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ETNO-STEM DALAM PEMBELAJARAN IPA : A SYSTEMATIC LITERATURE REVIEW

Ethno-STEM In Science Learning In Indonesia: A Systematic Literature Review

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INFORMASI ARTIKEL

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Ethno-STEM, Science Learning, Literature Review

Kata kunci: *Ethno-STEM, Pembelajaran IPA, Literature Review*

ABSTRACT:

Ethno-STEM research is the latest research in Indonesia. This is motivated by the socio-cultural diversity that is owned by Indonesia. This research is a systematic literature study that identifies ethno-STEM research trends in science learning (science, physics, chemistry, and biology) at each level of education. Based on the data obtained, the trend of Ethno-STEM research is dominated by development research (4D, ADDIE, Bolg and Gall, and R&D). the trend of research topics is more related to the development of Ethno-STEM-based teaching materials in science learning. The variables that are widely measured are the increase in creative thinking skills, learning outcomes, and scientific knowledge.

ABSTRAK

Penelitian etno-STEM merupakan penelitian terbaru di Indonesia. Hal ini dilatarbelakangi oleh keragamaan sosial budaya yang dimiliki oleh Indonesia. Penelitian ini merupakan penelitian studi literatur sistematis yang mengidentifikasi tren penelitian etno-STEM dalam

pembelajaran IPA (sains, fisika, kimia dan biologi) pada setiap tingkat pendidikan. Berdasarkan data yang diperoleh, trend penelitian Etno-STEM didominasi oleh penelitian pengembangan (4D, ADDIE, Bolg and Gall dan R&D). trend topik penelitian lebih banyak terkait dengan pengembangan bahan ajar berbasis Etno-STEM dalam pembeljaran IPA. Variabel yang banyak diukur adalah peningkatan kemampuan berfikir kreatif, hasil belajar dan pengetahuan sains.

INTRODUCTION

The development of the 21st century is marked by the development of technology, communication, and information as well as ease of access in terms of life. This development touches all aspects of people's lives, both in terms of social, economic, and educational. The development of the 21st century also demands higher human resources. Higher competencies are also presented in social life (Daryanto and Karim, 2017). So that this problem becomes an important homework for the world of education in preparing competent future generations to face the challenges of life in the 21st century.

Based on the TIMSS Science Framework (2019), students must be able and proficient in scientific practice to increase and develop knowledge and understanding of how scientific endeavors are carried out. This practice includes skills acquired from everyday life and systematic classroom learning. This practice is essential for all scientific disciplines. In this case, Indonesia is required to participate in producing human resources that can compete in the 21st century. To be able to achieve the world's demands, great efforts are needed to improve human resources in Indonesia, especially through education.

Since 2000, Indonesia has participated in an international level assessment program that measures the level of ability and skills of students in dealing with real-world problems, namely PISA (Program for International Student Assessment). PISA aims to provide indicators of the effectiveness and equity of the education system, education standards for international comparison, and monitoring educational progress (PISA, 2015). In this program, Indonesia is one of the countries with the lowest score, ranking 63 out of 72 participating countries in 2016 (OECD 2016). This shows that the quality of education in

Indonesia is still low compared to other countries. If this continues, it will have an impact on the low quality of the graduates produced.

Based on these problems, a modern approach is needed that can develop 21st-century skills. One approach that can develop students' abilities is the STEM approach. STEM learning is learning that integrates science, mathematics, technology, and engineering principles (Gonzalez and Kuenzi, 2012). STEM learning can also grow the skills students need to face competition in the 21st century (Sumarni, 2018). The STEM approach is an approach that can create students who can face the challenges of life in the increasingly complex 21st century by developing problem-solving skills, critical thinking, creativity and innovation, systematic, and logic.

Indonesia is a country that has ethnic, cultural, and religious diversity (Lestari, 2016; Pitoyo and Triwahyudi, 2017). Socio-cultural diversity in Indonesia can be used as a strong reference in connecting local science knowledge with science learning. Science learning that relates to local culture is still very little done in Indonesia compared to western countries. Science learning can be seen from the cultural and scientific context by connecting indigenous culture, indigenous knowledge, and scientific knowledge (Nisaâ, A., Sudarmin, S., & Samini, 2015; Setiawan *et al.*, 2017).

