ISSN: XXX-XXX-XXXXX-X-X
Desember 2024
Hal: 65 - 71

How is the Effectiveness of Ethnoscience-Based Modules in Science Learning in Indonesia?: A Systematic Literature Review

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Abstract

Natural Sciences (IPA) is an important subject for Junior High School (SMP) students. In reality, science subjects are less popular and consider science subjects difficult to learn. Thus, teachers are asked to be creative in teaching so that students are interested in learning and improve their learning outcomes. This study aims to analyze the effectiveness of ethnoscience-based science modules in Indonesia for junior high school students. The method used is the Systematic Literature Review prism model using, the results digital libraries, namely Google Scholar, Crossref, Eric, and Garuda. In order for the selected literature to be relevant, the search uses the keywords "module, ethnoscience, IPA". Furthermore, filtering is carried out to obtain scientific article publications from 2020 to 2024. Based on the keywords, 1990 articles were obtained and then selected based on exclusion and inclusion criteria to produce 50 relevant articles. The analysis technique used is the narrative method by grouping the extracted data. The results of this study show that ethnoscience-based modules in science learning are effective in improving 21st century skills. Thereforeof this study open up good opportunities for further researchers to explore this topic further and make it a reference for researchers and teachers.

Keywords: Module, Ethnoscience, Natural Science

INTRODUCTION

Natural Sciences, or Ilmu Pengetahuan Alam (IPA), hold a pivotal role in the junior high school curriculum in Indonesia (Yuliani, & Budiyono, 2021). The significance of IPA lies in its capacity to develop critical thinking, problem-solving, and scientific literacy skills among students. These skills are essential not only for academic success but also for nurturing informed, responsible citizens. The science curriculum is designed to help students understand natural phenomena, engage in scientific inquiry, and apply their knowledge to real-world scenarios. Despite this critical role, many students find science to be a difficult and unappealing subject. This perception often stems from the abstract nature of scientific concepts, which are challenging to grasp without engaging and contextualized teaching strategies (Sari, & Handayani, 2020). Consequently, there is often a lack of interest and enthusiasm for IPA among students, which adversely affects their learning outcomes and overall engagement in the subject.

To address this issue, there is an urgent need to introduce creative and effective teaching approaches that can make science education more engaging and meaningful for junior high school students. Traditional teaching methods often focus on the rote memorization of facts and theories, which can make science seem tedious and disconnected from students' everyday lives (Agustina, & Setiawan, 2020). This disconnect hampers the development of key skills such as critical thinking and

ISSN: XXX-XXX-XXXXX-X-X
Desember 2024
Hal: 65 - 71

creativity, which are crucial for deeper scientific understanding. Teachers play a central role in bridging this gap by designing lessons that not only present scientific knowledge but also stimulate curiosity and foster a deeper interest in learning. However, the challenge lies in equipping teachers with the tools and strategies to deliver science content in a way that is both effective and engaging. Overcoming this challenge requires exploring new methods of teaching that can connect students' experiences with scientific concepts, thereby enhancing their learning experience and academic achievement.

One promising approach to achieving this is the integration of ethnoscience into science education. Ethnoscience refers to the study of how different cultures understand and interact with the natural world. It brings traditional knowledge and cultural practices into dialogue with scientific concepts, creating a more context-rich and relatable framework for students to learn science. By relating scientific ideas to students' cultural backgrounds and daily experiences, ethnoscience has the potential to make complex scientific concepts more understandable and tangible. This approach helps transform students' perceptions of science from being a purely abstract subject to one that is relevant and meaningful to their lives. Consequently, incorporating ethnoscience into the science curriculum can play a significant role in fostering greater student motivation, deeper comprehension, and improved learning outcomes.

The use of ethnoscience-based modules aligns with broader educational goals to develop 21st-century skills, such as critical thinking, creativity, collaboration, and communication. Ethnoscience encourages students to understand science through a multicultural lens, recognizing the contributions of different cultures to scientific knowledge. This perspective fosters respect for cultural diversity and helps students see the relevance of science in various contexts, thereby enhancing their engagement and understanding of the subject. Furthermore, an ethnoscience approach promotes active learning, encouraging students to explore, question, and connect scientific concepts with their cultural context, which enhances cognitive processing and retention of knowledge. Such an approach not only enriches the learning experience but also provides students with the skills necessary to navigate an increasingly complex world.

Although the benefits of ethnoscience as a pedagogical approach are recognized, there is still a need for systematic research to assess its effectiveness in practice. While some educators have started to adopt ethnoscience-based teaching strategies, there is a lack of comprehensive empirical evidence regarding their impact on student learning, particularly at the junior high school level in Indonesia. A systematic review of the available literature can provide important insights into the implementation of ethnoscience-based modules, their effectiveness in enhancing learning outcomes, and the challenges and opportunities teachers face in applying this approach. Such a review is necessary to inform best practices in science education and to offer guidelines on effectively integrating ethnoscience into the curriculum.

