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Ethno-STEM Research Trends Through Bibliometric Analysis on Science Learning in Elementary School

Nyi Mas Ayu Ratna Gumilar✉, Sudarmin, Putut Marwoto, Nanik Wijayati

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Universitas Negeri Semarang, Indonesia

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Abstract

The Ethno-STEM approach has not been widely developed, while the STEM approach has developed in many countries, including Indonesia. This study aims to 1) What are the results of visualization of bibliometric mapping on Ethno-STEM learning research trends, 2) Who are the authors who play a role in Ethno-STEM research, and 3) What are the implications of Ethno-STEM in science learning in elementary school. This study uses a descriptive method with a bibliometric analysis approach based on the Google Scholar database published in 2018-2022. The results of this study indicate that the implications of Ethno-STEM learning in science learning in elementary school can improve students' creative thinking skills by integrating HOTS (Higher Order Thinking Skill) learning models such as inquiry learning models, project based learning, and problem based learning that can support the skills of students in the 21st century.

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✉ Correspondence Author:
E-mail: nyimasayuratna25@gmail.com

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INTRODUCTION

The rapid development of science and technology (IPTEK) in the 21st century demands complex skills that students must possess. One of the goals of 21st century learning is to make students have practical communication skills and can collaborate (Muttaqiin et al., 2021)students are required to be active in processing knowledge so as to achieve learning objectives optimally. Contextual science learning will be more meaningful if it has a close relationship with the surrounding context. This research develops integrated science teaching materials with the Ethno-STEM Approach through ADDIE (Analysis, Design, Development, Implementation, and Evaluation. In the 21st century, learning uses a curriculum that combines aspects of knowledge with aspects of skills, aiming that students have the skills to answer challenges in the era of technological and information advancement (Wijaya et al., 2016). Priyani et al., (2020) suggests that these 21st century skills consist of several specific skills that will support an individual in facing challenges in the 21st century. Sumantri stated that the skills needed in the 21st century include: 1) learning innovation skills, 2) information skills, median and technology, and 3) life skills (Sartika et al., 2022).

Ethno-STEM is a learning approach based on local culture by connecting science concepts. STEM is by the objectives of the 2013 Curriculum in Indonesia, which emphasizes critical, creative, and innovative thinking skills, essential aspects of national development (Palopo, 2021). STEM education has received considerable attention because of its importance in the global economy (Adamuti-Trache & Sweet, 2014). STEM is an interdisciplinary learning approach between Science, Technology, Engineering, and Mathematics. The term STEM is popular in the world of education. It has even been recognized that mastering STEM knowledge and skills becomes a capital for every individual to face future challenges. STEM literacy is based on three learning domains: (1) cognitive, (2) effective, and (3) psychomotor from learning theory education (Zollman, 2012). The assessment review results by Gao et al. (2020) show that STEM education has received increasing attention in recent years and proposes developing assessments in STEM education programs. Ethno-STEM is a culture-based STEM or local wisdom that makes more use of the local culture in the STEM learning process. STEM is becoming popular among educators due to the increasingly global technology perspective of the 21st century (Ariyatun, 2021). Instead of isolating science, technology, engineering, and mathematics from one another, STEM training emphasizes original production and learning activities using research, design, problem solving, teamwork, and communication skills (Khoiri, 2019; Çetin, 2020).

Applying the STEM approach will also be more meaningful for students if learning is connected with the culture of the community (Andira, 2020). Something that students learn will be directly used in life and their environment. Different cultures in Indonesia's regions will affect how students think and learn. If learning is supported by things that are by the culture of students, then learning will be more meaningful and meaningful. The Ethno-STEM approach has not been widely developed, while the STEM approach has developed in many countries, including Indonesia (Sudarmin, Sumarni, et al., 2019). The local wisdom of certain cultural groups can certainly encourage developments in education and scientific research (Handriyan et al., 2018). Therefore, in science subjects, the Ethno-STEM approach can be carried out by teachers by integrating scientific concepts with real-world problems. In Ethno-STEM learning, students are expected to be able to apply their knowledge in the environment to solve problems, become logical thinkers, and link local wisdom culture with learning. They are very suitable to be implemented in 21st-century learning.

