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POTENTIAL IMPLEMENTATION OF ETHNOSCIENCE-ORIENTED LEARNING ON BIOTECHNOLOGY MATERIAL

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ABSTRACT

This study aimed to explore the potential implementation of ethnoscience-oriented learning in biotechnology material at The Junior High School level. Data were collected through interviews with 11 science teachers from Sub Rayon 05 of Grobogan Regency and classroom observation involving three peer teachers at SMP Negeri 1 Ngaringan. The interview was conducted using a Google form-based questionnaire, while observation data were obtained through direct observation using a structured observation sheet. The result showed that teachers had a good understanding of Ethnoscience (78,7%), and the potential for implementation was considered very high (84%). However, curriculum development was observed to be the lowest aspect (67%). These findings indicate that while the conceptual understanding and enthusiasm of teachers toward Ethnoscience are strong, effective implementation requires systemic support, training, and curricular alignment to be successful.

INTRODUCTION

As we navigate the era of globalization and the Industrial Revolution 4.0, the role of education is evolving. It's no longer just about academic excellence, but also about equipping students with 21st-century skills. These skills, including critical, creative, communicative, and collaborative thinking, are crucial for tackling global challenges and seizing opportunities in our rapidly changing world. In this context, Natural Sciences (IPA) education is strategically positioned, as it inherently fosters exploration, observation, analysis, and problem-solving.

Critical thinking skills are one of the primary competencies that must be developed, as they enable students to assess information objectively, construct logical arguments, and make informed decisions in complex situations (Dewanti et al., 2020). Along with rapid social and technological changes, students need to be equipped with the ability to think reflectively and analytically to adapt to future challenges. Critical thinking skills enable students not only to receive information passively but also to be active in critically evaluating, testing, and building understanding based on scientific evidence. In science learning, this ability is essential to help students master scientific concepts in more depth and contextually (Dewanti et al., 2020; Rahmawati et al., 2023).

Our current learning process needs to be in sync with the development trends of the 21st century. It's not just about producing academically capable students, but also about equipping them with critical, creative, communicative, and collaborative skills. These competencies are vital for addressing global challenges and seizing opportunities in the era of globalization and technological advancement. However, in the field, many science learning practices still focus on memorization and fail to relate the subject matter to real life or the local cultural context of students.

Similar findings have been reported by several studies, which show that science learning in various contexts often relies heavily on rote memorization and abstract concepts without adequate connection to everyday life, making it difficult for students to apply knowledge meaningfully (Mardhiyah et al., 2021). Research by Ardianti & Raida (2022) highlights that integrating local cultural contexts can increase student engagement and understanding; however, this approach is still rarely implemented. Similarly, Gummah et al. (2023) emphasize that science is often perceived as complex and uninteresting due to its heavy use of technical terminology and lack of contextualization, which hinders students from connecting what they learn to real-life situations. Science is often perceived as a complex and tedious subject because it relies heavily on technical terms and abstract material.

As a result, students struggle to connect what they learn to everyday situations (Ardianti & Raida, 2022; Gummah et al., 2023). This less contextual and textual learning has an impact on students' low reflective and critical abilities in responding to scientific phenomena. Amidst the rapid flow of information and the complexity of the modern world, students should be trained to evaluate data, assess arguments, and draw logical

conclusions. These abilities have not been fully developed in conventional learning systems (Sarkingobir & Bello, 2024).

Ethnoscience is an activity of transforming between original science, which consists of all knowledge about the facts of society that comes from hereditary beliefs, and still contains myths. The scope of ethnoscience encompasses the fields of science, agriculture, ecology, and medicine, as well as the study of flora and fauna (Rahayu & Sudarmin, 2015). The birth of ethnoscience cannot be separated from the knowledge discovered through trial and error, as well as the inability to translate the results of its findings into scientific knowledge. This is because the starting point of ethnoscience lies at the local to regional level, as a form of knowledge that results from trial and error (Novitasari et al., 2017).

