

From Local Knowledge to Epistemically Meaningful Science Learning: A Critical Integrative Review of Ethnoscience in Primary Education

Sylva Sagita¹, Apit Dulyapit¹, Maisa Hurul Aeni,¹ Ariyatun¹

¹Universitas Negeri Jakarta, Indonesia

ABSTRACT

Purpose – Although ethnoscience research has established the value of local knowledge for contextualizing science learning, less attention has been given to how its pedagogical use enables epistemic engagement. This study examines how local knowledge is positioned, transformed, and used in primary science education, addressing whether its presence necessarily constitutes meaningful epistemic integration.

Methods – A critical integrative review followed the five-stage process: problem identification, literature search, data evaluation, data analysis, and presentation. A systematic Scopus search of English-language journal articles published from 2007–2026 was conducted in 2026, with selection reported using PRISMA 2020. Eighteen studies met the eligibility criteria. Data were synthesised through deductive-inductive analysis and constant comparison.

Findings – Three analytical dimensions emerged: local knowledge positioning, assessed by its role as illustration or context; pedagogical transformation, assessed by its incorporation into observation, investigation, or problem solving; and epistemic engagement, assessed through students' questioning, evidence use, explanation, or comparison of knowledge claims. Studies using local knowledge mainly to contextualise science concepts showed limited integration, whereas those engaging students in investigating local phenomena or comparing local and scientific explanations demonstrated deeper integration. Thus, local knowledge alone does not ensure meaningful science learning; its contribution depends on its transformation and the epistemic work students perform.

Research Implications – The proposed framework distinguishes three conditions: local knowledge presence, pedagogical transformation, and epistemic engagement and provides a practical basis for designing and evaluating ethnoscience learning.

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Corresponding Author:

Sylva Sagita

Master Program of Basic Education, Universitas Negeri Jakarta, Indonesia

Jl. Rawamangun Muka, RT/RW 11/14, Rawamangun, Pulo Gadung, Jakarta Timur, Daerah Khusus Ibukota Jakarta

Email: sylva.sagita@unj.ac.id

Introduction

Science learning does not take place outside culture. Primary school students encounter the natural world through family practices, local environments, community activities, language, and culturally transmitted explanations before and alongside their formal exposure to school science. Local knowledge can be broadly understood as knowledge, practices, and ways of understanding developed within communities through interaction with environments and transmitted across generations. In science education, *ethnoscience* refers broadly to efforts to bring such culturally situated knowledge into dialogue with school science. This perspective is increasingly important because it challenges the assumption that meaningful science learning begins only when students encounter formal scientific concepts.

The educational rationale for connecting local knowledge and science is well established. Local contexts can make science more relevant and comprehensible, provide familiar phenomena for investigation, and create opportunities for students to connect classroom concepts with their lived experiences. A systematic review by Ogegbo & Ramnarain, (2024), for example, identified contextualised instructional materials, experiential learning, engagement with knowledge holders, and argumentative discussion as important pedagogical approaches for integrating Indigenous knowledge into science teaching. At the same time, the integration of local knowledge raises a more fundamental question: what does it mean to integrate two knowledge traditions in a science classroom? The answer is not straightforward because local knowledge and school science may differ in their origins, purposes, forms of evidence, relationships with place and community, and ways of establishing knowledge claims.

This issue has generated different and sometimes competing positions. One perspective emphasises the value of connecting local and scientific knowledge to make science more culturally responsive and meaningful. Other cautions that local knowledge can be reduced to a cultural example and subsequently judged only according to its correspondence with Western scientific concepts. From this perspective, simply translating local explanations into scientific terminology may preserve the visibility of culture while leaving the epistemic hierarchy of the classroom unchanged. The Two-Eyed Seeing framework, for example, seeks to establish more meaningful relationships between Indigenous and contemporary science perspectives through pedagogy and content while remaining sensitive to place and context (Cirkony et al., 2023). Similarly, research on the integration of Indigenous knowledge in primary schools has identified persistent barriers associated with its representation and recognition within formal education systems. These divergent perspectives indicate that the key issue is not simply whether local knowledge is included, but how its inclusion changes what students do with knowledge.

