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INTEGRATING ETHNOSCIENCE TO IMPROVE STUDENTS' CRITICAL THINKING SKILLS: SYSTEMATIC LITERATURE REVIEW

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Abstract
21st-century science education demands the development of critical thinking skills. However, field realities, such as observations at SDN Dungkek I, indicate that learning remains dominated by textbook dependence without contextual modification. This leads to low student engagement and an inability to connect scientific concepts with local culture. This study aims to analyze the potential and effectiveness of integrating ethnoscience into science modules to improve students' critical thinking skills. The study employs a descriptive qualitative method using a Systematic Literature Review (SLR) approach based on Cooper's (2016) model. Data were collected from accredited databases such as Google Scholar, DOAJ, and GARUDA, and analyzed using Miles and Huberman’s techniques. The review results demonstrate that ethnoscience integration has a significant positive impact across educational levels: at the primary level (SD), it helps visualize abstract concepts into concrete ones; at the junior secondary level (SMP), it trains students to verify myths versus scientific facts; and at the senior secondary level (SMA), it strengthens argument evaluation and complex data interpretation. It is concluded that ethnoscience-based learning, particularly when combined with Problem-Based Learning (PBL) or Deep Learning models, effectively transforms students into active learners capable of valid scientific reasoning and inference based on local wisdom.
Keywords: Ethnoscience, Critical Thinking, Systematic Literature Review, Science Education, Local Wisdom

Abstrak
Pendidikan sains abad ke-21 menuntut pengembangan keterampilan berpikir kritis, namun realitas di lapangan, seperti hasil observasi di SDN Dungkek I, menunjukkan bahwa pembelajaran masih didominasi oleh penggunaan buku teks tanpa modifikasi kontekstual. Hal ini mengakibatkan rendahnya keterlibatan siswa dan ketidakmampuan mengaitkan materi dengan budaya lokal. Penelitian ini bertujuan untuk menganalisis potensi dan efektivitas integrasi etnosains dalam modul ajar sains untuk meningkatkan keterampilan berpikir kritis siswa. Penelitian ini menggunakan metode kualitatif deskriptif dengan pendekatan Systematic Literature Review (SLR). Data dikumpulkan dari basis data terakreditasi seperti Google Scholar, DOAJ, dan GARUDA, kemudian dianalisis menggunakan teknik Miles dan Huberman. Hasil tinjauan menunjukkan bahwa integrasi etnosains memberikan dampak positif yang signifikan pada setiap jenjang pendidikan: pada tingkat SD, etnosains membantu memvisualisasikan konsep abstrak

menjadi konkret; pada tingkat SMP, pendekatan ini melatih siswa memverifikasi mitos versus fakta sains; dan pada tingkat SMA, etnosains memperkuat kemampuan evaluasi argumen dan interpretasi data kompleks. Disimpulkan bahwa pembelajaran berbasis etnosains, terutama yang dipadukan dengan model Problem Based Learning (PBL) atau Deep Learning, efektif mentransformasi siswa menjadi pembelajar aktif yang mampu melakukan penalaran ilmiah (scientific reasoning) dan penyimpulan (inference) yang valid berdasarkan kearifan local.
Kata kunci: *Etnosains, Berpikir Kritis, Systematic Literature Review, Pendidikan Sains, Kearifan Lokal*

INTRODUCTION

in the education system (Istianah et al., 2025). Critical thinking is a vital skill for survival in the 21st century (Suryanti et al., 2018). 21st-century science education must develop critical thinking skills, where strengthening this aspect is important for science literacy (Cahyana et al., 2017; Novandi et al., 2025). Science competency is very important for students so that they are able to master the material (Suryanti et al., 2020). Effective science learning uses strategies such as question-based learning, class discussions, and inquiry-based approaches to improve students' critical thinking skills (Sidiq et al., 2021). The essence of science learning involves an attitude that encompasses curiosity about objects, natural events, living things, and cause-and-effect relationships, which triggers new challenges that can be overcome with the right steps, as well as the process of problem solving using scientific methods that produce new innovations (Istianah & Melawati, 2022). Research shows that science literacy is very important for developing students who are able to think critically and deal with complex issues in society (Cahyana et al., 2017; Khan & Ahmed, 2024). By integrating the 6C competency model, students are expected to experience a more interactive and applicable learning process that promotes creativity and collaboration (Yulianti & Herpratiwi, 2024). Therefore, developing critical thinking skills through science education is key to solving problems authentically and relevantly in their environment.