Indigenous knowledge is the knowledge that comes from the community which can then be verified with literature studies and scientific explanations so that it can become an authentic source of science learning (Turiman *et al.*, 2012; Izzah, Sudarmin and Prasetyo, 2020). Original knowledge is related to ethnoscience which becomes interdisciplinary or transdisciplinary knowledge (Van Laar *et al.*, 2017) both in the fields of science, social, or mathematics. In line with the notion of ethnoscience, STEM learning is considered very suitable in teaching ethnoscience integrated science.

In the 2013 curriculum, science learning can be supported by linking culture and local wisdom in the local area (Kemendikbud, 2018). So Ethnoscience-based STEM learning (STEM-Ethno) can be an alternative for science teachers in teaching science concepts by linking original scientific knowledge with scientific science. Through ethnoscience-based STEM learning, students can develop an attitude of love for their own country's culture and character

values. In addition, students can also understand the natural events that are around them and relate them to the knowledge learned by students (Yuliana, 2017).

The implementation of ethnoscience-based STEM learning in science learning can be done with the help of technology. The use of technology in the 21st century is a necessity that cannot be separated from the learning process. Ethnoscience-based STEM learning packaging in the form of e-books, e-modules (Nadhifah and Muslih, 2017) or assisted by other technologies that can be done to improve the abilities of students in the 21st century. so that learning is more efficient, effective, and flexible to use both in terms of place and time (Perinpasingam *et al.*, 2014; Wijayanti, Ahmadi and Sarwi, 2019; Tresnawati *et al.*, 2021).

the researchers are interested in research related to the trend of implementing STEM-ethnoscience research in science learning. Knowing the trend of implementing STEM-Ethnoscience research can be a reference for researchers, teachers, and policymakers in schools in implementing STEM-Ethnoscience in science learning. Strengths and weaknesses of STEM-Ethnoscience learning can be seen and can be re-evaluated to realize better learning activities. The details of the research questions that guide the analysis process are as follows: (1) what topics are most explored in ETNO-STEM research?; (2) what methods are most often used in ETNO-STEM research?; (3) what is the pattern of ETNO-STEM integration in science learning?; (4) what are the dominant variables associated with ETNO-STEM?; (5) what research topics have the most potential to be developed in the future?

RESEARCH METHODS

This research is qualitative research using a content analysis approach with a systematic literature review technique to analyze trends in the implementation of Ethno-STEM research in science learning. A systematic literature review is a secondary research that combines findings from various primary studies to answer research questions (Newman and Gough, 2020). This study adopted the review process by Sharif, (2019), which is described as follows: (1) formulating research questions; (2) setting the inclusion criteria (Table 1); (3) searching for articles in various databases (Google Scholar, ERIC, DOAJ, journal websites) by typing the keywords

"STEM" "ethnoscience", indigenous knowledge", "Ethno-STEM" and "local wisdom"; (4) article coding using Paper Classification Form (PCF); (5) identify patterns across articles; (6) synthesize these patterns to answer the research question. The coding instrument resulting from the PCF adaptation was developed by Kızılaslan et al. (2012). The instrument has met the requirements of validity and reliability. The collected data were analyzed using percentage calculations.

Table 1. Inclusion Criteria for Ethno-STEM Articles

Category	Inclusion Criteria
Publication Type	Scientific articles published in journals and proceedings
Publication Year	2018-2021
Field of study	Science, physics, chemistry, and biology
Types of research	Empirical and conceptual
Research subject	Students and teachers at all levels of Education (Elementary School, Junior High School, High School, and College)

Based on the research objectives and the criteria for articles that can be used as data for this research, the researchers recruited 25 articles that were valid and could be analyzed as research data. the articles used as research data are ethno-stem articles in science learning (physics, biology, chemistry and science)

RESULT AND DISCUSSION

This study analyzes 25 recent articles related to Ethno-STEM research in science learning in the last 5 years, 2018-2021. This study looks at the trend of ethno-STEM research in science learning. Details of the analysis of Ethno-STEM research in science learning can be seen in table 2.