Existing reviews have advanced the field by identifying pedagogical practices and educational outcomes. Ogegbo & Ramnarain, (2024), for example, synthesised 25 studies and demonstrated the diversity of approaches used to integrate Indigenous knowledge into science teaching. More recent reviews have similarly documented the growth of ethnoscience and local-wisdom research and its links with inquiry, STEM, and project-based learning. However, these reviews have paid less attention to how local knowledge is positioned and transformed as it moves from a community context into science-learning activities. In particular, they do not systematically distinguish between the presence of local knowledge, its pedagogical transformation, and students' epistemic engagement with it. Consequently, these dimensions may be treated as equivalent. This review addresses this gap by developing an analytical framework of local knowledge presence, pedagogical transformation, and epistemic engagement to examine the depth and function of ethnoscience integration in primary science education. Thus, its novelty lies not in another inventory of pedagogical practices, but in analysing how local knowledge becomes epistemically meaningful science learning.

This conceptual gap motivates the present review. We argue that the critical unit of analysis should not be the mere presence of local knowledge, but the epistemic work enabled by its pedagogical use. Local knowledge may enter a lesson as an illustration, become a resource for conceptual learning, serve as an object of investigation, or provide a basis for students to compare explanations, evaluate evidence, construct arguments, and reflect on different ways of knowing. Distinguishing these possibilities is important for understanding why apparently similar ethnoscience approaches may produce different learning processes and outcomes.

Accordingly, this study aims to examine how local knowledge is positioned, transformed, and used in primary science education. Three research questions guide the review: (1) How is local knowledge represented and positioned in ethnoscience-oriented primary science education research? (2) How is local knowledge transformed into science learning through pedagogical practices? and (3) What learning and epistemic outcomes are associated with the integration of local knowledge into primary science education? A critical integrative review with systematic elements was employed to synthesise diverse empirical, conceptual, and pedagogical evidence while critically examining the assumptions underlying "integration."

The principal contribution is a framework distinguishing local knowledge presence, pedagogical transformation, and epistemic engagement. This framework provides a more precise way to evaluate ethnoscience learning: not simply by asking whether local knowledge appears in a lesson, but by examining whether it is transformed into meaningful learning activity and whether students are enabled to use it for inquiry, evidence, explanation, comparison, and reflection. The paper first describes the review methodology, then presents the synthesised findings according to the three research

questions, followed by a discussion that positions these findings within broader scholarship on culturally responsive and epistemically attentive science education. The paper concludes by outlining how the framework can inform future research and the design and evaluation of primary science learning.

Methods

This study employed a critical integrative review following the five-stage integrative review process described by Whitemore & Knafl, (2005) and further elaborated by Hopia, Latvala, and Liimatainen (2016): problem identification, literature search, data evaluation, data analysis, and presentation. An integrative review was selected because research on ethnoscience in primary science education encompasses heterogeneous forms of evidence, including empirical studies of classroom practice, pedagogical interventions, learning resources, and conceptually oriented studies. This design allows these forms of evidence to be synthesised while maintaining differences in their evidential status.

The problem identification stage established the central concern of the review: the inclusion of local knowledge in science education does not necessarily indicate meaningful pedagogical or epistemic integration. Accordingly, the review examined how local knowledge is positioned, transformed into learning activities, and used in students' epistemic engagement with science.

