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Bibliometric Analysis From 2014-2024: Integration of Ethnoscience in Science Learning

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ABSTRACT

Purpose of the study: Ethnoscience has become a fairly well-established field among academics, although the topic is still developing. This study aims to analyze research trends related to ethnoscience published in the period 2014 to 2024.

Methodology: This study uses bibliometric analysis and systematic literature review. Data collection was carried out by searching for the keyword "Ethnoscience" in October 2024. The data was sourced from the Scopus database and obtained 271 documents. 166 articles were obtained after filtering. Furthermore, analyzed using VOSviewer.

Main Findings: The results showed that ethnoscience has increased significantly as a research topic from 2014 to 2021; ethnoscience in science learning is more widely studied in Indonesia. The author who researched the most ethnoscience is Sudarmin, with a total of 16 documents. This study also highlights the latest research approaching 2022–2024 and its impact on student skills.

Novelty/Originality of this study: These findings also highlight the importance of ethnoscience in local and traditional studies and focus on the development of science and education.

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1. INTRODUCTION

The 21st century brings major changes and challenges to society in various fields [1]. The 21st century is marked by very rapid technological developments. This causes major challenges to face the 21st century and the flow of globalization. In the 21st century, students are required to have various competencies. In the field of education, students are required to have 16 skills that are categorized into three major categories, namely foundation literacies, competencies and character quality [2]–[4]. Basic literacy consists of literacy, numeracy, ICT literacy, financial literacy, cultural and citizenship literacy and science literacy [5], [6]. Competencies consist of critical thinking and problem solving skills, creativity and innovation, communication, and collaboration [7]–[11].

The government is making efforts to improve the quality of Indonesian education, one of which is by changing the 2013 curriculum to the independent curriculum. The independent curriculum is a new curriculum that has been implemented in Indonesia. The independent curriculum is also considered more flexible than the previous curriculum. This means that teachers, students, and schools are freer to carry out learning activities in schools. This curriculum also emphasizes core material, character development, and student competencies. One

of the characteristics of the independent curriculum is implementing more interactive and collaborative learning methods. According to Sine et al, one of the main focuses of developing the independent curriculum is to improve students' numeracy and literacy skills and prioritize the profile of Pancasila students consisting of those who believe in, are devoted to God Almighty, and have noble character, are globally diverse, independent, work together, think critically and creatively [12].

Science education is a major milestone in the development of technology. In junior high school, students are required to study science through natural science subjects. Natural science is a science that studies natural phenomena obtained from science process skills to foster a scientific attitude [13], [14]. In reality, students often have difficulty understanding science material [15], [16]. Several previous studies have stated that science is easier to learn if it is integrated with the student's environment. Culture is very close to students' lives, the integration between culture and science is called ethnoscience.

Ethnoscience comes from the word ethnos which means nation and scientia which means science [17]–[19]. Ethnoscience is a cross-disciplinary science that connects human or cultural anthropology with science learning. The study of scientific knowledge obtained by examining local knowledge contained in the culture of a society or ethnic group [20]–[23]. The ethnoscience-based learning process aims to create very dynamic meanings. The ethnoscience-based learning process allows students to express their various curiosities, engage in creative analysis and exploration processes to find answers, and engage in various conclusions [24]–[26].

Bibliometric analysis of the development of ethnoscience research trends in journals can provide a comprehensive picture of the direction and development of this research over a certain period of time. This study aims to analyze research trends related to ethnoscience published in the period 2014 to 2024.

2. RESEARCH METHOD

This study uses bibliometric analysis to measure the development of published articles, scientific contributions and research trends [27], [28]. Bibliometric analysis is very suitable using the Scopus database. Scopus was chosen as an indexing tool because almost all international journal publications are included in its database [29]. This study was conducted by searching with the keyword "Ethnoscience" in October 2024, the initial results were 271 documents. Furthermore, to refine the results, filters were carried out based on certain criteria. First, the researcher made a selection by limiting articles published in 2014 to 2024 and obtained 177 documents. Second, to make it easier for researchers and there was no bias in reading the articles, a selection was carried out based on language, namely the articles used were articles using English, 166 articles were obtained. The final results of the search documents found 166 articles that were ready to be processed. The search results on the Scopus indexing engine are stored in CSV format. The research procedure is shown in Figure 1.

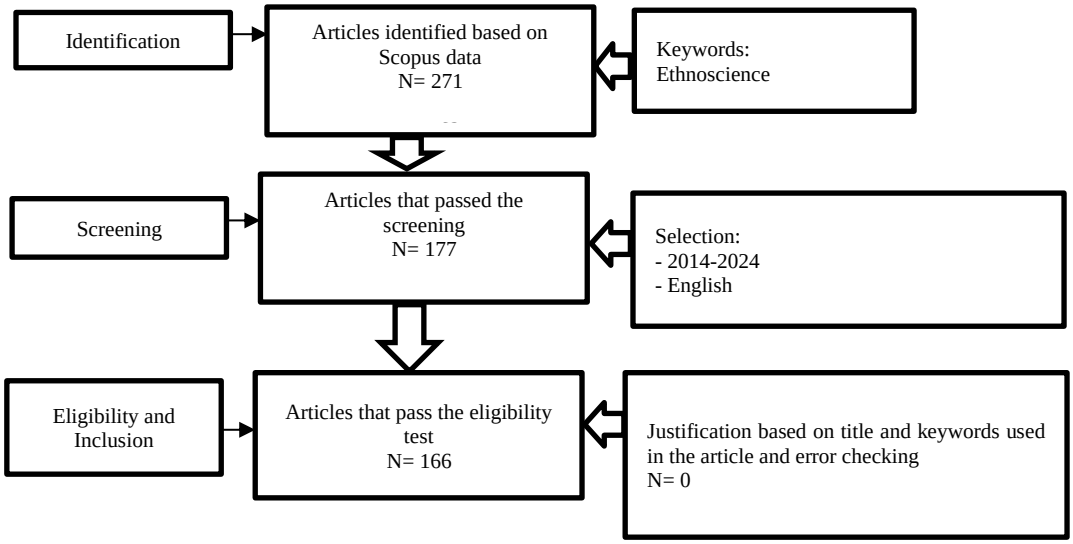

Figure 1. Research steps

The analysis technique in this study uses the VOSviewer application using co-authors based on country and co-occurrence. Co-occurrence analysis is a method that focuses on examples when two or more keywords appear together in a document or article. This analysis identifies relationships between keywords in literature, helping to visualize context connections through bibliometric networks. Co-occurrence analysis leads to conclusions about scientific literacy and science education.

3. RESULTS AND DICUSSION

Based on the results of Scopus data on ethnoscience, a trend of ethnoscience research was obtained in the range of 2014-2024. Ethnoscience has increased significantly as a research topic from 2014 to 2021. Then, it decreased in 2022 and increased again in 2023. In 2024 there were 17 documents in the Scopus data and in 2024 it is still October and there are still November and December to see whether this topic has increased or decreased.