Table 2. Analysis of Ethno-STEM Research in Science Learning in 2018-2021

No.	Trend Category	Article Code	Amount	Percentage
		Types of research		
1	Quantitative	ES01, ES05, ES18, ES21	4	16
2	Qualitative	ES03, ES08, ES09, ES10, ES11, ES16, ES19, ES20, ES24, ES25	10	40
3	Development		11	44
	- R&D	- ES02, ES12, ES17		
	- Ball and Gall	- ES07, ES6		
	- ADDIE	- ES14, ES15, ES22, ES23		
	- 4D	- ES04, ES13		
		Ethnoscience Topic		
5	Batik	ES02, ES06, ES09, ES10, ES16, ES17, ES19, ES25	8	33.3
6	Limestone burning by collectors (cohort stones)	ES01, ES20	2	8.3

7	Water Treatment Topic Using Moringa (Moringa oleifera)	ES03	1	4.2
8	the process of making candied carica and its impact on water quality	ES07	1	4.2
9	Essential oil manufacture	ES08, ES18	2	8.3
10	Nginang Culture	ES11	1	4.2
11	Brebes Terasi Production, Kendal Fish Smoking Process, and Juwana Milkfish Cultivation	ES13	1	4.2
12	Jamu turmeric tamarind	ES12	1	4.2
13	Rimbo larangan	ES15	1	4.2
14	Beduk	ES23	1	4.2
15	Traditional Salt Process	ES20, ES24	1	4.2
16	Soka tile production process	ES20	1	4.2
17	Production of anto crackers (fried crackers with hot sand)	ES20	1	4.2
18	Removing the scale on the heating kettle	ES20	1	4.2
19	Traditional food production (making tofu and grass jelly)	ES20	1	4.2
		Integration Form		
20	Ethno-STEM PJBL	ES17, ES18, ES19, ES20, ES21	5	62.5
21	Etno-STEM model inkuiri	ES12	1	12.5
22	Etno-STEM model Hybrid	ES13	1	12.5
23	Etno-STEM Living Value Education	ES24	1	12.5
	Dependent variable			
24	Learning outcomes	ES01, ES11	2	8.33
25	Student generic ability	ES01	1	4.17
26	HOTS	ES05, ES08	2	8.33
27	Creative Thinking Ability	ES06, ES09, ES20, ES23	4	16.67
28	Understanding Science Concepts	ES06, ES21	2	8.33
29	Problem solving skill	ES13, ES21	2	8.33
30	Innovative thinking skills	ES09, ES20	2	8.33
31	STEM Literacy	ES15	1	4.17
32	Motivation	ES15	1	4.17
33	Science knowledge	ES10,ES11, ES15, ES16, ES17	5	20.83
34	Entrepreneurial Character	ES18, ES19	2	8.33
	Research Topic			
35	Learning model	ES01, ES03, ES12, ES17, ES18, ES19, ES20, ES21	8	32
36	Material Teaching	ES04, ES07, ES14, ES15, ES22, ES23, ES24	7	28
37	Evaluation and assessment	ES06	1	4
38	Learning Instruments	ES13	1	4
39	Approach	ES02, ES05, ES08, ES09, ES10, ES11, ES16, ES25	8	32

Based on the findings of the researcher, Ethno-STEM research is suitable to be carried out in Indonesia because of the Indonesian background which has a diverse socio-cultural background and can improve creative, innovative (Sudarmin *et al.*, 2020), analytical thinking skills needed by students in facing the challenges of the 21st century. This means that the scientific knowledge of the local community can be studied scientifically and can be used as teaching material by teachers in understanding science concepts in class. Ethno-STEM studies are still not

widely carried out in Indonesia. This can be seen from the distribution of Ethno-STEM research data in 2018-2021 which can be seen in Figure 1.

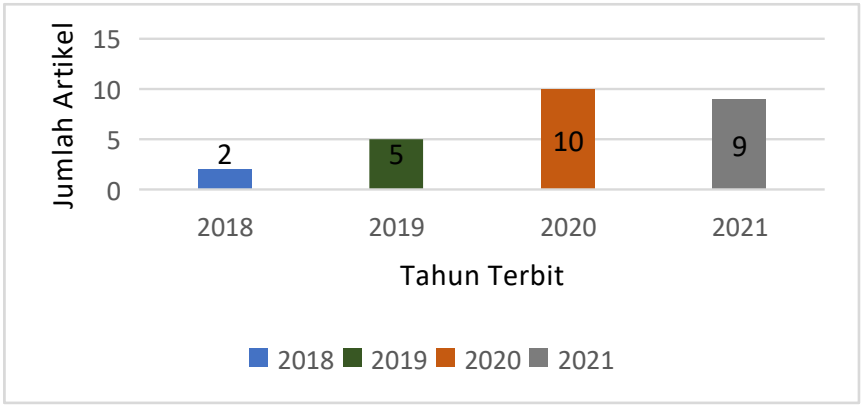

Figure 1. Distribution of Ethno-STEM Research Data in Science Learning in 2018-2021