The literature search stage was conducted exclusively in Scopus on 2026, covering publications from 2007 to 2026. The search was restricted to English-language journal articles. The predefined Boolean search strategy was: TITLE-ABS-KEY (("ethnoscience" OR "local knowledge" OR "indigenous knowledge" OR "traditional knowledge" OR "traditional ecological knowledge" OR "local wisdom") AND ("science education" OR "science learning" OR "science teaching") AND ("primary education" OR "primary school" OR "elementary education" OR "elementary school"))

The search terms were intentionally broad to capture variations in terminology across ethnoscience and culturally situated science education research. Scopus was selected because of its multidisciplinary coverage and structured indexing of science and education research. However, the use of a single database may introduce coverage bias, particularly for relevant regional literature not indexed in Scopus.

The study selection process followed predefined eligibility criteria and was reported using the PRISMA 2020 reporting guideline (Gual-Montolio et al., 2020). PRISMA was used to document the number of records identified, screened, assessed for eligibility, excluded, and included, together with the reasons for full-text exclusion. The search identified 49 records. After applying document-type and language criteria, 34 English-language journal articles remained for title and abstract screening. Eleven records were excluded at this stage, leaving 23 articles for full-text assessment. Five articles were subsequently

excluded based on the predefined eligibility criteria, resulting in a final corpus of 18 studies. The complete selection process is presented in Figure 1.

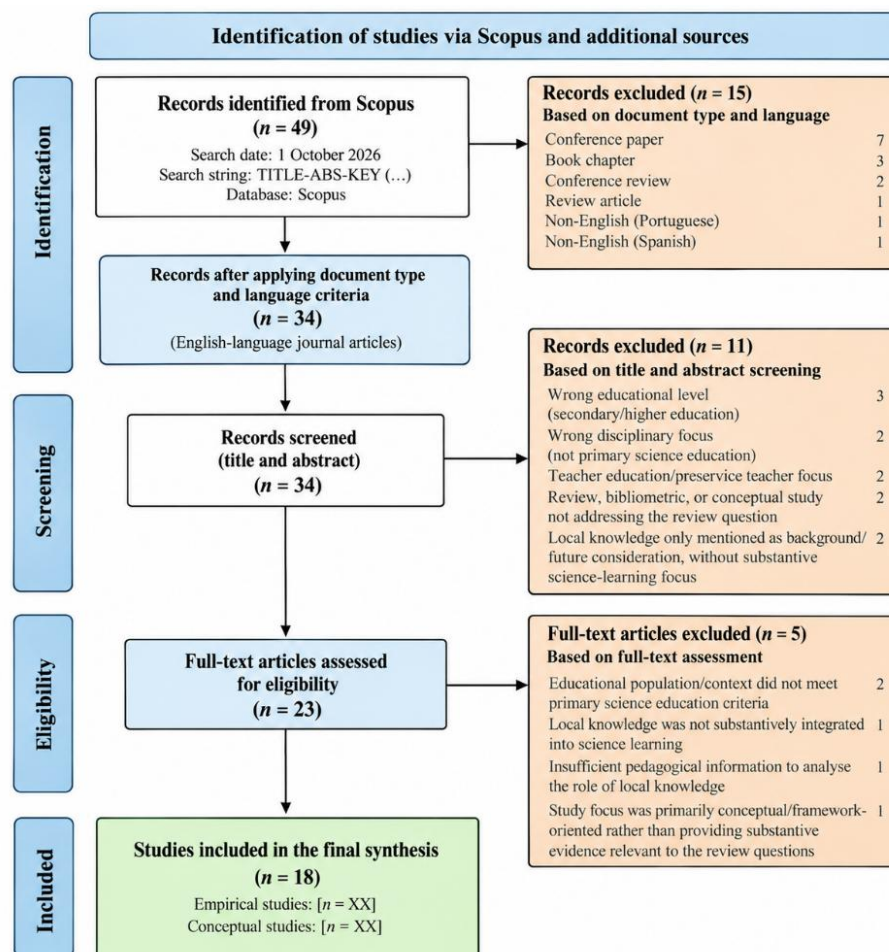


Figure 1. Identification of literature studies

The data evaluation stage assessed the relevance and evidential value of the included studies in relation to the review questions. Evaluation considered contextual adequacy, methodological transparency, pedagogical information, evidence of student activity or learning, and relevance to the analytical framework. Rather than assigning a single numerical quality score, studies were considered in terms of the strength and relevance of the evidence they provided.

