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Ethnoscience-Based Learning in Elementary Schools:

A Systematic Literature Review

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Abstract
This study examines implementing an ethnoscience approach in elementary schools, using the local environment as a key learning resource. Integrating local wisdom into the curriculum is expected to enhance the connection between school topics and student's daily lives. A systematic literature review selected 38 articles from 2,070 using purposive sampling, analyzed per PRISMA guidelines, with the PICOS model and Systematic Review for data mapping. The study aims to guide educators and researchers in designing ethnoscience-based learning to improve student outcomes. Based on the results of the literature review, a learning approach using the ethnoscience method in elementary schools provides enormous potential for increasing student's scientific literacy, critical thinking skills, and awareness of the surrounding culture. Effective strategies include guided inquiry, problem-based, and project-based learning, evaluated through observations, quizzes, interviews, tests, and project-based assessments.

Keywords
Curriculum Integration, Elementary School Education, Ethnoscience, Learning Outcomes, Systematic Literature Review

INTRODUCTION

Most elementary school students still have problems understanding science because they are still limited in their understanding of various complex scientific concepts. Learning methods that are too theoretical make it increasingly difficult for students to apply concepts learned when faced with more complicated problems. Therefore, teachers must develop a learning method that applies a more interactive and relevant approach to elementary school student's daily lives. Integrating everyday life into learning enhances student's learning outcomes and creative thinking abilities (Rismaningtyas et al., 2019), as well as facilitates the application of knowledge in meaningful contexts (Srinivasa et al., 2022).

Some studies have demonstrated the effectiveness of ethnoscience-based learning models, such as problem-based learning, in enhancing student's scientific literacy skills and cultural understanding (Hidyanti & Eka, 2023; Mudana, 2023). Developing ethnosocial learning models also highlights the importance of integrating local cultural wisdom into

learning (Na thongkaew et al., 2024). Other studies recommend future research on implementing independent curricula using ethnoscience approaches (Hasibuan et al., 2023. However, gaps in the literature regarding the implementation of ethnoscience in elementary school education must be addressed adequately (Pratama & Jumadi, 2023).

Therefore, systematic research through literature reviews, such as a Systematic Literature Review (SLR), is essential to identify areas of study that require further attention and evaluate the quality of existing research (Jannah et al., 2022; Wati et al., 2021). This research is expected to analyze on the learning outcomes with ethnoscience and traditional methods comparison and recommend research designs that are usually used to analyze learning methods.

METHODS

This study uses qualitative and quantitative approaches in the form of a systematic literature review (SLR) using Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) protocol based on database search from 2017 to 2023. Furthermore, this study used the Participants, Intervention, Comparison, Outcomes, and Study Design (PICOS) framework to formulate the study questions (Table 1).

Table 1 PICOS criteria used for formulating research questions

Components	Description
Participants	Elementary school teachers and students
Intervention	Strategies employed in ethnoscientific approach learning
Comparison	Comparison with other teaching approaches
Outcomes	Learning outcomes
Study Design	Research design employed

Research questions

Based on the formulated PICOS criteria for structuring research questions, this systematic literature review (SLR) is conducted to answer the following questions:

1. How do ethnoscience learning strategies influence learning outcomes in elementary schools with diverse cultural backgrounds?
2. What are the strategies or interventions used in the research?
3. How are the implementation strategies of ethnoscience-based learning in elementary schools?
4. Are learning outcomes different between ethnoscience and traditional science learning students in elementary schools?
5. How are the learning outcomes of students in ethnoscience learning measured and evaluated in elementary school?
6. What research design was employed to analyze the strategies and outcomes?

Keyword Development

The researchers used the keywords "strategies in ethnoscience AND approaches in ethnoscience AND achievement in ethnoscience AND methods in ethnoscience for elementary schools" and "strategies in ethnoscience AND OR approaches in ethnoscience AND OR achievements in ethnoscience AND OR methods in ethnoscience for elementary schools" which were collected using Publish or Perish (PoP) software.

Database Search

In this systematic literature review, the researchers used journal indexing portals accessed through Google Scholar, Scopus, and CrossRef from 2017 to 2023.

Data Filtering

This study established criteria and exclusions to limit the scope of article identification so that researchers could map relevant factors in mapping results with the research topic. After citation data from 2,070 papers retrieved in RIS format were first filtered to eliminate duplicates, 1,985 articles were found. Tupan and Rosiyan (2022) conducted a systematic literature review that aimed to identify, evaluate, and interpret research findings related to a given issue. Further filtering from 771 by eliminated through an examination of the full paper resulting 38 papers used in this review (Figure 1).