Learning science is a science that studies scientific phenomena with everything that exists in nature. Lederman states that science is a characteristic of scientific knowledge directly related to how knowledge is produced (Cofré et al., 2019). Science in school is often associated with specific content (facts to memorize) and an authoritative teaching approach (Hansson et al., 2020). Science as science is not just knowledge of facts, but can include concepts, principles, laws through observations and experiments that are systematically verified. Science learning requires students to be actively involved, which is implied in physical or mental activities (Yuliati et al., 2019). Science-based learning is expected to develop students' ability to adapt and compete in the 21st Century.

Ethno-STEM research is research related to scientific concepts embodied in the culture of a particular society that integrates these aspects of science, technology, engineering, and mathematics in discussing certain topics (Sudarmin, Kurniawan, et al., 2019). Ethno-STEM research is widely used in scientific research. The application of science is very much found in technol-

ogy products. It could be the opposite; science is found in the emergence of technological products. Several research results show that learning science in the context of technology and design can increase scientific literacy (NSTA, 2006). Students can interpret science's importance more deeply for technological development and vice versa. STEM (*Science, technology, engineering, and mathematics) education* is currently an *alternative* science learning that can build a generation that can face the challenging 21st century (Permanasari, 2016). Therefore, Ethno-STEM learning is very important to be applied in science learning (science).

The Ethno-STEM model in science learning strategies is effective for students and teachers during the pandemic. Ethno-STEM-based approaches, strategies, and learning models have not been widely used in elementary schools. Various learning methods can support the application of STEM. Integrative STEM allows various learning methods to be used to support its implementation. The use of local (ethnic) culture in culture-based learning is very beneficial for the meaning of learning processes and outcomes because students get contextual learning experiences (goat footbridge) and apperception materials to understand the concept of science in their local (ethnic) culture (Pieter, 2016). In addition, the model of integrating culture in learning can enrich the local (ethnic) culture, which in turn can also develop and strengthen the national culture, which is the peak of local culture and developing ethnic culture. Suastra found two local cultural influences that students in Penglipuran village (Bali) have on science learning in schools. First: a positive influence will appear if the science learning materials in schools being studied are by every day (cultural) knowledge (Darmadi, 2018). In this situation, the learning process supports the student's perspective on the world around him (inculturation), so learning can increase student understanding or make learning more meaningful. On the other hand, the science learning process becomes a "disruption" when the science subject matter in schools is not in harmony with their cultural background.

Students' understanding of science must be built through the basic education level so that as adults, they can make decisions related to various kinds of issues and can overcome these issues scientifically. To meet these needs, an effort is needed to prepare students with a significant proportion in the field of science and technology which is currently needed (Pertama, 2017). One of them is learning with an Ethno-STEM approach that teachers in 21st century learning can use. The purpose of compiling this article includes several sections, namely about trends in Ethno-STEM learning research in terms of bibliometric analysis in the last five five-years (2018-2022) and find out the latest research to be implemented into science learning in elementary school with three questions, including: a. What are the results of bibliometric mapping visualization on research trends in Ethno-STEM learning?; b. Who are the authors involved in Ethno-STEM research?; c. What are the implications of Ethno-STEM in science learning in elementary schools?

METHOD

This research method uses a descriptive method with a bibliometric approach. Bibliometrics aims to measure the progress of the publication of scientific articles and scientific contributions (Ahlgren et al., 2015). Bibliometric mapping will help convert publication metadata into maps or visualizations, which will benefit the scientific community and the public making it easier to manage and process into more useful insights, for example keyword visualization to identify research topics or clusters in various disciplines, author maps from a particular journal to identify the geographical coverage of authors and journals as well as a map of institutional cooperation, international cooperation as part of the framework for identifying new technologies (Handayani, 2021).