The data analysis stage combined deductive and inductive approaches. Data were extracted using a structured matrix covering study context, educational level, local knowledge, pedagogical approach, teacher and student activities, epistemic positioning, learning and epistemic outcomes, and reported tensions. The deductive analysis used three predefined analytical dimensions: local knowledge positioning, pedagogical transformation, and epistemic engagement. Inductive coding was then used to identify patterns, tensions, and relationships emerging across studies. Consistent with the integrative review approach, constant comparison was used to examine similarities, differences, and boundary conditions across the evidence (Hopia et al., 2016). The first

author conducted the initial extraction and coding; ambiguous cases were revisited against the operational definitions and original full-text evidence, with coding decisions recorded in an audit trail to maintain analytical consistency.

The critical orientation was applied primarily during data evaluation and analysis rather than during study identification. The analysis did not treat the presence of local knowledge as evidence of meaningful integration. Instead, it examined whether local knowledge functioned as cultural illustration, contextual material, learning resource, inquiry object, or epistemic resource; how it was transformed through pedagogical activity; and whether students were enabled to engage in questioning, investigation, evidence use, explanation, comparison, argumentation, or reflection. Thus, the systematic procedures determined which evidence entered the review, whereas the critical-interpretive analysis determined how that evidence was compared and understood.

Finally, the presentation stage synthesised the findings thematically and comparatively, emphasising patterns, contrasts, tensions, and boundary conditions rather than treating ethnoscience integration as a binary condition. The reporting of the study identification and selection process follows PRISMA 2020, while the overall review procedure follows the five-stage integrative review methodology of Whitemore and Knafl (2005) and Hopia et al. (2016).

Result

The 18 included studies showed substantial variation in how local, Indigenous, and ethnoscientific knowledge was positioned and used in science education. Table 1 summarises the analytical contribution of each study to the synthesis. Across the corpus, local knowledge appeared not only as cultural context but also as a learning resource, an object of inquiry, and, in fewer cases, a basis for students' scientific reasoning. Studies on Faloak plants (Uslan et al., 2024), Balinese local wisdom (Eka Heriyanti et al., 2025), ethnoscience-based STEM learning (S. E. Atmojo et al., 2025), and ethnoscience-based project learning (Setianingsih et al., 2026) incorporated familiar cultural or environmental practices into formal science learning. Other studies used local cultural products or phenomena more explicitly as objects of investigation. For example, Adi Putra et al., (2026) used the *Rumah Tuan Kadi* as an epistemic mediator in Grade 5 inquiry, with students examining observable features such as stair design, ventilation, and building structure. The study illustrates how a local cultural context can support students' movement toward questioning, investigation, evidence-based reasoning, and reflection. Overall, the pedagogical role of local knowledge varied substantially across studies rather than following a single pattern of integration.

A second pattern concerned the transformation of local knowledge into science-learning activity. Several studies reported learning designs in which local knowledge was connected to scientific concepts or student activities rather than simply presented as

background. (Uslan et al., 2024), for example, used knowledge of the Faloak plant in a Grade 4 local-knowledge-based module to support scientific literacy and thinking skills. Similarly, (Nadra et al., (2026) transformed community knowledge of the blue-eyed cuscus around Lake Tolire into learning resources addressing adaptation, organism–habitat relationships, food chains, and ecosystems. Atmojo et al., (2025)(I. R. W. Atmojo et al., 2022) combined ethnoscience with STEM activities and reported gains in critical thinking and cultural literacy, while Setianingsih et al. (2026) connected traditional soil cultivation with project-based learning and reported higher critical-thinking gains in the experimental group (N-gain = 0.71) than in the comparison group (0.33). Other studies used ethnoscience-themed picture books (Yuliana et al., 2021), Balinese local wisdom within Think–Pair–Share (Heriyanti et al., 2025), and ethnoscience-based 7E learning (Diwatin & Daza, 2025) to connect local contexts with literacy, communication, problem solving, or science learning outcomes. The evidence therefore shows that local knowledge can function as a pedagogical resource when it is transformed into questions, activities, comparisons, observations, or problem-solving tasks.