RESULTS

Bibliometric analysis by VOSviewer provide a comprehensive picture that will help identify research over time and conceptually analyze research patterns (Ingale & Paluri, 2022; Sassanelli et al., 2019; Stout et al., 2018). As a result, there are two well-separated subfields, referred to as "ethnoscience" (upper left) and "strategy" (middle left), as well as another distinct subfield labeled "category" (middle right), as shown in Figure 2. The relationship between the subfield “ethnoscience” and the subfield “strategy” appears to be slightly more substantial than the relationship between this subfield and the subfield “categories.”. The relationship between "ethnoscience" is closer to "strategy" which indicates that the topic "ethnoscience" is more often connected with "strategy" than with "categories" which are characterized by a greater distance.

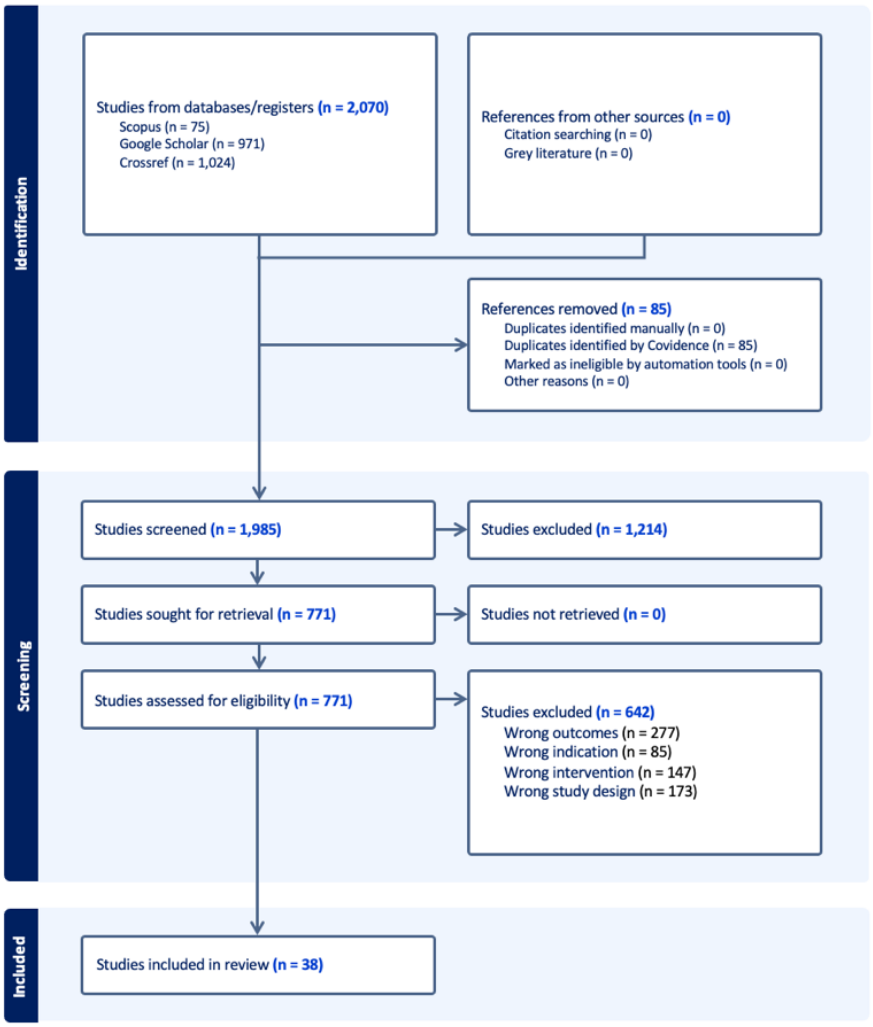

Fig. 1 PRISMA flow diagram

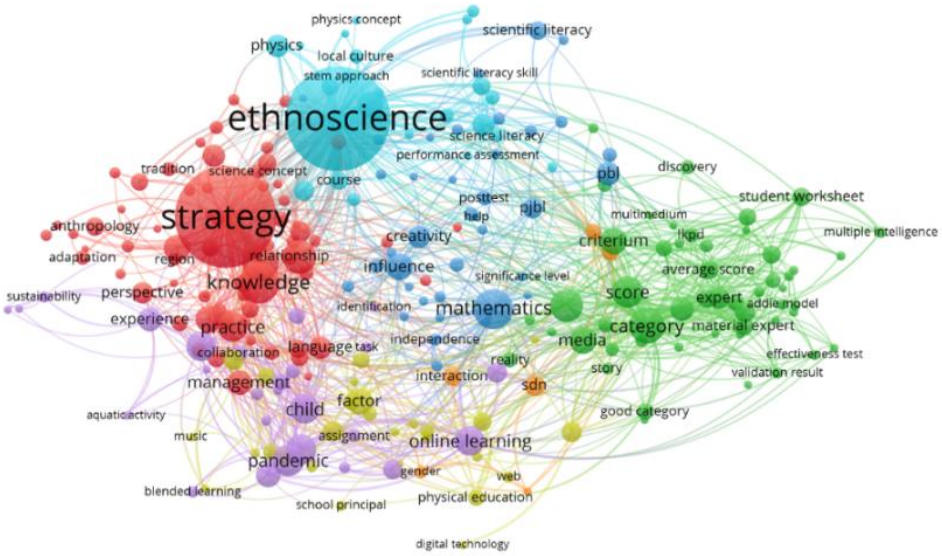

Fig. 2 Research topic distribution

Classification Based on the Publication Year

The bibliometric analysis conducted using VOSviewer provides a comprehensive visualization of research trends from 2017 to 2023, each year represented by a different color, as shown in Figure 3. Yellow clusters indicate research conducted in 2023, whereas dark blue