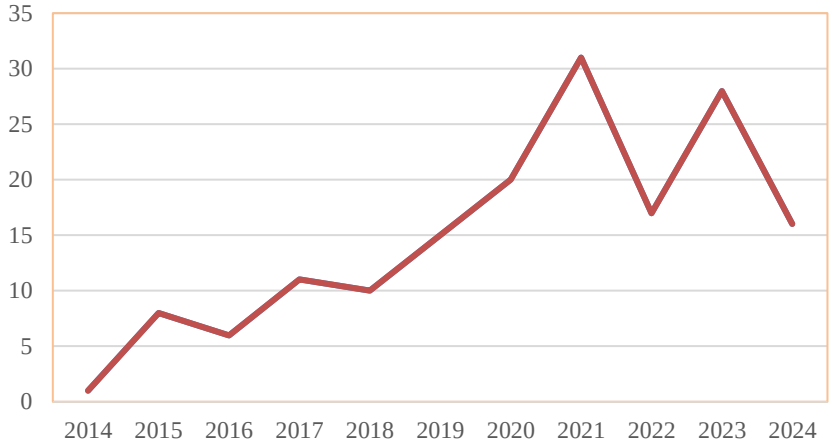

Figure 2. Graph of ethnoscience research in science learning in 2014-2024

Next, reviewed based on countries researching ethnoscience topics is shown in Figure 3.

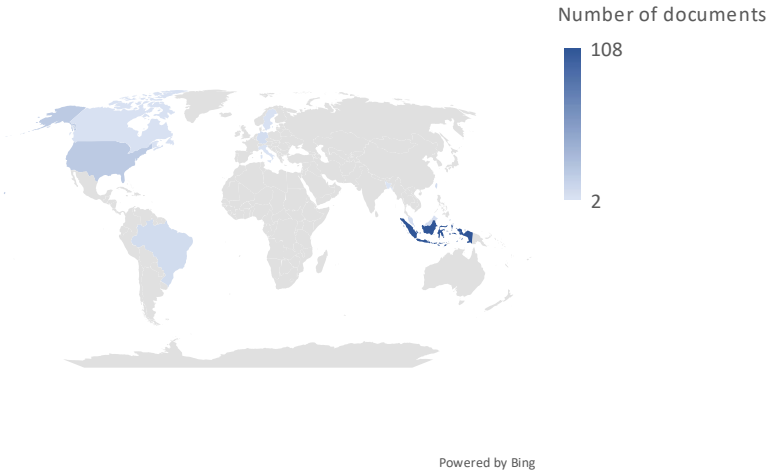

Figure 3. Countries researching ethnoscience topics

Figure 3 shows that ethnoscience in science learning is more widely researched in Indonesia. The number of documents on the topic of ethnoscience through Scopus data in each country is shown in Table 1.

Table 1. Top 10 countries that research ethnoscience

Country	Number of documents
Indonesia	108
United States	20
Brazil	7
Taiwan	6
Germany	6
Malaysia	5
Canada	3
Sweden	3
Bangladesh	2
Italy	2

Based on Table 1, it shows that the ten countries that conduct the most research on ethnoscience in Scopus data. Indonesia is the country with the first rank that produces the most documents on ethnoscience research, namely 108 documents, the United States is the country with the second rank that produces the most ethnoscience research documents, namely 20 documents and Brazil is the third country that conducts the most research on ethnoscience with a total of 7 documents. Table 1 shows the top 15 articles with the most citations.

Table 2. Top 15 articles with the most citations

No	Authors (Year)	Journal	Citation	Country
1.	[30]	Science & Education	113	Germany
2.	[31]	BioScience	81	Inggris
3.	[32]	International Journal of Science Education	35	Nigeria
4.	[33]	Jurnal Pendidikan IPA Indonesia	33	Indonesia
5.	[34]	Jurnal Pendidikan IPA Indonesia	29	Indonesia
6.	[35]	Journal of Turkish Science Education	27	Indonesia
7.	[36]	Journal of Ethnobiology and Ethnomedicine	23	Brazil
8.	[37]	Big Data and Society	22	Denmark
9.	[38]	Jurnal Pendidikan IPA Indonesia	21	Indonesia
10.	[39]	Journal of Physics: Conference Series	20	Indonesia
11.	[40]	Evolutionary Human Sciences	18	United States
12.	[41]	Journal of Physics: Conference Series	16	Indonesia
13.	[42]	Library Philosophy and Practice	14	Indonesia
14.	[43]	Journal of Ethnobiology and Ethnomedicine	14	Brazil
15.	[44]	International Journal of Evaluation and Research in Education (IJERE)	13	Indonesia

Based on Table 2, it shows that the research conducted by Zidny et al in 2020 is a highly cited research with the number of citations being 113. The authors who have conducted a lot of research on ethnoscience are shown in Table 3.

Table 3. Ethnoscience Researcher

No	Authors	Number of Documents
1.	Sudarmin	16
2.	Sumarni, W	11
3.	Suprapto, N	7
4.	Prahani, B.K.	5
5.	Diliarosta, S	4
6.	Mursiti, S	4
7.	Sarwi, S	4
8.	Subali, B	4
9.	Wiyanto	4
10.	Zidny, R	4

Based on Table 3, it shows that the author who researched the most ethnoscience is Sudarmin with a total of 16 documents in the Scopus data. Furthermore, the results of the analysis of ethnoscience in science learning obtained the results of network visualization shown in Figure 4.

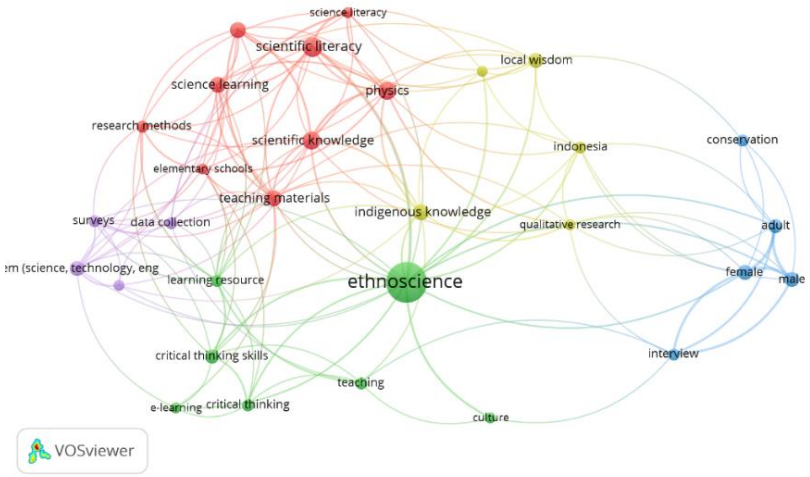

Figure 4. Network visualization

Figure 4 shows the development of the number of articles related to the fluctuating keywords. The ethnoscience network visualization produces 30 words/items with 5 clusters. Cluster 1 is red, cluster 2 is green, cluster 3 is blue, cluster 4 is yellow and cluster 5 is purple.