Table 1. Characteristics and analytical contribution of the 18 included studies

Code	Study	Context/focus	Main evidence contributed to the synthesis
S1	<i>The Metacognition–Social Complexity-Based Learning Model</i>	Culturally grounded science learning	Culture positioned within a learning model addressing higher-order thinking and collaboration
S2	Adi Putra et al. (2026), <i>From Talk to Networked Reasoning</i>	Grade 5; Rumah Tuan Kadi	Local architecture used as a context for questioning, reasoning, investigation, evidence, and reflection
S3	<i>Challenges and Significance of Using Indigenous Knowledge Systems to Teach Food Preservation...</i>	Indigenous knowledge and school science	Indigenous knowledge connected with science/technology learning through culturally situated practice
S4	Cahyadi et al. (2025), <i>The Urgency of Islamic Ethnoscience-Based Science Learning in the 4.0 Era</i>	Elementary science; Banjar and Islamic context	Local culture and Islamic values incorporated into contextual and digital science learning
S5	Minsih et al. (2025), <i>The Integration of Culture Literacy...</i>	Elementary science	Cultural literacy and local wisdom positioned as components of science learning and student development
S6	Khairiyah et al. (2025), <i>Development of an Ethnoscience-Based REA Learning Model</i>	Changes in matter	Ethnoscience embedded in Read–Explore–Apply learning model; model validity/reliability examined
S7	<i>Keystone Characteristics that Support Cultural Resilience in Karen Refugee Parents</i>	Community/cultural knowledge	Evidence concerning characteristics of cultural knowledge transmission and resilience
S8	Uslan et al. (2024), <i>Integrating the Etnopedagogik of Sterculia quadrifida (Faloak Plants)</i>	Elementary education; Kupang	Faloak transformed into science-learning material and associated with scientific literacy and thinking skills

Code	Study	Context/focus	Main evidence contributed to the synthesis
S9	Rati et al. (2025), <i>Unplugged Coding and Tri Hita Karana</i>	Elementary education; Bali	Local cultural values integrated with learning activities addressing computational thinking and environmental awareness
S10	Rahmawati et al. (2025), <i>Ethnoscience Materials to Build Scientific Literacy</i>	Grade 4; Sukoharjo	Existing materials showed weak cultural relevance and low scientific-literacy support
S11	Ali et al. (2026), <i>Analysis of Primary Science Teachers' Lesson Plans...</i>	Grades 5–6; East Lombok	Actual incorporation of local content in lesson plans was limited
S12	Yuliana et al. (2021), <i>Ethnoscience-Themed Picture Books Embedded within Context-Based Learning</i>	Grade 5	Ethnoscience picture books combined with context-based learning improved scientific literacy
S13	Shizha (2007), <i>Critical Analysis of Problems Encountered in Incorporating Indigenous Knowledge...</i>	Primary science; Zimbabwe	Examination, language, textbook, and curriculum structures constrained Indigenous knowledge integration
S14	Sexton (2024), <i>Culturally Responsive Teaching Through Primary Science in Aotearoa New Zealand</i>	Primary science; Aotearoa New Zealand	Mainstream science and Mātauranga Māori positioned within culturally responsive pedagogy
S15	Kurniawan et al. (2019), <i>Ethnoscience Investigation in Primary Schools</i>	Elementary teachers	Relationship between ethnoscience knowledge and teachers' pedagogical competence
S16	<i>The Effectiveness of the Environment-Oriented Practicum Guide Integrated with Catur Pramana</i>	Environment-oriented science learning	Local philosophical/epistemological principle incorporated into science-practicum design
S17	<i>A Rights-Based Approach to Science Literacy Using Local Languages</i>	African science literacy	Local language and contextual inquiry used to address participation and science-literacy issues
S18	<i>Students' Misconceptions on the Concept of Sound: A Case Study about Marinyo</i>	Local cultural explanation of sound	Local cultural explanation examined in relation to students' scientific conceptions