Indonesia, with its rich cultural diversity, has great potential to apply ethnoscience, which is the integration of local wisdom into science education. This approach allows students to relate abstract scientific concepts to everyday cultural practices, making learning more relevant and meaningful (Wati et al., 2021). Research shows that ethnoscience-based teaching materials can improve students' understanding and critical thinking skills, as they contextualize learning in everyday life and local values (Nisa et al., 2024; Nurhasnah et al., 2022). In addition to improving conceptual understanding, this integration also serves a strategic function in preserving diversity and local cultural identity among the younger generation, giving them awareness and appreciation of their own culture (Fitriyah, 2022; Sarkingobir & Bello, 2024).

Although the Merdeka Curriculum demands student-centered learning, the reality in the field shows that teachers still experience difficulties in developing quality teaching modules. Several studies show that many teachers have not received adequate training, resulting in challenges ranging from learning outcome analysis to the preparation of

Learning Objective Sequences (ATP) (Agusty et al., 2023; Puspitosari et al., 2023; Rahma Harfiani & Anatri Desstya, 2023). In this context, effective training and mentoring have proven to be important in improving teachers' understanding of the pedagogical modifications required in this new curriculum (T. Lestari et al., 2023; Madang et al., 2022). As a result, teaching modules are often merely administrative in nature without sufficient pedagogical depth, as revealed in various studies that indicate the need for further refinement so that teaching modules can meet the expected educational objectives (D. Kuntuamas et al., 2025; Rajagukguk, 2025).

Research shows that the integration of ethnoscience in science education in elementary schools can improve students' understanding of scientific concepts in a more contextual and relevant way to their local culture (Putri et al., 2024; Sihombing et al., 2025). General teaching modules tend to ignore the local cultural context, which causes difficulties in the application of science (Budiarti et al., 2022). In addition, technical challenges such as a lack of teacher training and curriculum demands play a significant role in the limited use of ethnoscience (Puspasari et al., 2019; Rochintaniawati, 2015). Therefore, it is important to develop teaching modules that explicitly accommodate local cultural aspects in teaching materials (Ali et al., 2025). The implementation of ethnoscience can also deepen students' environmental awareness and improve their character (Munira et al., 2024; Sawitri et al., 2024).

Thus, the emphasis on developing context-based teaching modules for ethnoscience needs to be a priority to improve the quality of science education at the elementary level (Indah Dwi Febrianti & Melva Zainil, 2025; Murwitaningsih & Maesaroh, 2023). Based on observations and interviews at SDN Dungkek I in September 2025, fundamental problems were found in the IPAS learning process. Most teachers (90%) still rely heavily on textbooks and downloaded modules without contextual modifications and do not yet understand the concept of Deep Learning. As a result, the majority of students feel bored, are unable to relate the material to local culture, and have low critical thinking skills. This condition emphasizes the need to improve teachers' competence in developing ethnoscience-based teaching modules with a Deep Learning approach.