clusters represent older studies. The clusters, connected by commonalities in titles and abstracts, revealed emerging trends and well-established areas. Notably, research on “blended learning” forms a prominent yellow cluster that points to research gaps and opportunities for future investigation. These underexplored areas represent the potential advancements in this field. Several studies have stated that the blended learning method can be applied to various subjects, such as physical education (Wang et al., 2023), English performance (Hafeez et al., 2023),

science learning (Purnama et al., 2023), and reading comprehension (AlManafi, 2023). Pramesworo et al. (2023) also identified challenges in integrating a self-directed learning curriculum into a blended learning environment, highlighting the importance of teacher support, collaboration, and access to technology and resources to successfully adopt self-directed learning practices in the digital-age classroom. Contributions to "strategies in ethnoscience" are also highlighted, with color intensity reflecting the volume and recency of research, showing that these topics are receiving heightened scholarly attention.

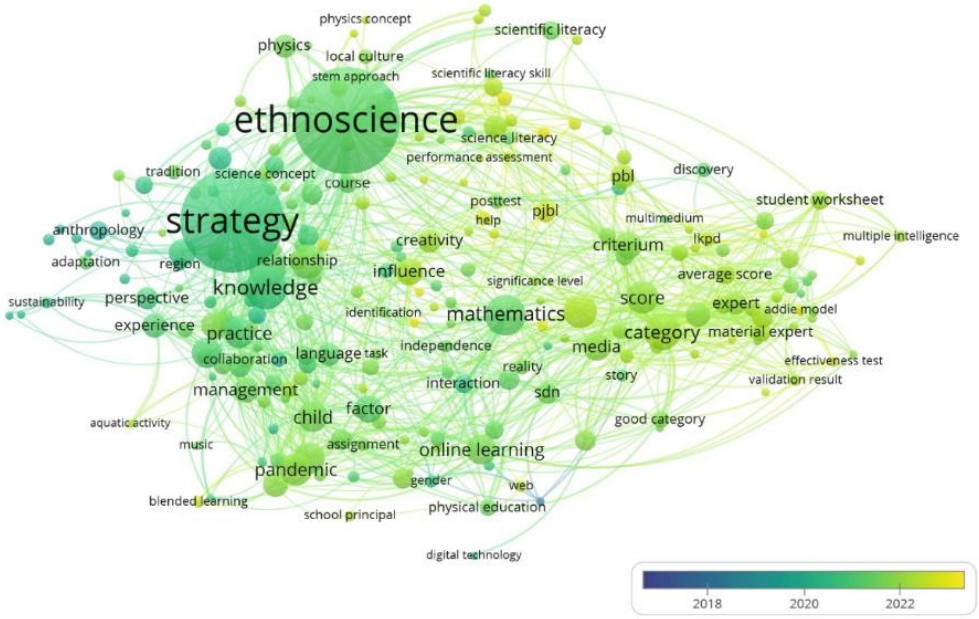

Fig. 3 Distribution of the subject on 'strategies in ethnoscience' based on publication by years