In cluster 1, the red color is related to the terms elementary schools, junior high schools, physics, science learning, science literacy, scientific knowledge, scientific literacy, and teaching materials. Cluster 1 shows that many previous studies have examined ethnoscience in learning materials at elementary and junior high school levels. Cluster 1 also shows that ethnoscience is closely related to science and physics learning and there is a relationship between ethnoscience and scientific knowledge and scientific literacy. Furthermore, cluster 2 is green with related terms, namely critical thinking, critical thinking skills, culture, e-learning, ethnoscience, learning resources, teaching. Cluster 2 shows that ethnoscience is related to learning resources sourced from electronic learning and culture to improve critical thinking skills. Cluster 3 is blue with the terms, namely adult, conservation, female, interview, and male. Cluster 3 shows that ethnoscience in previous studies was obtained from interview methods and was studied based on gender. Cluster 4 is yellow with the terms indigenous knowledge, Indonesia, local wisdom, qualitative research and science education. Cluster 4 shows that previous studies have studied ethnoscience using qualitative research types in Science Education and ethnoscience which are widely studied based on indigenous knowledge and local wisdom in Indonesia. Cluster 5 is colored purple with related terms, namely integration, stem (science, technology, engineering and mathematics). Cluster 5 shows that the ethnoscience approach can be integrated with the stem approach.

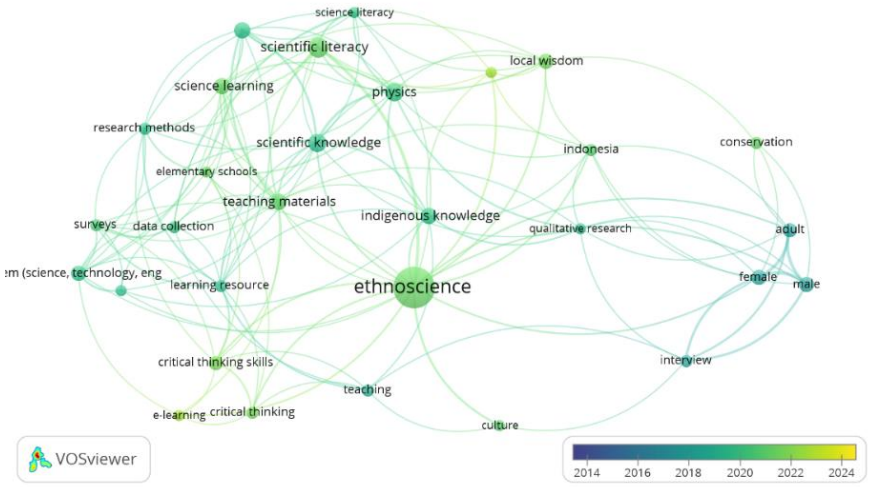

Figure 5. Overlay visualization

Overlay visualization serves to illustrate the year of research related to keywords/items based on color. The brighter the color (yellow), the newer the research. Figure 5 shows that the latest research approaching 2022 to 2024 discusses ethnoscience, critical thinking, e-learning, critical thinking skills, teaching materials, elementary schools, science learning, scientific literacy, conservation. Research from 2018 to approaching 2022 discusses Indonesia, teaching, learning resources, stem, scientific knowledge, physics, indigenous knowledge and science literacy. In 2014 to approaching 2018, many ethnoscience studies used qualitative research types with adult subjects and were directed based on gender. Furthermore, density visualization is useful for determining the density of keywords. Density visualization is shown in Figure 6.

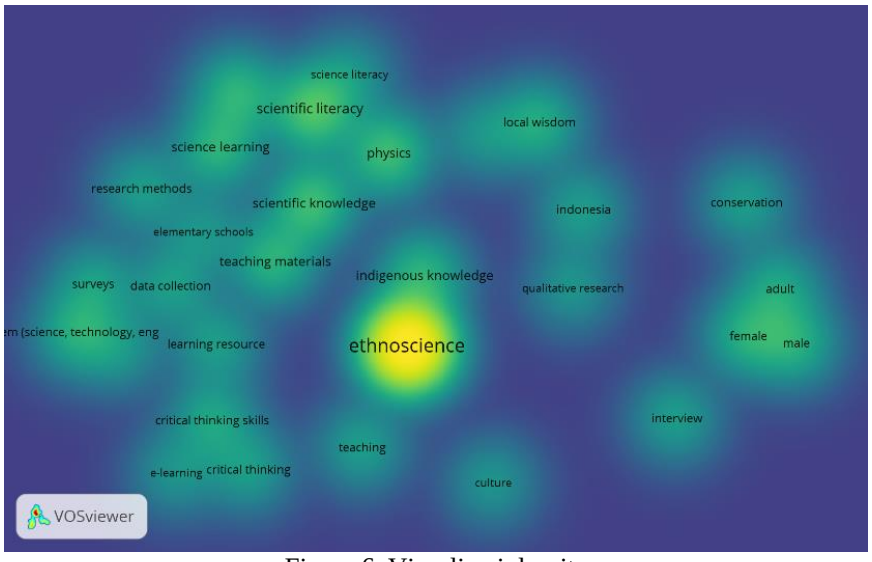

Figure 6. Visualisasi density

Figure 6 shows that the mapping of topics that are the focus of research. Figure 6 shows that ethnoscience has become the most researched trend topic over the past ten years. The greenish yellow color and increasingly faded indicate that the topic has not been done much and can be a novelty in research such as culture, Indonesia, science learning, science literacy, local wisdom, e-learning, critical thinking, learning resource conservation and elementary schools and stem.

3.1 Implementation of ethnoscience approach to improve scientific literacy in science learning

The development and progress of science and technology in developed and developing countries in the world of education emphasizes how important scientific literacy is for students. Scientific literacy allows students to understand various aspects of life, such as the environment, health, economy, and various challenges faced by modern society [45], [46]. Based on the literature review study that has been conducted, 166 articles have been selected from the Scopus database which shows that 15 articles discuss the application of the

ethnoscience approach to improve students' scientific literacy. The results of the literature study are presented in Table 4.