Based on Figure 1. it can be seen that Ethno-STEM Research has increased from year to year. however, researchers found that by 2021 there would be a decline in ethno-STEM-related research. The decline in this research is based on the lack of research related to ethno-STEM in learning and teacher constraints when applying Ethno-STEM in science learning. It can be concluded that the interest of researchers with the Ethno-STEM approach is very high. The Ethno-STEM approach supports students more easily in understanding science concepts because the science concepts presented are in the form of integrating local culture that is close to students' lives in the science knowledge taught in schools. Students will feel more enthusiastic about learning and learning will be more meaningful. meaning that the integration of local culture in science learning can be one solution to the problems found in the science learning process ((Mulbar and Bahri, 2021; Syazali and Umar, 2022).

Learning that is presented with concepts that are close to students' daily lives will make students more active in learning. Student activity will also have an impact on the level of student understanding and student learning outcomes in understanding

science concepts. Science learning has been viewed by students as difficult, so with the ethno-STEM approach, it is hoped that it will be easier and more enjoyable for students. In addition, the integration of the ethno-STEM approach can also be done with the 21st-century learning model. the integration of ethno-STEM with 21st-century learning models can also support the improvement of 21st-century skills that students must possess. As a form of preparing students to face the times and technology.

STEM Research Topics

STEM research in Indonesia is conducted on various topics. Table 2 shows that the topic of learning models (found in the article Harto *et al.*, 2019; S. Sudarmin, Sumarni, *et al.*, 2019; Sudarmin, Kurniawan, *et al.*, 2019; Sudarmin, Sumarni, *et al.*, 2019; Azalia, Sudarmin and Wisnuadi, 2020; Sumarni and Kadarwati, 2020; Semarang, Diliarosta and Padang, 2021; Tresnawati *et al.*, 2021) and approaches (32%) (found in the article (Sudarmin *et al.*, 2018, 2020; Sudarmin, Sumarni and Mursiti, 2019; Izzah, Sudarmin and Prasetyo, 2020; Qori *et al.*, 2020; S. Sudarmin *et al.*, 2020; Tresnawati *et al.*, 2020; Anugrah, 2021) dominates ethno-STEM research, followed by evaluation and assessment (4%) (found in the article Izzah *et al.*, 2020), and learning instruments (4%) (found in the article Reffiane *et al.*, 2021) as shown in Figure 2. These findings are generally in line with the trend of Science education research during 2016-2021 published in Scopus indexed journals and conferences, which mainly focuses on the topic of learning contexts (Lin *et al.*, 2019). In addition, the current trend of Indonesian ethno-STEM research is also in line with international trends, which are dominated by goals, policies, curriculum, evaluation, and assessment (Li *et al.*, 2020).

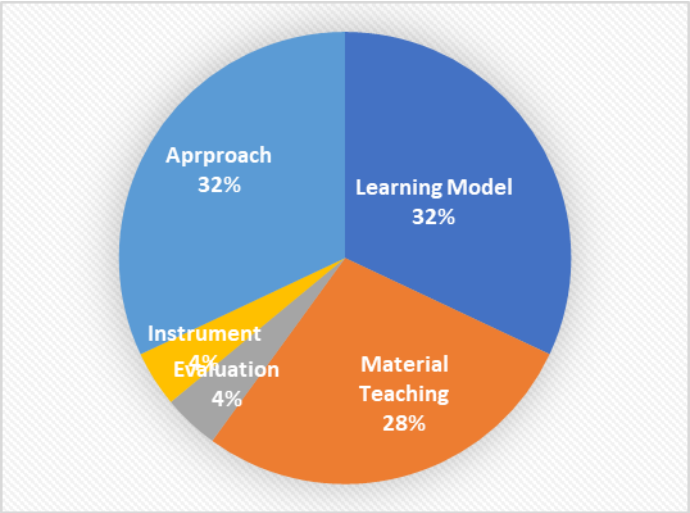

Figure 2. Percentage of Ethno-STEM Research Topic Distribution in Science Learning