Classification Based on Learning Outcomes

Further analysis by VOSviewer based on integrated ethnoscience learning studies showed that. employing the ethnoscience approach significantly enhanced various aspects of student achievement (Figure 4). These include advancements in knowledge acquisition, scientific literacy, creativity, critical thinking skills, perspectives, language proficiency, scores, discovery abilities, increased interaction, and development of character values (Alviya et al., 2023; Rosidah et al., 2024; Rosidah et al., 2024; Wirama et al., 2023; Yanto et al., 2023).

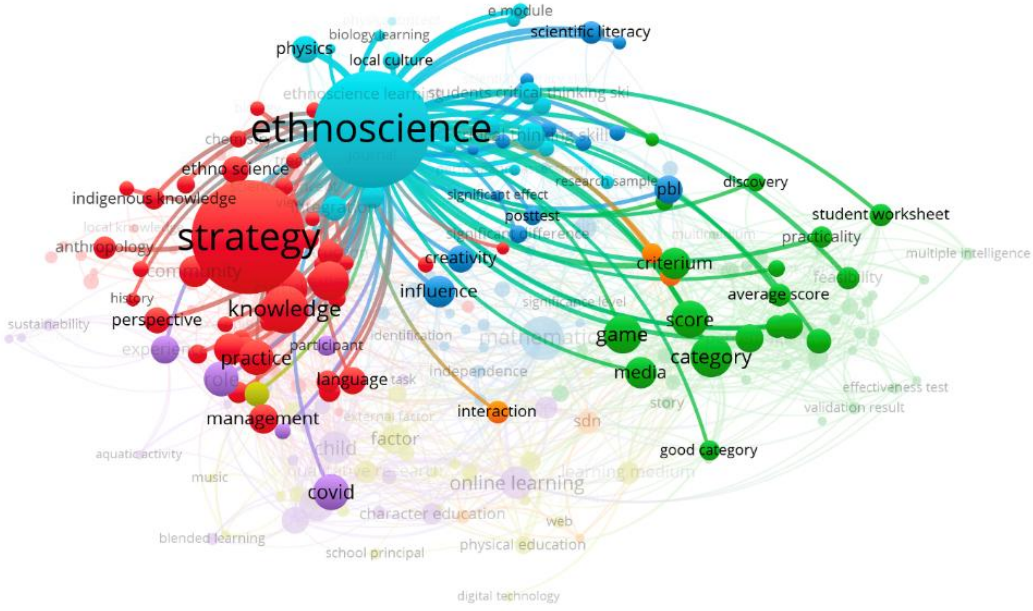

Fig. 4 Correlation subject based on types of ethnoscience approach

Classification Based on Types of Learning Strategies

The results of implementing the ethnoscience learning model by integrating it into the framework of further education in elementary schools (Figure 5).