Table 4. Matrix of ethnoscience implementation to improve scientific literacy in science learning

No	Authors (Year)	Research Subject	Ethnoscience Content	Science Concept	Learning Model	Result
1.	[47]	Class VII grade in SMP N 1 Bandung Tulungagung	Batik	Classification of Matter and Its Changes	CTL	Batik ethnoscience-based teaching materials are worthy of being tested with the aim of improving students' scientific literacy skills on the material of material classification and its changes.
2.	[48]	Chemistry Education Study Program FPMIPA IKIP Mataram	Tradisi mamaq suku Sasak to strengthen teeth, Terasi Nisa suku Samawa, Tamban awet using original Sasak salt, turmeric, betel leaves, ketapang leaves, and hibiscus flowers, ilo by the tribe Mbojo, jaje Celilong suku Sasak.	Topics of acids and bases, buffer solutions, salt hydrolysis, natural acid-base indicators on the topic of acid-base titration, hydrocarbons and on the topic of colloidal systems.	-	The development of scientific literacy needs to be carried out by emphasizing the preparation of the next generation of scientific literacy with curriculum content that pays attention to culture and everyday life to be more contextual.
3.	[49]	Students of PGSD Yogyakarta PGRI University class A1 and A2 class of 2017 who take courses in Natural Sciences 1	Jumputan batik	Integrated IPA	-	Integrated science learning ethnoscience can improve students' science literacy with a gain score of 0.81 which is included in the high category. The average value of students' scientific character in integrated science learning ethnoscience is in the high category, where the average value of scientific character in each aspect at each meeting is > 70%.
4.	[50]	Class of VIII at Junior High School Yogyakarta	-	-	Inquiry Based Learning	The results of improving scientific skills and scientific literacy were 0.73 and 0.69 respectively and the integration of IBL and ethnoscience was more effective in improving students' scientific skills and scientific literacy

No	Authors (Year)	Research Subject	Ethnoscience Content	Science Concept	Learning Model	Result
						than the scientific approach.
5.	[51]	SDN di Wonosobo	Carica plant or commonly called Dieng papaya or Dieng barren	Classification of plants	Guided Inquiry	The application of an ethnoscience-based guided inquiry model effectively improves students' mastery of healthy food science literacy and character development.
6.	[35]	Chemistry Education UNDIKMA Mataram	Crude oil	Chemistry	Contextual Collaborative Learning Based Ethnoscience (CCLBE Model)	Contextual collaborative learning based on ethnoscience influences students' scientific literacy capacity in terms of content, process, and attitudes.
7.	[25]	Kerebet Elementary School as an experimental group and Sendangsari Elementary School as a control group	Making wooden batik	Class V thematic on Theme 9 subtheme 1 and subtheme 2	Ethnic based thematic learning	Ethnoscience-based learning can improve elementary school students' science literacy and civic literacy. This is proven by the results of the study which showed differences in increasing science literacy and civic literacy in the control and experimental groups.
8.	[52]	-	-	Environment	-	Ethnoscience learning significantly improves students' scientific literacy. Therefore, ethnoscience learning in schools is very important to improve students' scientific literacy skills in developing science education for students in the 21st century and protecting the environment.
9.	[53]	Junior High School Students in Wonosobo Regency	Bundengan	Vibrations, Waves and Sound	-	The validity of the teaching materials Vibration, Waves and Sound integrated with Bundengan ethnoscience is very valid in terms of content, presentation, and language. This teaching material is also able to increase students' scientific literacy higher than other teaching materials.
10.	[54]	-	-	-	Model Pembelajaran Inquiry	The inquiry learning model has a very important role in stimulating curiosity,

No	Authors (Year)	Research Subject	Ethnoscience Content	Science Concept	Learning Model	Result
						developing critical thinking skills, and increasing student independence in learning. However, to maximize the potential of inquiry learning, it is important to integrate other concepts and practices, such as the ethnoscience learning approach and science literacy skills. The ethnoscience approach allows for recognition and respect for students' local and cultural knowledge, while science literacy provides a strong foundation for evidence-based and critical learning.
11.	[55]	Grade 8 students at a rural high school in Central Java	Tarutu, tintelepon, calung, dan sempritan manuk	Sound waves	RE-STEM	Students' scientific literacy skills increased by 61.33% in the moderate category in general, also in every aspect. The RE-STEM application has supported teachers to improve students' scientific literacy skills. By implementing ethno-STEM through the RE-STEM Application, teachers can help students to investigate scientific concepts in ethnoscience.
12.	[56]	8th grade junior high school students in Muaro Jambi Regency	Tangkul/anco, Kajang Lako stilt house, and wooden pulley	Simple Machines	Model pembelajaran discovery	The application of ethnoscience learning integrated with the discovery model has a significant influence on students' scientific literacy.
13.	[57]	Senior High School	Traditional Banjar food	-	Model Project Based Learning	Students' scientific literacy in both classes increased from low to high categories. It is necessary to explore more extensively other ethnoscience elements to improve meaningful learning and students' scientific literacy.
14.	[58]	-	-	-	PjBL-ethnoSTEM	PjBL-ethnoSTEM applied to the experimental group can improve science literacy

No	Authors (Year)	Research Subject	Ethnoscience Content	Science Concept	Learning Model	Result
						better than learning carried out in the control group.
15.	[59]	Junior High School	-	Solar system	-	The use of pop-up books containing ethnoscience is effective in improving students' scientific literacy in solar system material.

Table 4 shows that there are 15 studies that examine the application of ethnoscience to improve science literacy by integrating various learning models such as Contextual Teaching and Learning (CTL), Contextual Collaborative Learning Based Ethnoscience (CCLBE), Inquiry, Inquiry Based Learning (IBL), Guided Inquiry, Discovery, Thematic Learning based on ethnoscience, Project Based Learning (PJBL), RE-STEM and PJBL-ethnoSTEM. Furthermore, the materials used by previous researchers are related to the field of physics, namely sound waves, the solar system, simple machines, classification of matter and its changes. In the field of chemistry, there is a lot of discussion about acid-base material, buffer solutions, salt hydrolysis, and colloidal systems. In the field of biology, there is discussion about plant classification. Meanwhile, the ethnoscience studies that were studied studied more about ethnoscience on batik and traditional food.

The results of the study indicate that the ethnoscience approach can improve scientific literacy, but this literature study shows that the application of ethnoscience to regional culture studies more on physics material so that it is necessary to study other materials in the fields of chemistry, biology or integrated science. The results of the study also show that inquiry-based learning models are more widely used to improve students' scientific literacy.

3.2 Implementation of ethnoscience approach to improve critical thinking skills in science learning

Critical thinking skills are high-level thinking skills that need to be developed in students so that they can later be used to solve all problems by analyzing, solving problems, evaluating information, and then drawing conclusions systematically [60]–[63]. A person can think logically to solve a problem and can make rational decisions about what to do next [64]. Based on the literature review study that has been conducted, 166 articles have been selected from the Scopus database which shows that 9 articles discuss the application of the ethnoscience approach to improve students' critical thinking skills. The results of the literature study are presented in Table 5.