A bibliometric review focuses on quantitative research in journals, articles, books, and other forms of written communication (Regolini & Jannès-Ober, 2013). This research was conducted by searching the Google Scholar database. The search for article metadata is based on parameters that match the emphasis of the study with the keyword ethnostem in learning in the search results. The stages are collecting metadata in the 2018-2022 range and excavating data in the Google Scholar database on *Publish or Perish (PoP)*. Furthermore, to visualize metadata about ethnostem-based learning, VOSviewer *software*. Creating a visualization as a map is to export search results from the database into RIS format, then enter them into VOSviewer. The results of data visualization displayed by VOSviewer are used to analyze Ethno-STEM-based learning.

RESULT AND DISCUSSION

Results of bibliometric mapping visualization on Ethno-STEM research trends and its

implications for science learning in elementary schools

Based on the results of searching metadata about Ethno-STEM-based learning from the Google Scholar database with the help *of the Publish or Perish (PoP) search software* in the last five years (2018-2022), 130 documents were obtained. Figure 1 shows a visualization of the VOSviewer software network on Ethno-STEM-based learning based on the Google Scholar database.

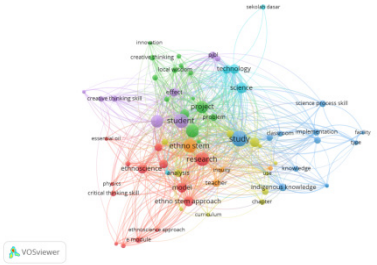

Figure 1. Network visualization of Ethno-STEM-based learning terms in the last five years (2018-2022)

Network visualization in Figure 1 about ethno-STEM-based learning in the Google Scholar database with a minimum number of occurrences of a term 3 out of 812 terms and produces 68 items that meet the threshold of 7 clusters. Cluster 1 is related to ethno-STEM *approach, critical thinking,* ethnoscience, etc. Cluster 2 is related to the terms stem, *creative thinking*, *nature science learning, outcome,* etc., Cluster 3 is related to *science process skills,* stem *education, knowledge,* etc. Current 4 is related to stem *approach, analysis, learning process,* etc., Cluster 5 is related to *creative thinking skills*, ethno-STEM *projects*, pjbl, etc. Cluster 6 is related to elementary school, *engineering, science,* etc. Cluster 7 is related to Ethno-STEM, *investigation, inquiry,* and *teacher* where each cluster consists of terms that describe the keywords of Ethno-STEM learning.

If we look at the relationship between Ethno-STEM terms and learning itself, from the VOSviewer visualization, it is clear that the two have a very close relationship. The most dominant Ethno-STEM-based learning visualization display is learning terms/keywords, the second is STEM, and the third is students (Figure 2), where the learning itself has 54 links with a total link strength of 261 and the emergence of 45. The term connected learning with project-based learning, STEM, *inquiry* based learning, problem-based learning, traditional knowledge, science, ethnoscience, and others.

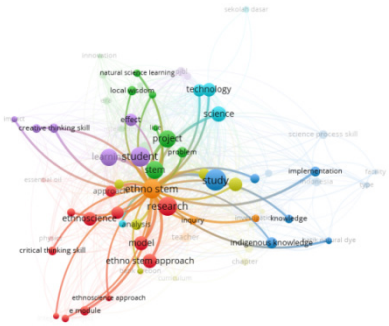

Figure 2. Dominant terms in keyword visualization related to Ethno-STEM learning Google Scholar database

Visualization of the author's collaboration on the trend of Ethno-STEM-based learning research

The results of the Co-authorship visualization on Ethno-STEM based learning with a minimum number of documents of an author 1 of 32 authors in the Google Scholar database obtained visualization results as shown in Figure 4. Based on Google Scholar, it can be seen that the top three researchers for the 2018-2022 period are Sudarmin et al and Sumarni et al. This shows that the authors who have researched Ethno-STEM-based learning for the last five years are writers from Indonesia.