However, the presence of local knowledge did not consistently result in deeper epistemic engagement. Govender (2011) found that primary teachers could hold scientific, intuitive, and Indigenous conceptions simultaneously; for example, teachers reported cultural interpretations of Moon phases and traditional observations of the Sun for agricultural purposes, but these observations were not always accompanied by scientific explanations. Shizha (2007) similarly found that primary science teaching in Zimbabwe remained strongly shaped by textbooks, examinations, English-medium instruction, and teacher-centred question–answer practices, limiting the classroom use of Indigenous knowledge. Ali et al. (2026) found a comparable implementation gap in East Lombok: only approximately 18% of Grade 5 and 11% of Grade 6 lesson-plan content incorporated local contexts. Studies on culturally responsive primary science in Aotearoa New Zealand (Sexton, 2024) and Two-Eyed Seeing (Cirkony et al., 2023) further illustrated

approaches in which cultural knowledge was deliberately connected with, rather than simply appended to, school science. The teacher-translation study by Bahtiar et al. (2026) provides the clearest process evidence: across 15 teacher cases and 26 instructional documents, local knowledge moved through six interconnected processes: accessing, selecting, interpreting, negotiating, transforming, and representing, with variation in both pedagogical depth and epistemic positioning. The study also showed that 23 of 26 instructional documents connected local knowledge with student questions, analysis, explanation, comparison, or other learning tasks, while several cases retained it mainly as an illustrative context (Bahtiar et al. (2026).

Overall, the synthesis identified three distinguishable conditions in the use of local knowledge: presence, pedagogical transformation, and epistemic engagement. Local knowledge may be visible in classroom content without becoming a substantive learning activity; it may be transformed into inquiry or conceptual learning without requiring explicit comparison between knowledge systems; or it may become a basis for students to generate questions, examine evidence, construct explanations, and reflect on different ways of knowing. Thus, the reviewed studies indicate that the presence of local knowledge, its pedagogical transformation, and its epistemic integration are analytically distinct conditions, rather than successive outcomes that occur automatically. This variation provided the basis for the thematic synthesis and the framework developed in the Discussion.

Discussion

1. How is local knowledge represented and positioned in ethnoscience-oriented primary science education research?

The findings indicate that local knowledge is positioned in substantially different ways across primary science education. It may function as a cultural context, a source of scientific examples, a learning resource, or a basis for examining different ways of knowing. This variation suggests that the term *integration* can conceal important differences in classroom practice. The present synthesis therefore supports the working proposition that the presence of local knowledge is not equivalent to epistemic integration. When local knowledge is used only to illustrate a science concept, its epistemic role remains limited; when it becomes a source of questions, observations, explanations, or comparisons, its role becomes more substantive. This interpretation is consistent with the Two-Eyed Seeing framework of Cirikony et al. (2023), which conceptualizes science learning as occurring through culture rather than merely learning *about* culture. The framework emphasizes that Indigenous and scientific perspectives can be brought into productive relationship through pedagogical design rather than simply placing cultural content alongside conventional science.

The distinction between epistemic positioning and pedagogical depth is particularly important. Bahtiar et al. (2026), found that teachers' translation of Indigenous knowledge involved accessing, selecting, interpreting, negotiating, transforming, and representing knowledge. Importantly, their cases showed that epistemic positioning and pedagogical depth did not necessarily develop together: a teacher could recognise local knowledge while using it only illustratively, whereas another could produce substantive inquiry while still positioning school science as epistemically dominant. This finding provides an important interpretive lens for the present review. It suggests that ethnoscience research should not classify studies simply as “integrated” or “not integrated,” but should examine what epistemic status local knowledge is given and what students are enabled to do with it.