Table 5. Matrix of ethnoscience implementation to improve critical thinking skills in science learning

No	Authors (Year)	Research Subject	Ethnoscience Content	Science Concept	Learning Model	Result
1.	[65]	Students of class XI MIPA MA Negeri Gombong	Culture in Kebumen Regency such as dawet, lanting, Sempor Reservoir, and Sokka Roof Tiles.	Koloid	Direct instruction scientific learning model	The direct instruction scientific learning model with ethnoscience learning video media is effective in improving students' critical thinking skills on the concept of colloids.
2.	[66]	Pekalongan 1 High School and Semarang 1 State Islamic High School	Urea and Compost Fertilizer	Hidrolisis	PBL	The integration of problem-based learning, green chemistry, and ethnoscience has proven effective in helping students to be actively involved in the learning process, fostering conservative character, and improving students' conceptual mastery of

No	Authors (Year)	Research Subject	Ethnoscience Content	Science Concept	Learning Model	Result
						the topic of hydrolysis.
3.	[67]	Grade XII students at several high schools in Surakarta	Javanese people prohibit sleeping with their heads facing north	Magnetic field	Ethnoscience Learning	There are differences between the experimental class and the control class with the following details: objectives (15.83%), questions (13.63%), information (8.63%), point of view (13.98%), assumptions (5.08%), concepts (6.79%), conclusions (8.90%), and effectiveness (10.62%).
4.	[68]	Grade IV Elementary School Students in Jekulo District, Kudus Regency	Patiayam Site	Integrated science	Discovery Learning Model	The results of the critical thinking skills of the experimental group were higher than the results of the critical thinking skills of the control group.
5.	[69]	High School	Sipak Rago Game	Newton's laws of motion, work, energy, and momentum dan impuls	Integrated Guided Inquiry Learning Model Ethnoscience	E-modules based on Guided Inquiry integrated with Etnosains can improve students' critical thinking skills which are valid and can be used by students.
6.	[70]	Elementary school students in grade IV in Wedung, Demak Regency, Central Java, Indonesia	Salt production	Environment	-	The application of ethnoscience-based teaching materials is effective in improving critical thinking skills and interpersonal intelligence.
7.	[18]	University of Mataram (Unram) and Mandalika University of Education (Undikma), Indonesia	-	-	Inquiry-Creative Learning Integrated with Ethnoscience	There was a significant difference in CT skills between the two groups compared. The findings of this study emphasize that in relation to improving CT performance, teaching practices with creative inquiry learning integrated with ethnoscience are most effective in improving PSTs' CT skills.
8.	[71]	55 Prospective Science Teachers at Mandalika University of		Sound waves	Integrated ethnoscience inquiry learning model	There is a significant increase in critical thinking skills through a digital learning platform that combines ethnoscience and inquiry

No	Authors (Year)	Research Subject	Ethnoscience Content	Science Concept	Learning Model	Result
		Education (UNDIKMA)				learning models dynamically.
9.	[72]	Students in basic physics course	Gendang Beleq	Sound waves	Ethno-Project Based Learning	Hybrid e-PjBL integrated with virtual assistance technology has been effective in improving CT skills. Students' CT performance increased from "less critical" to "very critical" after implementing the learning approach, as evidenced by the high score obtained on the n-gain criterion.

Table 5 shows that there are 9 studies that examine the application of ethnoscience to improve critical thinking skills by integrating various learning models such as direct instruction scientific learning models, PBL, Discovery, Guided Inquiry, Inquiry-Creative Learning Integrated with Ethnoscience, Inquiry integrated with ethnoscience and Ethno-Project Based Learning. Furthermore, the materials used by previous researchers are related to the field of physics, namely sound waves, Newton's Law and magnetic fields. The results of the study show that the ethnoscience approach can improve critical thinking skills, but this literature study shows that the application of ethnoscience to improve critical thinking skills is more studied at the high school and college levels so that studies are needed at the elementary and junior high school levels.

This study also highlights that the ethnoscience approach has been implemented in several schools and universities. Previous research studies also highlighted that ethnoscience has an impact on improving scientific literacy and critical thinking skills. This study shows the potential for innovation and suggestions for further research that ethnoscience is one of the trending topics and the topics of culture, Indonesia, science learning, science literacy, local wisdom, e-learning, critical thinking, learning resource conservation and elementary schools and stem have not been widely carried out and can be a novelty in research. This study also shows that the ethnoscience approach can improve scientific literacy, but this literature study shows that the application of ethnoscience to regional culture studies more on physics material so that studies are needed on other materials in the fields of chemistry, biology or integrated science. The application of ethnoscience to improve critical thinking skills is studied more at the high school and college levels so that studies are needed at the elementary and junior high school levels.

4. CONCLUSION

Based on the results and discussion, it can be concluded that ethnoscience has become a research trend in the last ten years. Countries that have conducted a lot of research on ethnoscience are Indonesia, the United States, and Brazil. Zidny's research in 2020 was the research with the most citations and the researcher who discussed ethnoscience the most was Sudarmin. Based on the results of VOSviewer, 5 clusters were obtained and the latest research approaching 2022 to 2024 discussed ethnoscience, critical thinking, e-learning, critical thinking skills, teaching materials, elementary schools, science learning, scientific literacy, conservation. The keywords culture, Indonesia, science learning, science literacy, local wisdom, e-learning, critical thinking, learning resource conservation and elementary schools and stem have not been widely studied so that ethnoscience associated with these keywords can be a novelty for future research. This study also highlights that the implementation of ethnoscience in previous research has an impact on students' critical thinking skills and scientific literacy abilities. Based on this, researchers recommend that ethnoscience needs to be implemented at various levels of education, providing media innovations or teaching materials based on ethnoscience and studying in more depth the competencies that can be developed through an ethnoscience approach.