MATERIALS AND METHODS

This research employed a quantitative descriptive design (Sugiyono, 2019) to analyze ethnoscience-based science learning in junior high schools (Hadi & Ahied, 2017). The research subjects were eleven science teachers who were members of the MGMP IPA Sub Rayon 05 Grobogan Regency and served as respondents in the interview activities. In addition, three science teachers from SMP Negeri 1 Ngaringan were selected purposively (Etikan et al., 2016) as the observation sample to represent schools actively implementing ethnoscience-based learning and to provide in-depth classroom observation data.

The research instruments were carefully selected to ensure methodological rigor. They consisted of an online questionnaire (Creswell & Creswell, 2018), an interview guide, and an observation sheet. The questionnaire, created using Google Forms, contained Likert scale and closed-ended questions (Joshi et al., 2015), providing a structured approach to collecting quantitative data regarding teachers' understanding of ethnoscience (Haryanto & Kencanawati, 2023), curriculum development, learning methods, and the potential for ethnoscience learning. The interview guide was used to gather more detailed qualitative insights from respondents, focusing on their experiences, challenges, and perceptions in implementing ethnoscience-based science learning (Emdin, 2011). The observation sheet was prepared to record classroom learning

activities based on four indicators: understanding of ethnoscience, curriculum development, learning methods, and ethnoscience learning potential (Asra & Akmal, 2021).

Prior to data collection, all instruments were validated through expert judgment (Taherdoost, 2016) by two science education lecturers and one experienced science teacher. Feedback from the validators, which included suggestions for clearer wording and additional questions, was used to revise the questionnaire and observation sheet before implementation. The research procedure consisted of distributing the online questionnaire to the eleven MGMP IPA Sub Rayon 05 teachers, conducting online interviews with selected teachers to clarify and deepen the questionnaire findings, and carrying out classroom observations of the three science teachers at SMP Negeri 1 Ngaringan over two weeks to examine the practical implementation of ethnoscience-based learning (Ardianti & Raida, 2022).

Data were analyzed using descriptive quantitative techniques (Miles et al., 2014) by calculating the percentage of achievement for each indicator and comparing the results of questionnaires, interviews, and observations. The results were presented in tables and graphs, providing a comprehensive overview of the research findings. In addition to primary data, supporting documents such as teaching modules were used, further reinforcing the thoroughness of the research.

RESULTS AND DISCUSSION

From the results of interviews with eleven teachers, it was found that most science teachers already had an understanding of ethnoscience; however, curriculum development and variations in learning methods still required improvement.

Supplementing the interview method, this study also gathered data through direct observation of science learning activities in the classroom. The results of this direct observation, which were in close alignment with the interview findings, suggest that teachers have a good grasp of ethnoscience. However, there is still room for improvement in curriculum development. The potential for ethnoscience-oriented learning, as indicated by the data, is indeed promising. This is clearly illustrated in Figure 2 :

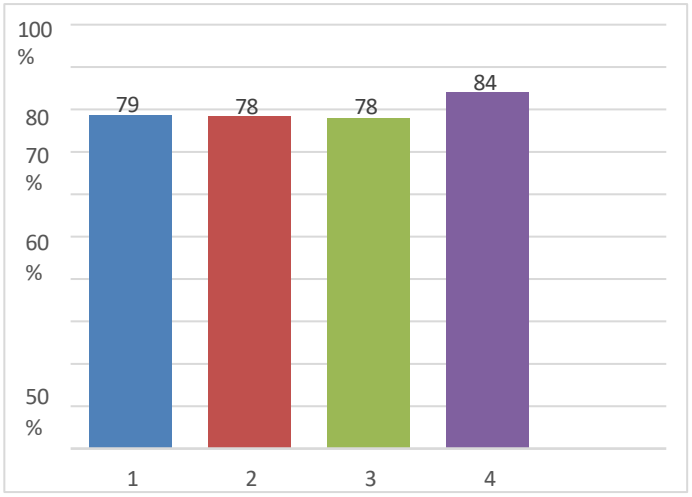

Figure 1. Graph of interview results with science teachers (1: Teachers' understanding of ethnoscience 2: Curriculum development 3: Learning methods 4: Potential for ethnoscience-oriented learning)