METHODS

This study applies a descriptive qualitative method using a Systematic Literature Review (SLR) approach. This method has been proven effective in systematically identifying, reviewing, evaluating, and interpreting existing research in related fields (Alhayat et al., 2023; Triandini et al., 2019). Through SLR, researchers can ensure that all relevant studies are critically examined and assessed, making it easier to answer specific research questions (Apriliani et al., 2024; Ertri et al., 2023). Each step in SLR, including journal identification and evaluation, follows a clear and structured protocol that has been established in advance (Priharsari, 2022). With this approach, researchers are able to explain in detail the phenomenon being studied and provide (Ali et al., 2025) a comprehensive overview of the existing literature. This study adopts the latest systematic review model from (Cooper et al., 2019), which divides the two stages into four separate stages. This is reflected in the literature describing how a systematic approach can be divided into several steps to improve research quality. The first stage involves searching for literature and extracting information from research, while the second stage involves summarizing and integrating evidence from individual studies. A comprehensive approach to systematic reviews often involves combining various methods and guidelines to achieve consensus in findings, as proposed by Moher et al., 2015. The methods used in this review are also in line with the systematic guidelines exemplified in the study by Hadi et al., 2020, on the seven essential stages in preparing a review. Thus, the integration of cumulative evidence is a crucial aspect of this framework, referring to the rules in writing systematic reviews that have been established by various authorities such as (Tricco et al., 2018).

Table 1. Systematic Review (Cooper, 2016)

STAGES	RESEARCH QUESTIONS	PURPOSE	VARIATIONS OF THE PROCEDURE
SUMMARIZING PROBLEM	Is there relevance to the question Research	Define variables and their relationships to determine their relevance	Variations in conceptual and definition can lead to differences in Operational
SEARCH LITERATURE	What procedure should be used to find relevant articles	Identify sources (*digital library*) and *keywords* to search for articles	Variations in search sources can cause differences
COLLECT INFORMATION FROM THE ARTICLE	What information is relevant to the research problem or question	Gather relevant information from articles in a reliable manner	Variations in (a) Important labeling of results (b) special attention only to certain studies may cause Differences in Interpretation of findings
EVALUATING THE QUALITY OF RESEARCH	What kind of research procedures are carried out in the research that can be used in the synthesis	Identify and implement criteria to separate research to fit research questions	Variations in criteria in deciding which studies to use in synthesis can lead to differences
ANALYZE AND INTEGRATING RESEARCH RESULTS	What procedures should be used to summarize and combine research results	Identify and implement procedures to combine results across studies and test differences in	Variations in the procedures used in each study such as narrative, *vote counting*, mean effect size can lead to

		outcomes between studies	differences in cumulative results
INTERPRETING EVIDENCE	What conclusion is can be written cumulatively from evidence Research	Summarize the evidence of the cumulative research regarding the general first and then the strengths and limitations of the study	Variations in (a) Important labeling of results (b) special attention only to certain studies may cause differences in interpretation Findings
PRESENTATION OF RESULTS	What information should be included in a *systematic review report*	Identification and the application of Editorial What is it like for Simplify Readers	(a) Directs the reader to judge a lot or little confidence in the results of the synthesis and (b) Influencing others to replicate results

According to Miles and Huberman (Sugiyono, 2019), there are four stages of analysis for qualitative research: (1) data collection to obtain information from various reliable sources; (2) data reduction to simplify the process of obtaining the desired information; (3) data display, and (4) conclusion withdrawal (Fuadi et al., 2020; Haryanto et al., 2024; Maryuni et al., 2023). In each of these stages, it is important to ensure that the data collected is valid and relevant, which can be achieved through triangulation techniques and clarity in data organization (Mundiri & Firdausy, 2022). In addition, these stages of analysis are interrelated and must be carried out interactively until data saturation is reached, which allows researchers to draw accurate conclusions (Misbahuddin & Espinosa, 2022). Based on Cooper's (2016) theory, the first step taken by researchers in this study was to define the problem related to the Systematic Literature Review (SLR) on the implementation of interactive multimedia learning to improve students' science literacy. The second step involved searching for literature from accredited sources such as Google Scholar, DOAJ (Directory of Open Access Journals), and GARUDA (Garda Rujukan Digital).