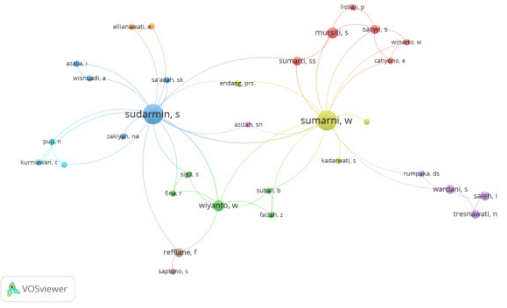

Figure 3. Visualization of collaboration between Ethno-STEM authors (2018-2022)

The authors with the most documents from the Google Scholar database were extracted and sorted by many Ethno-STEM learning publications. The authors with the most documents are Sumarni and Sudarmin with six documents. They were then followed by Azis, H, Mursiti, and Wijayanto with three documents.

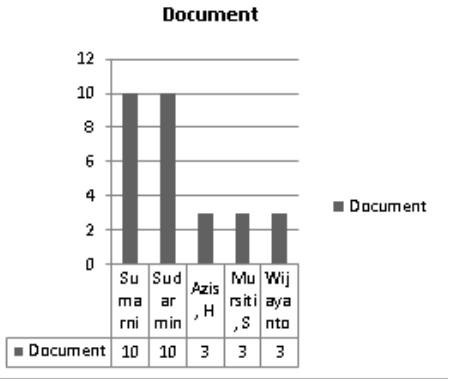

Figure 4. Distribution of documents by the author (2018-2022)

The implications of Ethno-STEM learning in elementary science learning

The results of visualization of Ethno-STEM learning in the last five years are closely related to science (Science) subjects; this can be seen in the image shown below based on the Google Scholar database.

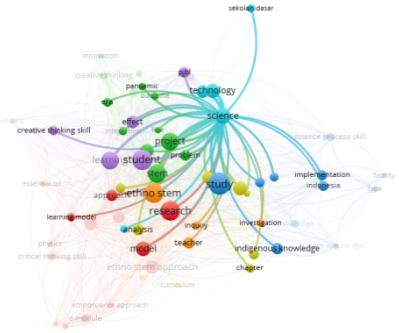

Figure 5. Visualization results of the Ethno-STEM research trend network with science subjects

In Figure 5, it can be seen that science subjects are related to creative thinking skills, elementary school students, pjbl models, and problem-based learning models. This means that Ethno-STEM-based science (science) learning can train the creative thinking level of elementary school students in making a project/product and improve problem-solving skills by integrating local cultural knowledge. This is in line with research that the influence of STEM-based learning can improve students' creative thinking skills (Wati, 2021) and improve problem solving skills (Bada, 2022).

Another study conducted by Soimah in an increase in student learning outcomes, especially in science subjects, after being given STEM learning with *project-based learning* (Soimah, 2019). The results of Khaira's research from research data show that STEM learning applied in fourth-grade elementary school in the learning process can increase motivation, knowledge, creativity, and innovations, so STEM learning is very promising to be implemented with science learning (Studi et al., 2018). So it can be concluded from the implications of Ethno-STEM learning on elementary science learning that it can improve students' creative thinking skills by integrating HOTS *(Higher Order Thinking Skill)* learning models such as inquiry learning models, *project based learning,* and *problem based learning* that can support skills students in the 21st century.

CONCLUSION

The results of the analysis and discussion of Ethno-STEM-based learning research trends and their implications for elementary science learning from the Google Scholar database (2018-2022) assisted by *Publish or Perish (PoP) Software* and network visualization from the VOSViewer application consists of seven clusters with the most dominant terms being learning, STEM, and students. The author of the Ethno-STEM research for the last five years is a writer from Indonesia. The implication of Ethno-STEM learning on elementary science learning is improving students' creative thinking skills by integrating HOTS *(Higher Order Thinking Skill)* learning models such as inquiry learning models, *project based learning,* and *problem based learning* that can support students' skills in this century. 21.

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