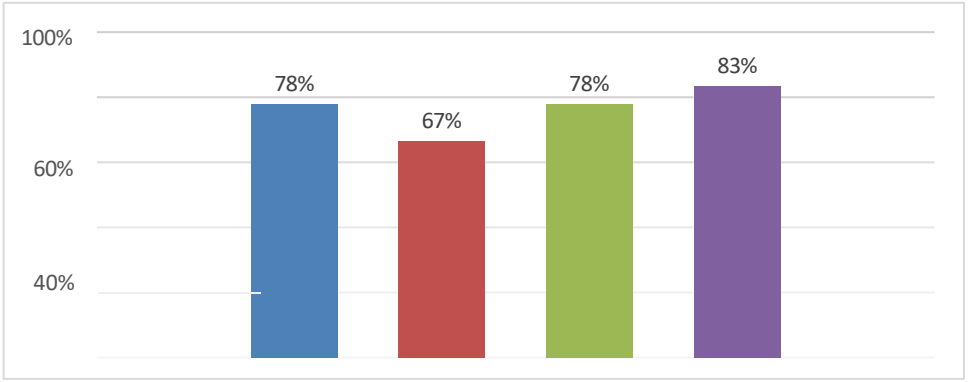

Figure 2. Graph of the results of observations of science teacher learning (1: Teachers' understanding of ethnoscience 2: Curriculum development 3: Learning methods 4: Potential for ethnoscience-oriented learning)

From the data obtained from two types of data collection techniques, the data is then compared. The following example illustrates how the two data sets are presented in Table 1.

Table 1. Recapitulation of interview and observation results on the potential for ethnoscience-oriented learning

No	Aspects measured	Interview Results (%)	Observation Results (%)
1	Teachers' understanding of ethnoscience	78.7	77.5
2	Curriculum development	78.5	67.0
3	Learning methods	78.0	77.5
4	Potential for ethnoscience-oriented learning	84.0	83.0

Based on the results of the data obtained, most teachers have a pretty good understanding of the concept of ethnoscience. This is evident in their ability to explain

the relationship between ethnoscience and science, as well as their enthusiasm for integrating local values into the learning process. Teachers also show a positive and open attitude towards the application of the ethnoscience approach in the classroom. This attitude is an important asset in encouraging changes in learning methods that are more contextual and relevant to students' lives. Previous studies have shown that teachers' positive attitudes and openness to integrating local culture into science learning significantly enhance student engagement and contextual understanding (Sudarmin et al., 2018). Similarly, Haryanto & Kencanawati (2023) emphasize that such attitudes support the successful adoption of ethnoscience-based learning by making lessons more meaningful and connected to students' daily experiences.

While teachers demonstrate a strong conceptual understanding of ethnoscience, there are still significant challenges in the technical aspects, particularly in developing ethnoscience-based curricula and teaching materials. The current 67% achievement rate in curriculum development indicates that many teachers are not fully equipped to design structured learning activities with an ethnoscience approach. This underscores the urgent need for additional support and training, including workshops and the development of learning modules. (Miaz et al., 2019) It was also emphasized that the success of implementing ethnoscience in schools is highly dependent on system support, including educational policies that bolster and enhance teacher capacity.

Furthermore, curriculum flexibility is also a crucial factor in implementing ethnoscience-based learning. Research (Miaz et al., 2019) highlights the need for space in the national curriculum to accommodate local cultural values without compromising the achievement of core competencies. When teachers' understanding of ethnoscience is sufficient, and learning practices begin to be directed towards a contextual approach, then there is an excellent opportunity to develop science learning that is more relevant and meaningful for students. Therefore, the synchronization between understanding, practice, and structural support needs to be continuously improved so that the ethnoscience approach can truly be applied optimally at the junior high school level.

