V., & Astra, I. M. (2015). Pengembangan media pembelajaran fisika berbasis web menggunakan pendekatan guided discovery learning. *Jurnal Penelitian & Pengembangan Pendidikan Fisika, 1*(1), 1–8. https://doi.org/10.21009/1.01101

Latip, A., Hernani, & Kadarohman, A. (2024). Local and indigenous knowledge (LIK) in science learning: A systematic literature review. *Journal of Turkish Science Education, 21*(4), 651–667. https://doi.org/10.36681/tused.2024.035

Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P. C., Ioannidis, J. P. A., Clarke, M., Devereaux, P. J., Kleijnen, J., & Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration. *PLoS Medicine, 6*(7), Article e1000100. https://doi.org/10.1371/journal.pmed.1000100

Moller, A. M., & Myles, P. S. (2016). What makes a good systematic review and meta-analysis? *British Journal of Anaesthesia, 117*(4), 428–430. https://doi.org/10.1093/bja/aew264

OECD. (2023). *PISA 2022 results (Volume I): The state of learning and equity in education*. OECD Publishing. https://doi.org/10.1787/53f23881-en

Ogegbo, A. A., & Ramnarain, U. (2024). A systematic review of pedagogical practices for integrating indigenous knowledge systems in science teaching. *African Journal of Research in Mathematics, Science and Technology Education, 28*(3), 343–361. https://doi.org/10.1080/18117295.2024.2374133

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., . . . Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ, 372*, Article n71. https://doi.org/10.1136/bmj.n71

Saminan, S., Irwandi, I., Kamza, M., & Rasul, M. S. B. (2024). Acehnese ethnoscience as an interdisciplinary approach in physics education: Innovating in the era of Merdeka Belajar. *Jurnal Ilmiah Peuradeun, 12*(3), 1071–1098. https://doi.org/10.26811/peuradeun.v12i3.1277

Sanjayanti, N. P. A. H., Suastra, I. W., Suma, K., & Adnyana, P. B. (2022). Effectiveness of science learning model containing Balinese local wisdom in improving character and

science literacy of junior high school students. *International Journal of Innovative Research and Scientific Studies, 5*(4), 332–342. https://doi.org/10.53894/ijirss.v5i4.750

Serevina, V., Sunaryo, Raihanati, Astra, I. M., & Sari, I. J. (2018). Development of e-module based on problem-based learning (PBL) on heat and temperature to improve students' science process skills. *Turkish Online Journal of Educational Technology, 17*(3), 26–36.

Suprapto, N., Prahani, B. K., & Cheng, T. H. (2021). Indonesian curriculum reform in policy and local wisdom: Perspectives from science education. *Jurnal Pendidikan IPA Indonesia, 10*(1), 69–80. https://doi.org/10.15294/jpii.v10i1.28438

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. In Y. Ding, R. Rousseau, & D. Wolfram (Eds.), *Measuring scholarly impact* (pp. 285–320). Springer. https://doi.org/10.1007/978-3-319-10377-8_13

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, 29*(1), 145–185. https://doi.org/10.1007/s11191-019-00100-x

Zupic, I., & Čater, T. (2015). Bibliometric methods in management and organization. *Organizational Research Methods, 18*(3), 429–472. https://doi.org/10.1177/1094428114562629