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REFERENCES

[1] J. Bernate, I. Fonseca, Z. García, M. Agudelo, and E. Zambrano, "Challenges And Technological Inclusion In Higher Education Of The 21st Century," *Rev. Gestão Soc. e Ambient.*, vol. 18, no. 6, pp. 1–13, 2024, doi: 10.24857/rgsa.v18n6-179.
[2] M. Dobryakova, I. Froumin, K. Barannikov, G. Moss, I. Remorenko, and J. Hautamäki, *Key Competences and New Literacies: From Slogans to School Reality*. switzerland: Springer Nature, 2023.
[3] W. E. Forum, *New Vision for Education : Fostering Social and Emotional Learning through Technology*, no. March. 2016.
[4] Harizon *et al.*, "Study of Correlation : Science Process Skills and Persistence Character of Middle School Students," *J. Mimb. Ilmu*, vol. 29, no. 1, pp. 23–31, 2024, doi: https://doi.org/10.23887/mi.v29i1.68267.
[5] T. N. Fitria, "Understanding Basic Literacy and Information Literacy for Primary Students," *J. Contemp. Issue Elem. Educ.*, vol. 1, no. 2, pp. 103–121, 2024.
[6] G. Triawang and E. Kurniawan, "The Effect of Digital Literacy Towards The Selection of Social Science Teacher Learning Media," *Pegem Egit. ve Ogr. Derg.*, vol. 11, no. 4, pp. 316–319, 2021, doi: 10.47750/pegegog.11.04.30.
[7] D. Darmaji, A. Astalini, D. A. Kurniawan, and E. F. Setiya Rini, "Gender analysis in measurement materials : Critical thinking ability and science processing skills," *JIPF Al-Biruni*, vol. 11, no. 1, pp. 113–128, 2022, doi: 10.24042/jipfalbiruni.v11i1.11509.
[8] I. Molderez and E. Fonseca, "The efficacy of real-world experiences and service learning for fostering competences for sustainable development in higher education," *J. Clean. Prod.*, vol. 172, pp. 4397–4410, 2018, doi: 10.1016/j.jclepro.2017.04.062.
[9] M. D. W. Ernawati *et al.*, "Do creative thinking skills in problem-based learning benefit from scaffolding?," *J. Turkish Sceince Educ.*, vol. 20, no. 3, pp. 399–417, 2023, doi: 10.36681/tused.2023.023.
[10] M. D. Wijayanti, S. B. Raharjo, S. Saputro, and S. Mulyani, "Identifying the Stud ent's Critic al Thinking Ability of PGSD in Accomplishing the Energy Material Problems," *Proceeding 2nd Int. Conf. Teach. Train. Educ. Sebel. Maret Univ.*, vol. 2, no. 1, pp. 695–701, 2016, [Online]. Available: jurnal.uns.ac.id/ictte/article/viewFile/6904/6148
[11] J. Jami, "Pengaruh Model Pembelajaran Group Investigation Terhadap Kemampuan Berpikir Kritis Siswa Pada Materi Kimia Unsur," *J. Eval. Educ.*, vol. 3, no. 2, pp. 49–54, 2022, doi: 10.37251/jee.v3i2.224.
[12] J. S. Sine, I. I. Pellokila, D. Sibulo, M. Adu, D. R. Sefi, and E. F. Nau, "Pelatihan Kompetensi Literasi dan Numerasi Guru Sebagai Penguatan Implementasi Kurikulum Merdeka Belajar," *Bubungan Tinggi J. Pengabdi. Masy.*, vol. 6, no. 1, p. 118, 2024, doi: 10.20527/btjpm.v6i1.10051.
[13] G. Ozdemir and A. Dikici, "Relationships between Scientific Process Skills and Scientific Creativity : Mediating Role of Nature of Science Knowledge," *J. Educ. Sci. Environ. Heal.*, vol. 3, no. 1, pp. 52–68, 2017.
[14] E. Suryawati and K. Osman, "Contextual learning: Innovative approach towards the development of students' scientific attitude and natural science performance," *Eurasia J. Math. Sci. Technol. Educ.*, vol. 14, no. 1, pp. 61–76, 2018, doi: 10.12973/ejmste/79329.
[15] A. Ramadina and L. Rosdiana, "Keterampilan Komunikasi Siswa Setelah Diterapkan Strategi Active Knowledge Ketika Pembelajaran Daring," *Pensa E-Jurnal Pendidik. Sains*, vol. 9, no. 2, pp. 247–251, 2021.
[16] Salafudin and N. Af'idah, "Validitas Media Tuas Pada Pembelajaran IPA Materi Pesawat Sederhana," *Discovery*, vol. 7, no. 2, pp. 66–71, 2022.
[17] N. N. S. P. Verawati, S. Prayogi, S. Gummah, A. Muliadi, and M. Y. Yusup, "The effect of conflict-cognitive strategy in inquiry learning towards pre-service teachers' critical thinking ability," *J. Pendidik. IPA Indones.*, vol. 8, no. 4, pp. 529–537, 2019, doi: 10.15294/jpii.v8i4.21002.
[18] N. N. S. P. Verawati, A. Harjono, Wahyudi, and S. Gummah, "Inquiry-Creative Learning Integrated with Ethnoscience : Efforts to Encourage Prospective Science Teachers' Critical Thinking in Indonesia," *Int. J. Learn. Teach. Educ. Res.*, vol. 21, no. 9, pp. 232–248, 2022, doi: 10.26803/ijlter.21.9.13.
[19] K. Aditia *et al.*, "Potential of local wisdom as an effort to prevent damage to forest resources," *J. Pendidik. Biol. Indones.*, vol. 10, no. 3, pp. 1171–1179, 2024, doi: 10.22219/jpbi.v10i3.34883.
[20] D. Juita and M. Yusmaridi, "The Concept of 'Merdeka Belajar' in the Perspective of Humanistic Learning Theory," *SPEKTRUM J. Pendidik. Luar Sekol.*, vol. 9, no. 1, pp. 20–30, 2021, doi: 10.24036/spektrumpls.v9i1.111912.
[21] D. W. Prabowo, Bramastia, Sarwanto, and J. Cohen, "Connecting Indigenous Knowledge of Keris with Science Through an Ethnoscience E-module : A Case Study in Surakarta, Indonesia," *J. Pendidik. Sains Indones. (Indonesian J. Sci. Educ.*, vol. 12, no. 3, pp. 693–704, 2024, doi: https://doi.org/10.24815/jpsi.v12i3.38652.
[22] B. Bramastia *et al.*, "Effectiveness of EthnoSTEM-Based Science Learning to Improve Junior High School Students' Science Literacy Ability," *J. Penelit. Pendidik. IPA*, vol. 9, no. SpecialIssue, pp. 332–337, 2023, doi: 10.29303/jppipa.v9ispecialissue.5710.
[23] N. A. I. Dini and E. F. S. Rini, "Integration of Local Potential in Science Learning to Improve 21st-Century Skills," *IJCER*, vol. 8, no. 2, pp. 157–165, 2024, doi: 10.20885/ijcer.vol8.iss2.art9.
[24] F. Rahmawati and I. R. W. Atmojo, "Analisis Media Digital Video Pembelajaran Abad 21 Menggunakan Aplikasi Canva pada Pembelajaran IPA," *J. Basicedu*, vol. 5, no. 6, pp. 6271–6279, 2021, doi: 10.31004/basicedu.v5i6.1717.
[25] S. E. Atmojo, B. D. Lukitoaji, and T. Muhtarom, "Improving Science Literation and Citizen Literation Through Thematic Learning Based on Ethnoscience," *J. Phys. Conf. Ser.*, vol. 1823, pp. 1–6, 2021, doi: 10.1088/1742-6596/1823/1/012001.
[26] S. W. Ningtiasih, "Analisis Permainan Tradisional Daerah Kabupaten Sarolangun," *J. Eval. Educ.*, vol. 2, no. 4, pp. 125–133, 2021, doi: 10.37251/jee.v2i4.241.
[27] N. Donthu, S. Kumar, D. Mukherjee, N. Pandey, and W. Marc, "How to conduct a bibliometric analysis : An overview and guidelines," *J. Bus. Res.*, vol. 133, no. April, pp. 285–296, 2021, doi: 10.1016/j.jbusres.2021.04.070.
[28] D. Fahrudin, S. Saputro, and Sarwanto, "Ethnoscience In Science Learning Research Trend : A Systematic Literature Review From 2013-2022," *J. Penelit. Pendidik. IPA*, vol. 9, no. 8, pp. 458–467, 2023, doi: 10.29303/jppipa.v9i8.3813.