RESULTS AND DISCUSSION

The first step that researchers took in this study, according to Cooper's theory (2016), was to formulate problems related to the Systematic Literature Review (SLR) research on the implementation of interactive multimedia learning with the improvement of students' science literacy. The second step taken by the researcher was to search for literature from accredited sources such as Google Scholar, DOAJ (Directory of Open Access Journals), and GARUDA (Garda Rujukan Digital). The next step taken by the researcher was to collect information from articles, evaluate the quality of the research, analyze and integrate the research results, and interpret the evidence presented in the table below.

Table 2. Collection of information from relevant articles

NO	RESEARCHER & YEAR (LEVEL)	FINDINGS	RECOMMENDATIONS FOR TEACHERS
1	(Ramadani, 2025)	Relationship: The integration of customary rules of environmental management (Kajang Local Wisdom) has been proven to increase the indicators of argument evaluation. Ethnoscience here serves as a real-life case study in which students must assess the logical validity of a cultural rule, training them to think highly evaluatively.	Teachers are advised to act as facilitators of socratic discussions, provoking students to not just accept customs as traditions, but to seek and debate the scientific reasons behind the rules.
2	(Hikmawati et al., 2020)	Relationship: Lombok's local culture-based science learning is effective in improving inference indicators and strategies. Ethnoscience provides contextual data that forces students to draw conclusions based on the evidence around them, rather than simply memorizing theories.	Carefully map the basic competencies (KD) with local cultural potential before the semester starts. Avoid "matching" (coercion of relationships) that confuses students' logic.
3	(Temuningsih et al., 2017)	Relationships: Reproductive materials associated with public health myths trigger cognitive conflict. This trains students to demarcate science (distinguishing fact vs myth), which is the core of critical thinking (truth verification).	Create a safe space in the classroom for students to dare to express the myths they believe in, and then guide them to conduct scientific investigations to verify these myths without degrading the culture.
4	(Hidayati & Julianto, 2025)	Relationship: The use of ethnoscience context in chemical materials succeeded in reducing misconceptions	Use diagnostic tests at the beginning to find out the students' cultural understanding, then use

		through strengthening data interpretation indicators. Students learn that empirical data from natural materials are more valid than misunderstood assumptions or theories.	ethnoscience experiments as a proof tool to correct wrong concepts (*conceptual change*).
5	(S. T. Lestari et al., 2024)	Relationships: A significant increase in elementary school students occurred because the ethnoscience E-Module provided concrete visualization. Critical thinking at this stage (providing simple explanations) grows because students can see cause-and-effect relationships visually and realistically.	Ensure the readiness of the technological infrastructure. Teachers must guide elementary school students intensively in using interactive features so that students remain focused on science content, not just playing gadgets.
6	(Susi P Sari et al., 2021)	Relationship: Ethnoscience bridges the "original science" to the "scientific science", training indicators provides a simple explanation. Familiar cultural objects make students dare to formulate critical questions and basic answers.	It is mandatory to present real objects (realia) or direct demonstrations of cultural processes in class. Elementary school students find it difficult to think critically if they only imagine an abstract narrative without physical objects.
7	(Sarkingobir & Bello, 2024)	Relationship: The ethnoscience-integrated PBL model improves *problem-solving skills*. Problems raised from the local context are felt to be more relevant by students, triggering motivation to look for critical solutions that can be implemented.	Give students the autonomy to choose environmental issues around their own residences as project topics, so that the sense of ownership of the issue triggers a deeper critical power.
8	(Syafitri et al., 2022)	Relationship: Analysis of natural materials (such as kitchen spices) on Hydrolysis materials trains students to perform chemical analysis critically. Students not only calculate formulas, but analyze	Compile LKPD (Worksheet) with sharp *guiding questions*, which connect natural material phenomena directly to chemical concepts, so that the practicum is not just

		the chemical properties of the objects they consume.	procedural (like cooking recipes).
9	(Aisyah & Khotimah, 2023)	Relationships: The ethnoscience-based PBL model is superior to lectures because the cultural investigation phase requires students to actively seek information, compare sources, and conclude, which is an exercise in critical thinking.	Teachers must actively monitor the group discussion phase. Often ethnoscience discussions extend to historical/social aspects; The teacher's job is to keep the discussion in the corridor of science/scientific analysis.
10	(Wulandari et al., 2023)	Relationships: Students are trained to critique traditional food-making procedures. Critical thinking arises when students question "Why is this step being taken?" or "What is its function chemically?".	Assign students to conduct direct interviews with cultural practitioners (local food makers) to obtain primary data. This trains students to verify field information with theory in the classroom.