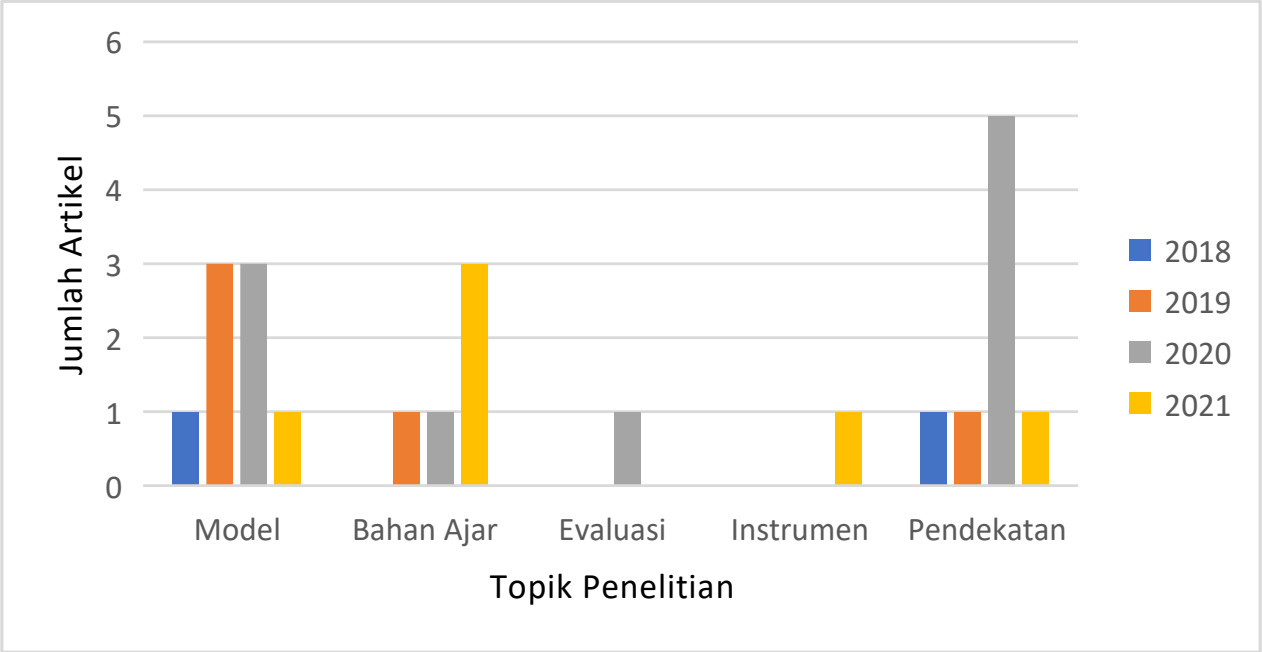

Figure 3. Ethno-STEM Research Topics Each Year

Figure 3 shows that the attention of ethno-STEM research is new research in Indonesia (Ni'mah, 2019). As a result, Kizilaslan, Sozbilir and Yasar, (2012) stated that it is not surprising that Ethno-STEM research began with fundamental topics in curriculum reform that focused on approaches and models of learning and the development of teaching materials. Figure 3 also shows that the ethno-STEM research conducted in Indonesia is still relatively small every year. Ethno-STEM research focuses more on ethno-STEM approaches and models in science

learning. As for the evaluation and instrument very few. Whereas evaluation and instruments also have an important role in achieving the success of the learning process (Ramdani *et al.*, 2019). Instruments that are not qualified or unable to measure students' abilities will result in wrong interpretations so the evaluation process will be difficult to carry out. The wrong evaluation results will have an impact on the next learning process.

Based on this data, it is hoped that further researchers will also be interested in conducting research and development related to instruments in Ethno-STEM learning to realize a better science learning process. Ethno-STEM learning can be one of the teacher's choices in developing students' scientific abilities in the classroom.

STEM Research Methods

A current systematic literature review reveals development research methods (R&D, 4D, Borg and Gall, and ADDIE) as a trend in Ethno-STEM research as much as 44%, followed by qualitative (40%) and quantitative (16%). The percentage of data on Ethno-STEM research methods in science learning can be seen in Figure 4. Trends in research methods are also influenced by trends in research topics, most of which are the development of teaching materials and evaluation.