2. How is local knowledge transformed into science learning through pedagogical practices?

The second finding is that the educational contribution of local knowledge depends on how it is pedagogically transformed. The strongest examples in the reviewed corpus were not those in which local knowledge was merely inserted into lesson materials, but those in which it became a basis for questioning, observing, comparing, investigating, explaining, or constructing evidence. The *Rumah Tuan Kadi* study, for example, showed how a local cultural artifact could generate questions about stair design, ventilation, and structural features and subsequently support hypothesis formation, investigation, evidence use, and reflection. This pattern is strongly compatible with the systematic review of Ogegbo and Ramnarain (2024), which identified argumentative discussion, contextualised materials, experiential learning, and engagement with knowledge holders as recurring pedagogical practices for integrating Indigenous knowledge into science teaching.

The role of dialogue and argumentation is particularly relevant to interpreting this finding. Diwu and Ogunniyi (2012) demonstrated how dialogical argumentation can create a space in which school science and Indigenous knowledge are not simply presented as two bodies of information, but are examined through claims, explanations, and justification. Similarly, Michie et al. (2023) describe Two-Ways Thinking and Two-Eyed Seeing as approaches that enable students to examine how different knowledge systems emerge and how they can contribute to understanding phenomena. These studies help explain why some ethnoscience interventions in the present corpus produced stronger learning outcomes than others. Local knowledge becomes educationally productive when it is converted into epistemic activity. Context provides relevance, but inquiry, comparison, argumentation, evidence, and reflection provide mechanisms through which that relevance can contribute to science learning.

This interpretation also qualifies the assumption that ethnoscience automatically improves learning outcomes. The reviewed studies reported gains in scientific literacy,

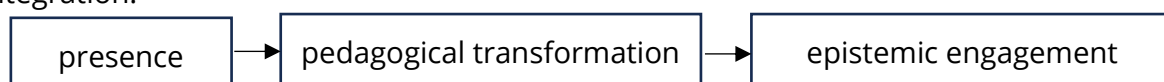
critical thinking, problem solving, communication, cultural literacy, and conceptual understanding, but these outcomes were associated with particular pedagogical designs rather than with local knowledge alone. The findings therefore support a conditional proposition: local knowledge can contribute to science learning when it is pedagogically transformed into meaningful student activity. Conceptually, the synthesis suggests a relationship among local knowledge, pedagogical transformation, student epistemic activity, and learning outcomes, rather than establishing a causal pathway. This proposition provides a basis for future empirical testing of how and under what conditions local knowledge contributes to science learning.

3. What learning and epistemic outcomes are associated with the integration of local knowledge?

The third finding concerns the relationship between ethnoscience and reported learning outcomes. The reviewed studies reported outcomes across multiple domains, including conceptual understanding, scientific literacy, critical thinking, problem solving, cultural literacy, and engagement with contextualised phenomena. However, these findings should not be interpreted uniformly as evidence of causal benefit, as the studies differed in design and evidential strength. The synthesis also reveals a gap in how outcomes are typically conceptualised. Most studies assess disciplinary or cognitive outcomes, whereas relatively fewer examine whether students develop an understanding of how knowledge is generated, compared, justified, and situated within particular cultural and environmental contexts.

This distinction is important because learning a scientific concept from a local example does not necessarily constitute an epistemic outcome. A deeper outcome occurs when students use local observations as evidence, compare explanations, examine the basis of competing claims, or reflect on relationships between knowledge systems. Cirkony et al. (2023) and Michie et al. (2023) provide theoretical support for this broader interpretation by framing culturally responsive science education as an encounter between knowledge perspectives rather than simply a contextualisation strategy. The argumentation perspective of Diwu and Ogunniyi (2012) further indicates that epistemic development can occur when learners are required to justify and examine knowledge claims rather than merely receive them.