At the elementary education level, the integration of ethnoscience has proven to be an effective solution to overcome the abstraction barriers that students often experience in understanding science, while also building the initial foundation for critical thinking. Recent research conducted by Lestari, Sumarni, and Rusdarti (2024) found that the use of interactive E-Modules based on ethnoscience can significantly improve the N-gain scores of elementary school students' critical thinking. This success was driven by digital visualizations of local culture that made science material concrete and relevant. These findings are in line with a study by Sari, Mapuah, and Sunaryo (2021), which specifically highlighted that ethnoscience-based learning successfully improved the indicator of “providing elementary clarification.” In this study, the presence of real cultural objects in the classroom triggered students to formulate basic questions and construct simple but valid cause-and-effect logic, changing their perception that science is not just memorizing textbooks, but rather a logical explanation of everyday phenomena.

Entering junior high school, the role of ethnoscience develops into an instrument for validating truths and testing hypotheses, which is crucial for training inference indicators. Hikmawati, Suastra, and Pujani (2020), through their research in Lombok, proved that a local culture-based science learning model effectively improves students' ability to draw conclusions (inference) and develop problem-solving strategies. This is reinforced by the research of Temuningsih, Peniati, and Marianti (2017) on reproductive system material, where the integration of ethnoscience creates productive “cognitive conflict.” Students were challenged to distinguish between health myths that had developed in the community and biological facts, a process of scientific demarcation that trained students to be skeptical and to verify information before accepting it as truth.

Similarly, Wulandari, Pamelasari, and Hardianti found that junior high school students were able to critique the procedures for making local food products, showing that they were beginning to think critically about the process, not just the results. At the senior high school level, the impact of ethnoscience reaches the highest level of critical thinking (Higher Order Thinking Skills), namely the ability to evaluate arguments, interpret complex data, and reconstruct knowledge.

Ramadani (2025) provides empirical evidence that the use of teaching materials based on local wisdom (such as customs of environmental management) is very effective in training argument evaluation indicators, where students are required to assess the validity of the reasons behind customary rules. On the other hand, Hidayati and Julianto (2025) found that the ethnoscience approach to chemistry material was able to reduce students' misconceptions by strengthening their ability to interpret empirical data. This finding is supported by Syafitri et al. (2022), who showed students' ability to critically analyze the pH of natural materials. Furthermore, in the context of global problem solving, Sarkingobir and Bello (2024) confirmed that the Problem-Based Learning (PBL) model integrated with ethnoscience produces far superior problem-solving abilities compared to conventional methods, proving that ethnoscience produces students who have applicable and analytical science literacy.

CONCLUSION

Based on a synthesis of various studies, the integration of ethnoscience in science education—particularly through the Problem-Based Learning (PBL) model—has been empirically proven to be a significant catalyst in improving students' critical thinking skills from less critical to critical. This improvement occurs because the ethnoscience approach transforms abstract scientific concepts into contextual problems based on local wisdom, which requires students to not only memorize theories, but also validate the scientific truth behind traditions or myths that have developed in the community. The findings show that the indicators of giving reasons (*reason*) and drawing conclusions (*inference*) experienced the most dominant strengthening, as students were trained to demarcate science or prove facts through active investigation of environmental phenomena. Thus, ethnoscience effectively changed the cognitive role of students from passive recipients of information to investigators capable of evaluating arguments and formulating solutions to problems that are culturally and scientifically valid.

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