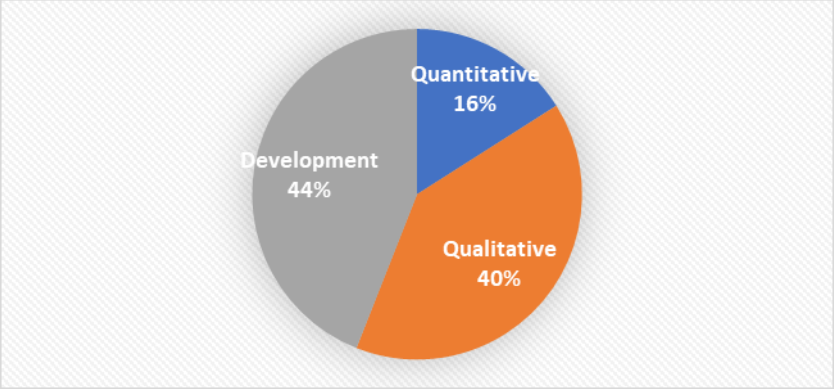

Figure 4. Percentage of Ethno-STEM Research Method Distribution in Science Learning

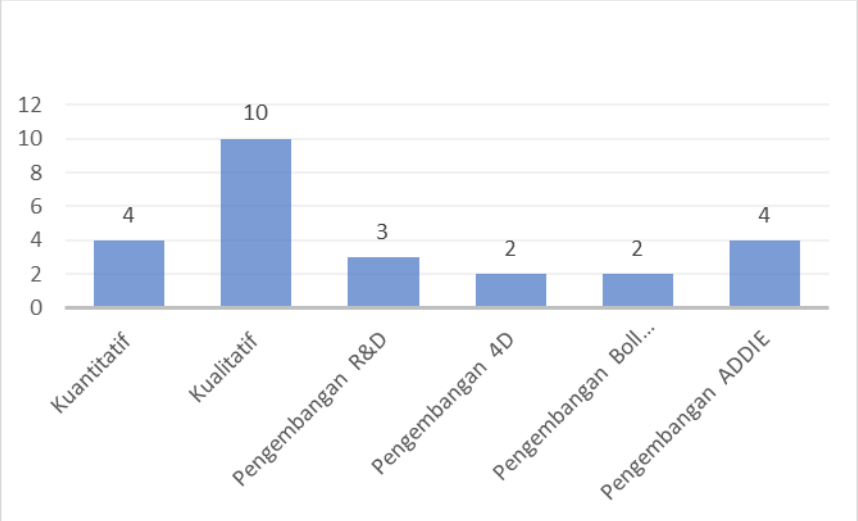

Figure 5. Ethno-STEM Research Methods in Science Learning

Figure 5 shows that Ethno-STEM research is still focused on development research, both the development of teaching materials, models, approaches, and reviewing original scientific knowledge and scientific knowledge. However, ethno-STEM research must also be able to measure the 21st-century skills that have been compiled by researchers. To be able to determine the effectiveness of the Ethno-STEM approach in science learning, research is needed in the form of implementation to students, prospective teachers, and teachers in teaching the Ethno-STEM approach. Implementation can also be carried out at every level of education (elementary, junior high, high school, and university) to see how big the influence of ethno-STEM is in science learning.

The next researcher can conduct further studies related to Ethno-STEM in its level of effectiveness in developing and improving the skills needed by students in the 21st century.

The pattern of Ethno-STEM Integration in science learning

The integration of Ethno-STEM learning is also carried out in the science learning process. The application of Ethno-STEM is carried out by integrating it with a learning model that is in accordance with the ethno-STEM learning criteria. The pattern of integration can be seen from the analysis of the articles that the researchers did. Details of the pattern of Ethno-STEM integration in science learning are presented in Figure 6.