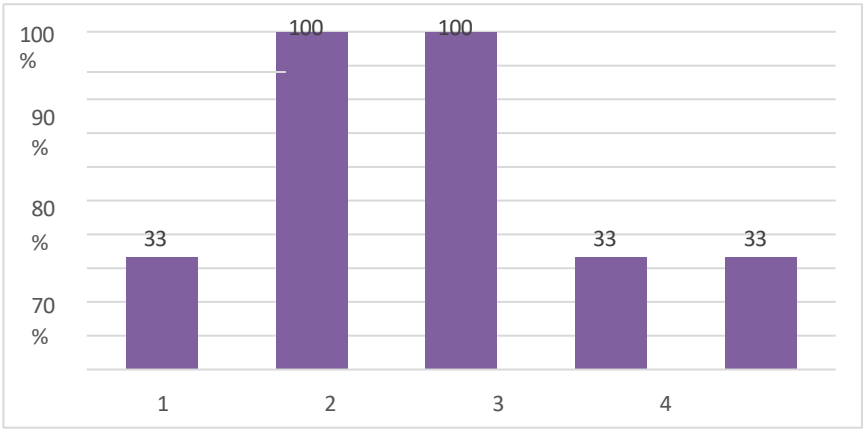

Figure 3. Graph of document analysis results

Description:

1. There are teacher reflection notes on the effectiveness of learning in the document (teaching module)
2. The teaching module lists various learning methods used, such as projects, experiments, and problem-based learning
3. The document (teaching module) lists activities that actively involve students in the learning process, such as group projects or experiments
4. There are teacher reflection notes on the effectiveness of learning in the document (teaching module)
5. The teacher uses feedback for future curriculum improvements written in the document (teaching module)

As illustrated in Figure 3, the results of the document analysis show that the most prominent aspects in the teaching module are the presence of varied learning methods (aspect 2) and activities that actively involve students (aspect 3), both of which achieved a score of 100%. This indicates that teachers have consistently designed active and student-centered learning experiences. This approach aligns with the principles of active learning, which have been proven to increase student engagement and understanding (Ramadhani et al., 2024), as well as support the development of 21st-century skills such as collaboration, communication, and problem-solving (Amin et al., 2020). In contrast, the aspects of teacher reflection on the effectiveness of learning (aspects 1 and 4) and the use of feedback for curriculum improvement (aspect 5) were only mentioned by around 30%. This indicates that reflective practices and the use of formative evaluation for long-term improvement have not been fully maximized. In fact, teacher reflection plays a crucial role in

continuously improving the quality of learning (Farrell, 2018), and the use of feedback is essential for adjusting the curriculum to be more responsive to student needs (Ismail et al., 2024). Therefore, increasing teacher capacity in terms of reflection and follow-up on curriculum improvements is a crucial agenda for enhancing the quality of learning.

Based on the analysis of the teaching module documents, specific indicators suggest that teachers are implementing reflective practices and active learning approaches. The existence of reflective notes (in points 1 and 4) shows that teachers have evaluated the effectiveness of the learning strategies used. This reflection is an essential part of the learning improvement cycle, as it enables teachers to continually review, assess, and revise their pedagogical approaches (Farrell, 2018). In addition, the inclusion of various learning methods such as projects, experiments, and problem-based learning in the teaching module (point 2) shows the application of a constructivist learning approach, which is believed to increase student engagement and in-depth understanding of concepts (Arega & Hunde, 2025; Hendry et al., 2016).

Furthermore, the presence of learning activities that actively involve students (point 3), such as group projects and experiments, reflects the strengthening of collaborative and problem-solving skills that are essential in 21st-century learning. These activities not only increase student learning motivation but also encourage meaningful and contextual learning (Manoppo, 2017). Finally, the aspect of using feedback for curriculum improvement (point 5) demonstrates the teacher's awareness of the importance of continuous evaluation in the development of teaching materials. This type of feedback is crucial in developing a learning system that is responsive and adaptable to student needs (Oktaviani & Gusmaneli, 2024).