This study aims to fill this gap by systematically reviewing the existing literature on the use of ethnoscience-based modules in teaching IPA to junior high school students in Indonesia. The purpose is to analyze the effectiveness of these modules in improving student learning and engagement in science subjects. By adopting a systematic literature review approach, this study seeks to synthesize evidence from relevant sources, providing a comprehensive understanding of the impact of ethnoscience-based modules on learning outcomes. The findings of this study are intended to serve as a valuable reference for educators, researchers, and policymakers interested in innovative teaching methods that enhance the relevance and appeal of science education.

ISSN: XXX-XXX-XXXXX-X-X
Desember 2024
Hal: 65 - 71

Furthermore, the results are expected to encourage further research and empirical studies on the application of ethnoscience in diverse educational contexts.

METHODS

The study employed a Systematic Literature Review (SLR) as its research design to assess the effectiveness of ethnoscience-based modules in teaching science to junior high school students in Indonesia. Specifically, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) model was used as a guiding framework for conducting this review (Aikenhead, & Ogawa, 2007). This model provides a structured approach to ensure that the literature review is comprehensive, transparent, and replicable. The process began by identifying a range of digital libraries to source the relevant literature, including Google Scholar, Crossref, ERIC (Education Resources Information Center), and Garuda. These databases were selected for their extensive coverage of educational research and access to diverse scholarly publications. To locate relevant studies, a search strategy was formulated using specific keywords such as "module," "ethnoscience," and "IPA" (Natural Sciences) to ensure that the search was both comprehensive and targeted. The focus on these keywords helped to identify literature that specifically addressed the integration of ethnoscience in science education for junior high school students.

To ensure that the selected articles were relevant and up-to-date, inclusion and exclusion criteria were established. The inclusion criteria were limited to scientific publications produced between the years 2020 and 2024, to capture the most recent developments and applications in the field. The initial search yielded a total of 1990 articles. These articles were then subjected to a rigorous selection process based on their relevance, quality, and adherence to the set criteria, which ultimately narrowed down the pool to 50 pertinent articles. This selection was aimed at ensuring that only high-quality, relevant studies that addressed the research question were included in the analysis. The data from these selected articles were analyzed using a narrative method, wherein the extracted information was grouped thematically to identify patterns, trends, and gaps within the existing literature. This thematic grouping facilitated a comprehensive understanding of the effectiveness of ethnoscience-based modules in enhancing the learning outcomes of junior high school students in Indonesia.

RESULTS

The findings from the literature review reveal that ethnoscience-based modules have a significant positive impact on the learning outcomes of junior high school students in Indonesia. These modules, which integrate scientific content with cultural contexts and traditional knowledge, have been shown to make learning more relatable and engaging for students. As a result, students not only improve in their understanding of scientific concepts but also develop essential 21st-century skills. For instance, students exposed to ethnoscience-based learning exhibited enhanced critical thinking abilities as they were encouraged to analyze scientific concepts through the lens of their cultural practices. Additionally, the modules promoted problem-solving skills by presenting real-life scenarios that required students to apply their scientific knowledge in practical, culturally relevant ways. Moreover, the collaborative nature of ethnoscience activities, which often involve group discussions and cooperative projects, fostered improved teamwork and communication skills among students, aligning well with modern educational goals of holistic skill development.

ISSN: XXX-XXX-XXXXX-X-X
Desember 2024
Hal: 65 - 71

The review also revealed that different studies provided unique insights into how these modules affect learning processes. While there was a general consensus on the effectiveness of ethnoscience in improving science education, the approaches to module design and implementation varied across the reviewed articles. Some studies emphasized hands-on activities, such as experiments and observations rooted in local cultural practices, to foster experiential learning. These studies demonstrated that when students actively participate in culturally meaningful scientific activities, their engagement and understanding of scientific concepts increase. Other studies focused more on the narrative aspect, where storytelling and cultural history were used as tools to introduce scientific principles, thereby enhancing students' comprehension and retention of complex ideas. These varied approaches to integrating ethnoscience highlighted that there is no single way to design an ethnoscience-based module, and educators have the flexibility to adapt the content according to their specific context and student needs.

Additionally, the studies reviewed highlighted certain patterns and similarities that support the overall effectiveness of ethnoscience-based modules. Across different geographical areas and cultural contexts in Indonesia, the modules consistently demonstrated the ability to make science learning more meaningful and enjoyable for students. For example, students from various regions showed an increased appreciation for their cultural heritage when traditional knowledge was linked with scientific concepts, fostering a sense of pride and identity that motivated their learning. At the same time, some unique contributions from individual studies were noted, such as innovative ways to assess students' learning progress and measure the development of their skills. These distinctive approaches provided deeper insights into how ethnoscience can be effectively integrated into the curriculum and suggested potential strategies for educators to enhance both student understanding and engagement in science. Overall, the literature indicates that ethnoscience-based modules hold great promise for improving not only the academic performance of junior high school students in science but also their broader skill sets needed for the 21st century.