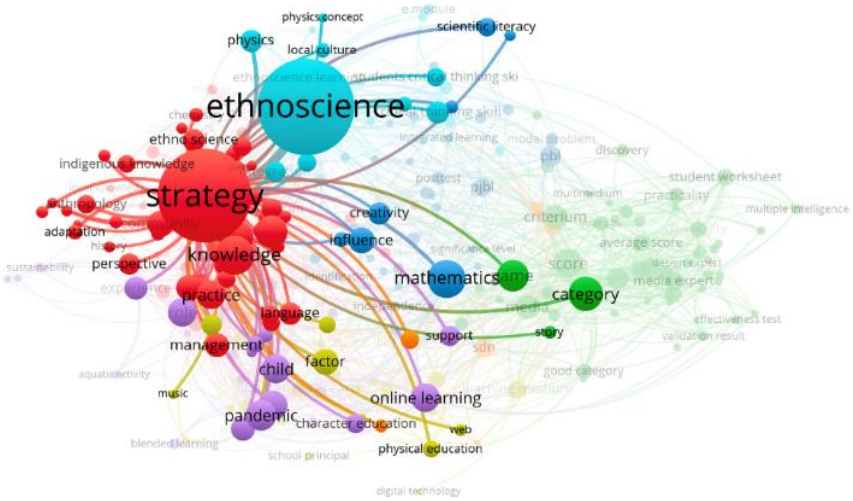

Fig. 5 Correlation subject by learning strategies based on ethnoscience approach

Figure 5 shows that this development method has utilized various learning models to support science education, with an ethnoscience approach mainly influencing physics, biology, chemistry, and mathematics. Since ethnoscience utilizes the local environment as a learning medium, it inherently intertwines with the local culture, as evidenced by connecting lines. Many ethnoscience studies align with advanced science-learning models, emphasizing problem-based, experimental/practice, and interactive methodologies. Using the Ethnoscience-based on Project Based Learning (PBL) model can improve the scientific literacy skills of V-grade students at SDN Bringinbendo 2 (Hidayanti, 2023). Project-based learning has also been reviewed by Puspita et al. (2023) in a systematic literature review. This shows that this method helps instill students with a positive attitude towards nature, including respect for nature and its inhabitants. This aligns with previous research, which indicates that integrating interactive multimedia into classroom learning can significantly enhance student learning outcomes compared with relying solely on PowerPoint presentations (Pratiwi et al., 2024). This method can also improve creative thinking skills and learning motivation through ethnomathematics-based interactive multimedia (Ilma et al., 2024). Moreover, the figure indicates the strategic adoption of ethnoscience amid the COVID-19 pandemic by leveraging online learning platforms such as websites or applications (Kusumawati, 2022). Practical support for ethnoscience education requires educational character development, support, and influence from individuals within the community.

DISCUSSION

The impact of ethnoscience learning strategies on student's learning outcomes in culturally diverse elementary schools

Some studies have shown that ethnoscience-based guided inquiry learning enhances student's mastery of scientific literacy (Alim et al., 2019; Azhary et al., 2018; Fathoni et al., 2018; Saputra et al., 2018). According to Yuniastuti (2013), utilizing guided inquiry methodologies in the classroom can help students develop their process skills, which in turn affects the completion of their learning. 21st-century competencies like critical thinking, creativity, generic science skills, concept understanding, character, chemical literacy, and scientific literacy can all be trained for, improved upon, and positively impacted by the application of ethnoscience learning (Putu et al., 2022; Risdianto et al., 2020; Tyas et al., 2020; Yuliana et al., 2021).

This integration was particularly effective in fostering student's ability to think creatively and critically, as well as their conservation character, which is closely tied to the values of their local culture (Sari et al., 2023). With ethnoscience-based science learning, it is expected that students will be more attracted to learning and that knowledge can easily permeate their minds (Pratama et al., 2023; Puspasari et al., 2019; Putri & Ananda, 2020; Suryanti et al., 2021). Science education that emphasizes local culture might help kids become more proficient in science and develop stronger morals, motivations, and interests (Fahrozy et al., 2022; Genisa et al., 2020; Hadi et al., 2019; Yulistina et al., 2024).

Exploring research strategies and interventions

Guided Inquiry Learning (GIL), based on ethnoscience, is an educational approach that combines scientific exploration with local knowledge and culture to enhance student's understanding in a contextual and relevant manner. Several studies have employed Guided Inquiry Learning for ethnoscience-based teaching in elementary schools because it involves students actively exploring scientific concepts through guided inquiry and hands-on activities (Alim et al., 2019; Asiah, 2021; Aulia et al., 2018; Suantara et al., 2022). Ethnoscience-Based Learning Resources are educational materials and tools that integrate traditional knowledge and cultural practices with scientific concepts to provide students with contextual and culturally relevant learning experiences. Utilizing local wisdom and cultural practices in Ethnoscience-Based Learning Resources can enhance student's acquisition of scientific literacy and character development (Ariska et al., 2021; Damayanti et al., 2022; Fajri, 2019; Khotimah et al., 2022). Contextual Collaborative Learning is an educational

approach in which students work together in groups to solve real-world problems and complete tasks directly related to their experiences and environments, thus making learning more relevant and meaningful. Research on Contextual Collaborative Learning integrating ethnoscience with contextual collaborative learning is often conducted because of its potential to enhance student's understanding of science and improve their scientific literacy skills (Hendawati et al., 2019; Selvianiresa & Prabawanto, 2017).