[29] Busro, A. Mailana, and A. Sarifudin, "Pendidikan Islam dalam Publikasi Internasional: Analisis Bibliometrik pada Database Scopus," *Edukasi Islam. J. Pendidik. Islam*, vol. 10, no. 01, pp. 413–426, 2021.
[30] R. Zidny, J. Sjöström, and I. Eilks, "A Multi-Perspective Reflection on How Indigenous Knowledge and Related Ideas Can Improve Science Education for Sustainability," *Sci. Educ.*, vol. 29, pp. 145–185, 2020, doi: 10.1007/s11191-019-00100-x.
[31] B. T. Wilder, C. O. Meara, L. Monti, and G. P. Nabhan, "The Importance of Indigenous Knowledge in Curbing the Loss of Language and Biodiversity," *Bioscience*, vol. 66, no. 6, pp. 499–509, 2016, doi: 10.1093/biosci/biw026.
[32] R. A. Fasasi, "Effects of ethnoscience instruction, school location, and parental educational status on learners' attitude towards science," *Int. J. Sci. Educ.*, vol. 39, no. 5, pp. 548–564, 2017, doi: 10.1080/09500693.2017.1296599.
[33] C. A. Dewi, Y. Khery, and M. Erna, "An Ethnoscience Study In Chemistry Learning to Develop Scientific Literacy," *J. Pendidik. IPA Indones.*, vol. 8, no. 2, pp. 279–287, 2019, doi: 10.15294/jpii.v8i2.19261.
[34] N. Suprapto, B. K. Prahani, and T. H. Cheng, "Indonesian curriculum reform in policy and local wisdom: Perspectives from science education," *J. Pendidik. IPA Indones.*, vol. 10, no. 1, pp. 69–80, 2021, doi: 10.15294/jpii.v10i1.28438.
[35] C. A. Dewi, M. Erna, Martini, I. Haris, and I. N. Kundera, "Effect of Contextual Collaborative Learning Based Ethnoscience to Increase Student's Scientific Literacy Ability," *J. Turkish Sci. Educ.*, vol. 18, no. 3, pp. 525–541, 2021, doi: 10.36681/tused.2021.88.
[36] E. Rodrigues *et al.*, "Participatory ethnobotany and conservation : a methodological case study conducted with quilombola communities in Brazil ' s Atlantic Forest," *J. Ethnobiol. Ethnomed.*, vol. 16, no. 2, pp. 1–12, 2020, [Online]. Available: https://ethnobiomed.biomedcentral.com/articles/10.1186/s13002-019-0352-x
[37] A. K. Munk, A. G. Olesen, and M. Jacomy, "The Thick Machine : Anthropological AI between explanation and explication," *Big Data Soc.*, vol. January-Ju, pp. 1–14, 2022, doi: 10.1177/20539517211069891.
[38] P. Parmin, S. Sajidan, A. Ashadi, S. Sutikno, and F. Fibriana, "Science Integrated Learning Model To Enchance The Scientific Work Independence of Student Teacher In Indigenous Knowledge Transformation," *J. Pendidik. IPA Indones.*, vol. 6, no. 2, pp. 365–372, 2017, doi: 10.15294/jpii.v6i2.11276.
[39] S. Sudarmin, R. Febu, M. Nuswowati, and W. Sumarni, "Development of Ethnoscience Approach in The Module Theme Substance Additives to Improve the Cognitive Learning Outcome and Student ' s entrepreneurship," *J. Phys. Conf. Ser. Pap.*, vol. 824, 2017, doi: 10.1088/1742-6596/755/1/011001.
[40] A. D. Lightner, C. Heckelsmiller, and E. H. Hagen, "Ethnoscientific expertise and knowledge specialisation in 55 traditional cultures," *Evol. Hum. Sci.*, vol. 3, no. e37, pp. 1–28, 2021, doi: 10.1017/ehs.2021.31.
[41] H. N. Hidaayatullaah, N. Suprapto, E. Hariyono, B. K. Prahani, and D. Wulandari, "Research Trends on Ethnoscience based Learning through Bibliometric Analysis : Contributed to Physics Learning Research," *J. Phys. Conf. Ser.*, vol. 2110, pp. 1–8, 2021, doi: 10.1088/1742-6596/2110/1/012026.
[42] N. Suprapto, B. K. Prahani, and U. A. Deta, "Research Trend on Ethnoscience through Bibliometric Analysis (2011-2020) and The Contribution of Indonesia," *Libr. Philos. Pract.*, pp. 1–17, 2021.
[43] M. C. Sotero *et al.*, "Local and scientific knowledge in the school context : characterization and content of published works," *J. Ethnobiol. Ethnomed.*, vol. 16, no. 23, pp. 1–28, 2020, [Online]. Available: https://ethnobiomed.biomedcentral.com/articles/10.1186/s13002-020-00373-5
[44] W. Sumarni, Z. Faizah, B. Subali, and W. Wiyanto, "The urgency of religious and cultural science in STEM education : A meta data analysis," *Int. J. Eval. Res. Educ.*, vol. 9, no. 4, pp. 1045–1054, 2020, doi: 10.11591/ijere.v9i4.20462.
[45] R. P. Situmorang, "Integrasi Literasi Sains Peserta Didik dalam Pembelajaran Sains," *Satya Widya*, vol. 32, no. 1, pp. 49–56, 2016.
[46] E. F. S. Rini, S. B. Rahardjo, and B. Bramastia, "Analisis Bibliometrik : Bagaimana Tren Penelitian Literasi Sains dalam Pembelajaran Sains Tahun 2014-2024 ?," *Semin. Nas. pembelajaran Mat. sains dan Teknol.*, vol. 4, pp. 242–251, 2024, [Online]. Available: http://e-jurnal.fkip.unila.ac.id/index.php/SINAPMASAGI/article/view/821/387
[47] N. S. Melyasari, S. Suyatno, and W. Widodo, "The Validity of Teaching Material Based on Ethnoscience Batik to Increase the Ability of Scientific Literacy for Junior High School The Validity of Teaching Material Based on Ethnoscience Batik to Increase the Ability of Scientific Literacy for Junior," *J. Phys. Conf. Ser.*, vol. 1108, pp. 1–7, 2018, doi: 10.1088/1742-6596/1108/1/012126.
[48] C. A. Dewi, Y. Khery, and M. Erna, "An ethnoscience study in chemistry learning to develop scientific literacy," *J. Pendidik. IPA Indones.*, vol. 8, no. 2, pp. 279–287, 2019, doi: 10.15294/jpii.v8i2.19261.
[49] S. E. Atmojo, W. Kurniawati, and T. Muhtarom, "Science Learning Integrated Ethnoscience to Increase Scientific Literacy and Scientific Character," *J. Phys. Conf. Ser.*, vol. 1254, pp. 1–6, 2018, doi: 10.1088/1742-6596/1254/1/012033.
[50] P. W. Hastuti, W. Setianingsih, and E. Widodo, "Integrating Inquiry Based Learning and Ethnoscience To Enhance Students' Scientific Skills and Science Literacy," *J. Phys. Conf. Ser.*, vol. 1387, pp. 1–6, 2019, doi: 10.1088/1742-6596/1387/1/012059.
[51] Sarwi, Alim, S. Fathonah, and B. Subali, "The analysis of ethnoscience-based science literacy and character development using guided inquiry model," *J. Phys. Conf. Ser.*, vol. 1567, pp. 1–6, 2020, doi: 10.1088/1742-6596/1567/2/022045.
[52] D. Nurcahyani, Yuberti, Irwandani, H. Rahmayanti, I. Z. Ichsan, and M. M. Rahman, "Ethnoscience learning on science literacy of physics material to support environment : A meta-analysis research," *J. Phys. Conf. Ser.*, vol. 1789, pp. 1–6, 2021, doi: 10.1088/1742-6596/1796/1/012094.
[53] A. Rusilowati, Sundari, and P. Marwoto, "Development of integrated teaching materials vibration, wave and sound with ethnoscience of bundengan for optimization of students' scientific literation," *J. Phys. Conf. Ser.*, vol. 1918, pp. 1–7, 2021, doi: 10.1088/1742-6596/1918/5/052057.
[54] Y. Mulyono, S. Sapuadi, Y. Yuliarti, and S. Sohnui, "A framework for building scientific literacy through an inquiry learning model using an ethnoscience approach," *Int. J. Adv. Appl. Sci.*, vol. 11, no. 8, pp. 158–168, 2024, doi:

https://doi.org/10.21833/ijaas.2024.08.017.
[55] B. Subali, Z. Faizah, and M. Sidiq, "Indonesian national assessment support : Can RE-STEM Android app improve students' scientific literacy skills?," *Int. J. Eval. Res. Educ.*, vol. 12, no. 3, pp. 1399–1407, 2023, doi: 10.11591/ijere.v12i3.24794.
[56] Jufrida, W. Kurniawan, and F. R. Basuki, "Ethnoscience learning: how do teacher implementing to increase scientific literacy in junior high school," *Int. J. Eval. Res. Educ.* , vol. 13, no. 3, pp. 1719–1730, 2024, doi: 10.11591/ijere.v13i3.26180.
[57] A. Sholahuddin, N. Hayati, R. Iriani, P. Saadi, and E. Susilowati, "Project-based learning on ethnoscience setting to improve students' scientific literacy," *AIP Conf. Proc.*, vol. 2330, no. 1, p. 20051, Mar. 2021, doi: 10.1063/5.0043571.
[58] W. Sumarni, S. Wahyuni, and Sulhadi, "The effect of application of ethno-STEM integrated project-based learning on increasing students' scientific literacy," *AIP Conf. Proc.*, vol. 2614, no. 1, p. 30039, Jun. 2023, doi: 10.1063/5.0126208.
[59] A. Fridayanti and M. Khusniati, "The effectiveness of pop-up books containing ethnoscience on increasing students' scientific literacy on the material of the solar system," *AIP Conf. Proc.*, vol. 2614, no. 1, p. 20036, Jun. 2023, doi: 10.1063/5.0127038.
[60] A. F. Islamiah, S. Rahayu, and N. N. S. P. Verawati, "Efektivitas Model Pembelajaran Problem Based Learning Berbantuan LKS Terhadap Kemampuan Berpikir Kritis Fisika Siswa SMAN 1 Lingsar Tahun Ajaran 2016 / 2017," *Lensa J. Kependidikan Fis.*, vol. 6, no. 1, pp. 29–36, 2018, [Online]. Available: journal.publication-center.com/index.php/ijse/article/view/1649/422
[61] M. Diana and P. Fadillah, "Analisis Penerapan Model Pembelajaran Group Investigation Dan Pengaruhnya Terhadap Kemampuan Berpikir Kritis Siswa pada Materi Kimia Unsur di Kelas XII MIA SMAN 5 Kota Jambi," *J. Eval. Educ.*, vol. 3, no. 4, pp. 108–113, 2022, doi: 10.37251/jee.v3i4.286.
[62] D. Herlo, E. Ambrosio, and P. Galcheva, "Analysis of the Application of the Group Investigation Learning Model and Its Influence on Students ' Critical Thinking Abilities on Chemical Elements in Eastern Europe," *J. Eval. Educ.*, vol. 4, no. 4, pp. 144–150, 2023, doi: 10.37251/jee.v4i4.785.
[63] E. Purwanti, "Korelasi Keterampilan Proses Sains dengan Kemampuan Berpikir Kritis Siswa pada Materi Pemantulan pada Cermin Datar," *J. Eval. Educ.*, vol. 1, no. 4, pp. 143–148, 2020, doi: 10.37251/jee.v1i4.146.
[64] S. N. Aisyah, Kosim, Gunawan, and I. W. Gunada, "The Effect of Problem-Based Learning Model Assisted by PhET Media on Students' Critical Thinking Skills," *Indones. J. STEM Educ.*, vol. 6, no. 2, pp. 86–101, 2024.
[65] S. Sudarmin, S. Mursiti, and A. G. Asih, "The use of scientific direct instruction model with video learning of ethnoscience to improve students ' critical thinking skills," *J. Phys. Conf. Ser. Ser.*, vol. 1006, pp. 1–7, 2018, doi: 10.1088/1742-6596/1006/1/012011.
[66] L. Zahro, R. S. E. Pujiastuti, R. Asyhar, and A. Rosita, "The Development of PBL-Based Worksheets Integrated with Green Chemistry and Ethnoscience to Improve Students' Thinking Skills," *J. Pendidik. IPA Indones.*, vol. 8, no. 4, pp. 492–499, 2019, doi: 10.15294/jpii.v8i4.17546.
[67] Y. Y. Gunawan, Sarwanto, and F. Nurosyid, "The analysis of students' critical thinking skill through ethnoscience instruction integrated on the topic of magnetic field?," *AIP Conf. Proc.*, vol. 2194, no. January 2023, 2024, doi: 10.1063/1.5139765.
[68] Rihayati, S. Utaminingsih, and Santoso, "Improving Critical Thinking Ability Through Discovery Learning Model Based on Patiayam Site Ethnoscience," *J. Phys. Conf. Ser.*, vol. 1823, pp. 1–8, 2021, doi: 10.1088/1742-6596/1823/1/012104.
[69] R. Kurniawan and Syafriani, "The validity of e-module based on guided inquiry integrated ethnoscience in high school physics learning to improve students' critical thinking," *J. Phys. Conf. Ser.*, vol. 1876, pp. 1–7, 2020, doi: 10.1088/1742-6596/1876/1/012067.
[70] S. Sarwi, G. Nisa, and B. Subali, "An analysis of critical thinking skill and interpersonal intelligence in the development of ethnoscience-based teaching material salt production," *J. Phys. Conf. Ser.*, vol. 1918, pp. 1–7, 2021, doi: 10.1088/1742-6596/1918/5/052060.
[71] S. Prayogi, N. Nyoman, and S. Putu, "Dynamic blend of ethnoscience and inquiry in a digital learning platform (e-learning) for empowering future science educators' critical thinking," *J. Educ. e-Learning Res.*, vol. 10, no. 4, pp. 819–828, 2023, doi: 10.20448/jeelr.v10i4.5233.
[72] W. Wahyudi, N. Nyoman, S. Putu, I. Islahudin, and S. Agustina, "Hybrid Ethno-Project Based Learning Integrated With Virtual Assistive Technology to Enhance Students' Critical Thinking in Fundamental Physics Course," *TEM J.*, vol. 12, no. 4, pp. 2006–2012, 2023, doi: 10.18421/TEM124.