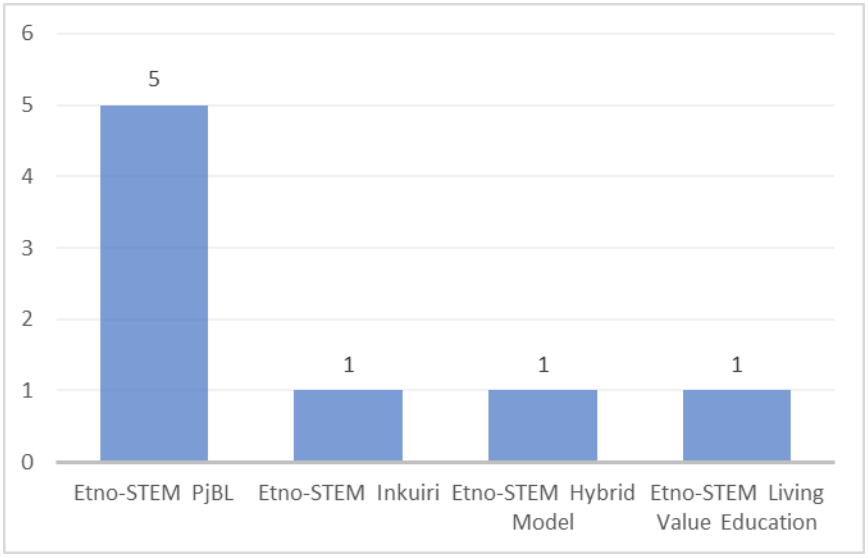

Figure 6. The pattern of Ethno-STEM integration in science learning

the findings from the analysis that the researchers did, the researchers did a lot of integrating Ethno-STEM with the PjBL model (Ethno-STEM Pjbl). Based on the ethno-STEM criteria, it is very suitable to be integrated with project based learning in supporting the science learning process. The trend of applying Ethno-STEM research in Indonesia supports the international trend which is dominated by experimental methods, followed by qualitative and mixed methods research (Li *et al.*, 2020). The application of Pjbl's Ethno-STEM in science learning can facilitate the development of 21st century skills needed by students. In addition to Pjbl, integration is also carried out with inquiry learning models, hybrids, living value education.

STEM Related Variables

Ethno-STEM learning is always associated with certain variables in conducting Ethno-STEM-based research. Table 5 shows that learning outcomes, creative thinking skills, and knowledge of science dominate the variables that are widely measured, namely 20%. According to Yuliana *et al.*, (2021), the philosophy of education in Asia and western countries is much different, whereas the Asian orientation remains on academic learning outcomes. However, the Ethno-STEM research conducted in Indonesia is still in reviewing the original scientific knowledge and scientific knowledge contained in the local culture. This can be seen at the percentage level of ethno-STEM research of 20.83%.

Then followed by an increase in creative thinking skills (16.67%),

learning outcomes, concept understanding, problem-solving, HOTS, innovative thinking, and planting entrepreneurial character by 8.33%. while for generic abilities, STEM literacy and student motivation are 4.17%.

Table 3. Variables related to Ethno-STEM Research in Science Learning

Related Variables	Article code	Amount	Percentage
Learning outcomes	ES01, ES11	2	8.33
Student generic ability	ES01	1	4.17
Hots	ES05, ES08	2	8.33
Creative Thinking Ability	ES06, ES09, ES20, ES23	4	16.67
Understanding Science Concepts	ES06, ES21	2	8.33
Problem solving skill	ES13, ES21	2	8.33
Innovative thinking skills	ES09, ES20	2	8.33
STEM Literacy	ES15	1	4.17
Motivation	ES15	1	4.17
Science knowledge	ES10,ES11, ES15, ES16, ES17	5	20.83
Entrepreneurial Character	ES18, ES19	2	8.33

Based on the data in table 2 also shows that Ethno-STEM research has not measured much of the skills needed in the 21st-century. This is also inseparable from the lack of experimental research related to the implementation of the Ethno-STEM approach in science learning.

Recommendations for Future Ethno-STEM Research

Based on the trend data on the implementation of Ethno-STEM research in science learning, several topics have not been fully explored. The recommendations of researchers related to these findings are as follows: (1) the need for quantitative research to be able to determine the effectiveness of ethno-stem in science learning; (2) the development of ICT-based learning media in Ethno-STEM learning needs to be done to deal with the rapid development of technology; (3) development of teaching materials with broader local science such as local culture in each region; (4) Integrating the ethno-STEM approach with 21st-century learning models to help students improve the 21 timeless skills that students need in dealing with technological developments.

CONCLUSION

The implementation of STEM-Ethnoscience research in science learning has a very good contribution in growing and improving the skills students need in facing the challenges

of the 21st century. In addition, STEM-ethnoscience is suitable for use with the help of technology or e-learning conditions. Learning in the current state of the COVID-19 pandemic can be an option for schools and teachers to apply STEM-Ethnoscience so that they can realize the learning goals they want to achieve. The trend of applying STEM-Ethnoscience research in science learning in 2016-2021 is more dominated by the development of original knowledge into STEM-based science. Based on the findings of the researchers, it is hoped that it can become literature and views for teachers and future researchers in reviewing new research in STEM-based science learning so that it can help develop students' scientific competence.

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