Based on research findings, science teachers at the junior high school level showed a relatively deep understanding of the concept of ethnoscience learning, especially in the context of teaching biotechnology. They also demonstrated a positive attitude and enthusiasm in incorporating local values into their teaching materials. For instance, when teaching ecosystem concepts, some teachers referred to traditional agricultural systems such as *tumpangsari* practiced in their community (Mukti et al., 2022). In biodiversity lessons, they introduced local medicinal plants and their uses, drawing from ethnobotanical knowledge of indigenous groups (Liliyanti et al., 2021; Pradita et al., 2021).

In physics topics such as simple machines, teachers used examples from local weaving looms or rice milling tools (Asra et al., 2021). Others applied regional folklore and

proverbs to explain natural phenomena, thereby linking cultural narratives with scientific concepts(Regina & Wijayaningputri, 2022). Such culturally grounded practices align with efforts to enrich science learning through a local wisdom-based approach. This enthusiasm demonstrates the teachers' readiness to explore contextual learning approaches that are more closely aligned with students' daily lives (Miaz et al., 2019). However, limitations in curriculum development and teaching tools remain significant obstacles that must be addressed immediately. To support the successful implementation of ethnoscience as a whole, strategic steps are necessary, including ongoing teacher training, the development of appropriate media and learning resources, and policy support that enhances the flexibility of the curriculum to accommodate local cultural values (Zahro et al., 2024). Without this structural support, the application of ethnoscience will be challenging to develop optimally in the education system. Therefore, collaboration among teachers, curriculum developers, and educational policymakers is essential so that the ethnoscience approach can become an integral part of meaningful and contextual science learning in junior high schools.

The teacher's ability to manage learning plays a strategic role in creating a conducive learning atmosphere, which can directly increase student motivation and have a positive impact on educational success (Soderstrom & Bjork, 2015, as quoted in Ramadan et al., 2021). Therefore, learning strategies are an important element in ensuring the effectiveness of the teaching and learning process. The learning strategy itself represents a systematic effort designed by educators in collaboration with students to achieve instructional goals optimally (Ramadan et al., 2021). Improving the quality of learning requires a strategy that is designed in a structured manner, starting with an evaluation of past weaknesses, strengths, and challenges, which are then described in continuous improvement steps(Telehala & Purba, n.d.). In this context, selecting the right learning strategy, including presenting an engaging learning situation, is a crucial key to building and maintaining student motivation for learning (Achadah, 2019).

Ethnoscience is a form of knowledge that develops in specific ethnic communities or social groups and reflects their unique understanding of natural phenomena (Asra & Akmal, 2021). The Dayak Kantuk community in Seluan Village, Kapuas Hulu Regency, continues to uphold the tradition of using plants as medicine for various diseases and body care, reflecting a genuine form of local wisdom rooted in ethnobotany. This knowledge is passed down from generation to generation without written documentation, making it vulnerable

to being lost amid the currents of modernization and globalization (Liliyanti et al., 2021; Pradita et al., 2021; Yusro et al., 2021). One prominent form of utilization is the use of medicinal plants for hair care, which is carried out by 61.6% of the community in the area. This high number indicates that the oral transmission of knowledge from parents to the younger generation is still actively occurring. This inheritance pattern is significant not only for the preservation of local wisdom but also for increasing public awareness, especially among the younger generation, of the importance of maintaining and caring for the body naturally, including hair care, as part of the healthy lifestyle culture of indigenous peoples (Liliyanti et al., 2021).

Ethnoscience is a form of knowledge that develops in specific ethnic communities or social groups and reflects their unique understanding of natural phenomena (Asra & Akmal, 2021). In the context of education, ethnoscience is employed as a pedagogical approach that integrates local cultural elements into the learning process to create a contextual and meaningful learning environment (Nadiyah et al., 2022). This approach aligns with the ideas of Hadi and Ahied (2017), who argue that science learning grounded in local cultural values serves as a means of strengthening national identity and preserving cultural traditions. The ethnoscience paradigm emphasizes the importance of using concrete objects from the environment around students as the primary means of learning, thereby supporting the development of conceptual understanding and science process skills (Nwosu, 2017). Thus, the ethnoscience approach in science learning not only strengthens the relevance of the material to students' daily lives but also reflects the basic principles of Natural Science (IPA) learning, namely the presentation of real and contextual material.