Through the process of solving open-ended, real-world problems, students engage in project-based learning (PBL), an instructional approach that fosters the growth of critical thinking, problem-solving abilities, and self-directed learning. Project-based learning combined with project-based learning can help students gain deeper understanding and strengthen their critical thinking abilities by teaching them to apply scientific ideas to real-world situations (Sajidan et al., 2022; Pamenan et al., 2022; Harianja et al., 2023; Ritonga et al., 2022). Integrating ethnoscience with Project-Based Learning (PBL) involves designing projects that incorporate local cultural knowledge and traditional practices into exploring scientific concepts, allowing students to engage deeply with their heritage and subject matter in a hands-on, meaningful way. Integrating ethnoscience with Project-Based Learning offers students the opportunity to investigate scientific concepts through hands-on projects grounded in their local culture and traditions, fostering a deeper understanding of scientific principles within a context that resonates with cultural heritage (Cai et al., 2023; Lavonen et al., 2021; Llorent et al., 2022; Munoz-Repiso & Gomez-Pablos, 2017). Ethnoscience-Based Inquiry Creative Learning (EBICL) is an educational approach that combines the elements of ethnoscience, inquiry-based learning, and creativity to foster deep understanding, critical thinking, and cultural appreciation among students. This approach encourages students to explore scientific concepts through inquiry, while incorporating traditional knowledge and cultural practices, fostering creativity in problem-solving and learning processes. Utilizing Ethnoscience-Based Inquiry Creative Learning methodologies has been shown to augment student's capacity for creative thinking and professionally develop their scientific literacy skills professionally (Solé-Llussà et al., 2022).

Implementing Ethnoscience-Based Learning in Elementary Education

As highlighted in a study published by Oktaviana (2024), efforts to implement ethnoscience learning in elementary schools emphasize incorporating culture-based learning to instill students with a profound appreciation for their cultural heritage and a sense of national pride. Examples of ethnoscience learning projects, such as exploring local cultures, traditions, and customs, underscore the potential to align such initiatives with the national curriculum. However, challenges persist in implementing ethnoscience learning in higher grades, requiring teachers to adapt to new teaching methods and students to develop more complex critical thinking skills (Wahyu, 2017; Yuliana, 2017).

Comparing Ethnoscience and Traditional Science Learning Outcomes

Traditional science education for elementary school students focuses only on systematic studies that occur in nature and are based on principles that have existed since the past. At the same time, ethnoscience will be updated by combining cultural elements of the surrounding environment and existing knowledge into one attractive learning unit (Bazelais & Doleck, 2018; Irwanto et al., 2019). Several studies have proven that learning using the ethnoscience method results in increased student's appreciation of the diversity of surrounding cultures, so that it will foster a deeper understanding of principles that are embedded in the brain regarding scientific concepts, for example, science, because they have been applied to events that occur every day around students (Ahmed & Opoku, 2021; Saputro et al., 2019; Ulandari et al., 2020). This can lead to the emergence of a level of skill, critical thinking, and sense of pride in the country's cultural heritage in the form of the surrounding culture (Kadaritna et al., 2020). This could cause a loss of local cultural richness due to eroding curriculum modernization, which is less suited to the environment of each school (Macaruso et al., 2020).

Assessing Learning Outcomes in Ethnoscience Education

Apart from measured academic evaluations, evaluations also need to be carried out regarding the level of ability and skills in critical thinking, problem solving, involvement in the use of local culture, and many others (Rajaram & Rajaram, 2021). Due to the difficulty of the evaluation process that needs to be carried out, teachers must play a vital role in this process so that adequate and practical training is needed to integrate ethnoscience principles into learning plans. Teachers must also be able to facilitate the holistic development of students by continuing to appreciate local culture and scientific knowledge (Syaifulla & Diliarosta, 2021; Nandia & Sayekti, 2023).

CONCLUSION

Based on the results of the literature review, a learning approach using the ethnoscience method in elementary schools provides enormous potential for increasing student's scientific literacy, critical thinking skills, and awareness of the surrounding culture. Various learning strategies, such as guided inquiry, problem-based, and project-based learning, the effectiveness of which has been explored by several researchers, have been proven to increase student's understanding of scientific concepts and their application in elementary school teaching. In addition to using these strategies, developing other resources, such as in the digital field based on ethnoscience, has become an innovative tool for promoting scientific literacy among elementary school students.

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DECLARATION OF CONFLICT
The author declares that there is no conflict of interest.

AUTHOR CONTRIBUTIONS
The idea and design of the study were contributed to by all authors. AA conducted the data analysis and literature search. AA wrote the original draft of the manuscript, SB, AFW, and EN provided feedback on earlier drafts. The final manuscript was read and approved by all writers.

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