The findings therefore support a three-level interpretation of ethnoscience integration:



These should not be interpreted as a fixed linear sequence. A study may demonstrate strong cultural presence but limited pedagogical transformation, another may transform local knowledge into inquiry without explicitly addressing differences between knowledge systems, and a smaller group may engage students in evidence,

comparison, explanation, and reflection across knowledge perspectives. Bahtiar et al. (2026) similarly demonstrate that teacher-mediated translation is recursive rather than strictly linear, with selection, interpretation, negotiation, transformation, and representation influencing one another. The present review therefore extends outcome-oriented interpretations of ethnoscience by proposing that epistemic engagement is an important intermediate dimension linking culturally grounded content with science learning outcomes.

4. Implications and future research

The synthesis has implications for both research and instructional design. First, future ethnoscience studies should report how local knowledge is transformed pedagogically, rather than only identifying the cultural context and measuring post-intervention outcomes. Second, assessment should distinguish conventional learning outcomes from epistemic outcomes, such as students' ability to formulate questions, use evidence, compare explanations, justify claims, and reflect on different knowledge systems. Third, greater attention should be given to teachers as epistemic and pedagogical mediators. Bahtiar et al. (2026) demonstrate that teachers make consequential decisions about what local knowledge enters the classroom, how it is interpreted, whose explanation is granted authority, and how it is represented in learning activities.

This teacher dimension is also supported by Photo (2026), whose longitudinal study of rural STEM teachers found changes in teachers' confidence and agency in integrating Indigenous knowledge and technology, while contextual limitations in resources and support remained. This suggests that meaningful ethnoscience implementation cannot be separated from teachers' capacity to design, interpret, and adapt culturally grounded learning experiences. Future research should therefore move beyond conventional pretest-posttest comparisons toward classroom-based and design-based studies that trace the transformation of a local phenomenon as seen in picture 2.

context → question → investigation → evidence → explanation → reflection

Such studies could also examine whether explicit teacher support improves the quality of epistemic negotiation and whether students' perceptions of local knowledge change as they engage in scientific inquiry.

Overall, the findings suggest that the central contribution of ethnoscience to primary science education is not simply that it makes science more culturally relevant. Its stronger contribution lies in creating opportunities for students to use local knowledge as a resource for investigating phenomena and constructing, comparing, and justifying explanations. The critical issue is therefore not whether local knowledge is present, but

what epistemic work pedagogical design enables students to perform with that knowledge.

Conclusion

At the point of writing, research on ethnoscience in primary education has provided evidence of the potential value of local knowledge for contextualising science learning and supporting outcomes such as scientific literacy, critical thinking, problem solving, and cultural understanding. However, the synthesis of 18 studies shows considerable variation in how local knowledge is used. It may remain a contextual illustration, become a resource for learning activities, or be transformed into a basis for inquiry, evidence-based reasoning, comparison, and reflection. The main conclusion is therefore that the presence of local knowledge does not necessarily constitute meaningful integration. Its educational contribution appears to depend on the extent to which it is pedagogically transformed and enables substantive epistemic engagement.

The proposed framework distinguishes three conditions: local knowledge presence, pedagogical transformation, and epistemic engagement and provides a practical basis for designing and evaluating ethnoscience learning. In practice, teachers can use the framework to identify a meaningful local phenomenon, transform it into questions and investigations, and assess whether students use evidence, construct explanations, compare perspectives, and reflect on knowledge. Future research should test this framework empirically across different cultural and science contexts, develop measures of epistemic learning outcomes, and examine teacher competence in transforming local knowledge into meaningful science learning. The next step for ethnoscience research is therefore to move beyond whether local knowledge is included toward understanding how it becomes a resource for scientific inquiry and epistemically meaningful learning.

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