Ethnoscience-based learning is an alternative approach to learning activities because it not only aligns with applicable curriculum rules but also reflects the current times. The implementation of ethnoscience-based learning also aims to instill a love for Indonesian culture and nation. Collaboration that combines student character education with local cultural values is considered an integral part of the concept of scientific learning (Massita et al., 2016). The implementation of ethnoscience-based learning is also expected to increase students' knowledge and understanding of the culture and potential of their region (Asra et al., 2021; Puspasari et al., 2019).

The integration of ethnoscience approaches into science learning has made a significant contribution to enhancing students' academic achievement while preserving

local cultural values in Indonesia. The study's results showed that ethnoscience has a positive impact on critical thinking skills, academic achievement, and cultural appreciation, with effect sizes ranging from 0.52 to 0.82 (Mukti et al., 2022). This approach aligns with the principles of Pancasila and the demands of 21st-century competencies. Various local wisdoms from regions such as Bali, Lombok, Medan, and Ende have been identified as relevant to science topics, including energy, classification of living things, and the water cycle (Lidi et al., 2022). Its implementation includes various innovative learning models such as STEAM, inquiry-based learning, and problem-based learning. In addition to learning models, supporting learning tools are needed, one of which is student worksheets. Ethnoscience worksheets on biotechnology material are very suitable for training students' science skills (Indrawati & Qosyim, 2017). In line with Nur Aura's thoughts, ethnoscience-based LKPD is suitable for application in learning activities and has been shown to be effective in improving argumentation skills (Novanda et al., 2024).

Biology learning, especially on the topic of local plant classification, is packaged with an ethnoscience approach, and students' critical thinking skills become more honed (Utaminingsih et al., 2021). This approach, as explained by Sudarmin and colleagues (2018), is not only about delivering material but also about creating a learning environment that is close to students' lives by incorporating culture as an integral part of the learning process. In a world increasingly dominated by science and technology, students need to possess strong scientific literacy. One way to make biology feel closer and more relevant is to link it to the students' home culture, so that they not only understand the concepts in depth, but also feel personally connected to what they are learning (Ardianti & Raida, 2022; Emdin, 2011; S. P. Ramadhani et al., 2021). This approach not only makes the learning process more meaningful but also encourages better academic achievement (Emdin, 2011). For example, a case study on plant structure learning shows that the relationship between science concepts and local cultural contexts can improve students' conceptual understanding (Sudarmin, 2014). However, the integration of ethnoscience into the curriculum still faces obstacles, particularly in terms of developing teacher capacity and adapting the national curriculum to local cultural characteristics (Hidayati, 2025; Mukti et al., 2022). Therefore, a systematic strategy is needed to support teacher professionalism and educational policies that are inclusive of Indonesia's cultural diversity.

CONCLUSION

This study reveals that junior high school science teachers in Grobogan Regency possess a solid understanding of the concept of ethnoscience and demonstrate enthusiasm for integrating local cultural values into their teaching. However, there are still challenges in developing ethnoscience-based curriculum and teaching tools, as reflected in the relatively low achievement of curriculum development indicators. Classroom observations and analysis of teaching module documents indicate that active and varied learning methods have been implemented; however, reflective practices and the use of feedback for curriculum improvement still require improvement. Ethnoscience integration has been proven to enhance students' critical thinking skills, conceptual understanding, and appreciation of local culture, aligning with the demands of 21st-century learning. To ensure the success of its implementation, ongoing training for teachers is crucial, as it provides them with the necessary skills and knowledge to effectively integrate ethnoscience into their teaching. This, along with curriculum flexibility and collaboration among teachers, curriculum developers, and education policymakers, will ensure the transformative, contextual, and sustainable learning strategy of the ethnoscience approach in science education in Indonesia.

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