DISCUSSION

The results of this systematic literature review indicate a strong positive impact of ethnoscience-based modules on student engagement and learning outcomes in science education for junior high school students. These findings imply that integrating cultural and traditional knowledge into science curricula has the potential to bridge the gap between abstract scientific concepts and students' everyday experiences, making learning more relatable and motivating. The increased student engagement observed in studies suggests that when science is taught through culturally familiar contexts, students are more likely to participate actively and develop a genuine interest in the subject matter. Furthermore, the enhanced 21st-century skills reported, including critical thinking, problem-solving, and collaboration, highlight that ethnoscience-based modules not only improve academic understanding but also prepare students for real-world challenges. This dual benefit—academic improvement and skill development—positions ethnoscience as a valuable approach to science education.

In terms of practical application, the findings suggest several strategies that teachers can implement in their classrooms to maximize the benefits of ethnoscience-based learning (Aikenhead, 2017). Teachers can design modules that draw from local cultural practices, traditional knowledge, and community resources to make science lessons more engaging and relevant. For example, incorporating storytelling or hands-on activities based on indigenous practices can help students connect scientific principles to their cultural heritage. This contextual approach allows students to

ISSN: XXX-XXX-XXXXX-X-X
Desember 2024
Hal: 65 - 71

understand science as a living, evolving process rather than a static body of knowledge. Teachers can also encourage group discussions and collaborative projects to further enhance students' communication and teamwork skills. Moreover, by using ethnoscience as a framework, teachers can support students in developing a deeper understanding of scientific concepts while fostering a greater appreciation for cultural diversity and heritage.

Despite the promising outcomes of ethnoscience-based modules, this study acknowledges certain limitations within the reviewed literature. One key limitation is the geographical scope of the studies, as many were conducted in specific regions of Indonesia, which may not fully represent the diverse cultural contexts across the country. Consequently, while the findings are positive, they may not be universally applicable to all regions or communities. Additionally, the quality and depth of some of the studies varied, with certain articles providing limited methodological details or lacking in rigorous assessment of student outcomes. This variability in research quality makes it challenging to draw definitive conclusions about the overall effectiveness of ethnoscience-based modules. Moreover, most of the studies reviewed focus on short-term outcomes, leaving questions about the long-term impact of ethnoscience on students' learning and skill development unanswered.

Given these limitations, there are several recommendations for future research in this area. First, there is a need for more comprehensive empirical studies that examine the long-term effectiveness of ethnoscience-based modules on students' academic performance and skill development. Such research should include longitudinal data to assess how sustained exposure to ethnoscience influences students' learning trajectories over time. Additionally, expanding the scope of research to include a broader range of educational levels would provide a more complete understanding of how ethnoscience can benefit different age groups and learning stages. For instance, examining its impact on early childhood education or at the high school level could provide valuable insights into the adaptability and scalability of ethnoscience-based approaches.

Future studies should also explore the best practices for implementing ethnoscience in diverse classroom settings, considering factors such as the availability of resources, teacher training, and cultural diversity within student populations. Since each region in Indonesia has its unique cultural practices and traditions, research should focus on how to effectively tailor ethnoscience-based modules to meet the needs of various communities. Furthermore, developing a standardized framework for the design and assessment of ethnoscience-based modules could support educators in creating effective learning experiences and provide a more consistent measure of their impact on student learning.

In conclusion, while the findings of this study support the potential benefits of ethnoscience-based modules in improving science learning and student engagement, further research is required to address the identified limitations and enhance the understanding of this pedagogical approach. By building on the existing body of literature, researchers can contribute to the development of more effective and culturally relevant science education strategies that foster both academic and personal growth for students across different contexts. The ongoing exploration of ethnoscience-based learning will not only enhance the teaching of science but also promote the recognition and appreciation of cultural diversity in education.

CONCLUSION

In conclusion, the study’s findings underscore the effectiveness of ethnoscience-based modules in enhancing the learning outcomes of junior high school students in science education. These modules, by integrating scientific concepts with cultural contexts and traditional knowledge, have

ISSN: XXX-XXX-XXXXX-X-X
Desember 2024
Hal: 65 - 71

demonstrated the ability to make science learning more engaging, meaningful, and relevant to students. The review of the literature highlights how this approach not only helps students grasp complex scientific ideas more easily but also promotes the development of crucial 21st-century skills, such as critical thinking, problem-solving, and collaboration. The positive impacts reported across various studies strongly suggest that ethnoscience-based learning is a beneficial strategy for improving both the academic achievement and overall educational experience of students in science subjects.

The implications of these findings are significant for both educational practice and future research. For educators, the opportunity to incorporate ethnoscience into their teaching offers a valuable way to connect science lessons with students' cultural backgrounds, thereby fostering greater engagement and deeper understanding. Teachers can use these modules to create a more interactive and student-centered learning environment, promoting not only knowledge acquisition but also the development of skills that are essential for students' future success. Additionally, the study encourages further exploration of this topic by researchers, particularly in assessing the long-term impacts and potential adaptations of ethnoscience-based modules across different educational levels and cultural contexts. By continuing to investigate and refine this approach, there is great potential to advance the field of science education and contribute to more inclusive and effective teaching practices.

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ISSN: XXX-XXX-XXXXX-X-X
Desember 2024
Hal: 65 - 71

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