Enhancing Teacher Competence through a Workshop on Developing Ethnophysics-Based Teaching Modules

Winny Liliawati[1], Agus Danawan[2], Harun Imansyah[3], Iyon Suyana[4], Rizki Zakwandi[5], Nurdini Nurdini[6], M. Reza Dwi Saputra[7]
[1,2,3,4,5,6,7]Physics Education Program, Universitas Pendidikan Indonesia, Indonesia
Email : [1]*winny@upi.edu*, [6]*nurdini@upi.edu*, [7]*mrezadwisaputra@upi.edu*
corresponding author

Abstract

This study aims to describe the implementation of a workshop on developing Ethnophysics-based teaching modules as part of a community service program. The workshop was conducted to enhance the ability of Physics teachers to develop teaching modules relevant to local cultural contexts, making Physics learning in schools more contextual and meaningful. The workshop was held online, combining synchronous and asynchronous learning through a video conferencing platform and a Learning Management System (LMS). A descriptive qualitative method was used to analyze data from 97 participating teachers from various provinces in Indonesia. The instruments included questionnaires to understand teachers' profiles and perceptions of teachers in developing Ethnophysics-based teaching modules, and participant worksheets to identify knowledge and local cultural practices relevant to physics concepts. The results from teachers' perceptions of Ethnophysics indicate that most teachers require guidance in understanding and developing Ethnophysics-based teaching modules. The outcomes of this community service activity also show that teachers were able to identify and plan Ethnophysics-based teaching modules appropriate to the local wisdom of their respective regions. These findings serve as a foundation for developing more structured mentoring programs for high school teachers to support their competencies in applying Ethnophysics in teaching.

Keywords: *ethnophysics; teaching modules; community service program*

1. INTRODUCTION

Education in Indonesia currently faces the challenge of making learning more contextual and relevant to students' daily lives (Zubaidah, 2016). One approach to achieving this goal is integrating local wisdom into learning, particularly in subjects often perceived as abstract, such as physics (Morales, 2016; Setiawan et al., 2017). The integration of local wisdom, known as ethnophysics, allows students to understand physics concepts through phenomena that are familiar to their lives, thereby increasing their interest and comprehension of the material taught.

The integration of cultural knowledge into science education, often referred to as ethnophysics, has gained increased attention in recent years. Ethnophysics involves understanding and teaching physics concepts through the lens of indigenous knowledge systems and cultural practices (Agustinasari & Fiqry, 2023; Zidny et al., 2020). This approach aligns with the recognition that science education should not be isolated from students' cultural contexts but should instead incorporate diverse ways of knowing offered by various communities, making physics more comprehensible and meaningful

for learners (Govender & Mudzamiri, 2022; Pieter & Risamasu, 2024). Each region has traditions passed down from generation to generation, known as local wisdom. These traditions play an essential role in the lives of the community and strengthen a sense of identity and togetherness (Bennett, 2015; Chan, 2022; Mungmachon, 2012; Shore & Black, 2021). By linking physics to local cultural contexts, ethnophysics helps students not only understand physics concepts but also appreciate and preserve their cultural heritage.

Ethnophysics is highly relevant in a culturally diverse country like Indonesia, where local wisdom and traditional practices offer a rich source of physics concepts (Hikmawati et al., 2021; Kasi et al., 2021). Several studies have explored the integration of ethnoscience into the physics curriculum in Indonesia and have demonstrated its potential to enhance student's understanding of physics concepts and critical thinking skills (Gunawan et al., 2019; Sari et al., 2024; Utaminingsih, 2021; Verawati et al., 2022). These studies show that using local cultural practices, such as traditional building techniques or environmental management, can provide an effective context for teaching physics. Ethnophysics seeks to bridge this gap by introducing cultural relevance into science education (Hidaayatullaah et al., 2021).

However, the application of ethnophysics in physics education still faces various challenges, particularly concerning teachers' readiness to develop teaching modules based on local wisdom. Many teachers are not yet accustomed to or lack the skills needed to integrate cultural aspects into physics instruction (Hidayati et al., 2019; Ng & Nguyen, 2006; Sari et al., 2024). Developing ethnophysics-based teaching modules requires a deep understanding of both physics concepts and local wisdom, as well as the ability to connect the two in meaningful learning contexts.

To address this challenge, conducting workshops on the development of ethnophysics-based teaching modules is crucial. These workshops aim to equip physics teachers with the knowledge and skills necessary to create teaching modules that are not only relevant to local cultural contexts but also capable of enhancing the quality of physics education in schools. By participating in these workshops, teachers are expected to gain confidence in designing and implementing ethnophysics-based teaching modules.

The workshop on developing ethnophysics-based teaching modules is also part of the efforts to support community service programs. As a part of the university's tridharma, community service aims to make a tangible contribution to improving the quality of education in Indonesia. Through these workshops, academics and education practitioners can actively help teachers in the field to provide more contextual and meaningful learning experiences for students (Weller, 2019).

Moreover, this workshop is expected to promote synergy between scientific knowledge and local wisdom in the educational curriculum. By introducing physics concepts through the lens of local culture, students not only learn about physical laws but also understand how these principles are applied in their everyday lives, providing a more holistic learning experience.

Therefore, this study aims to describe the implementation process of the workshop on developing ethnophysics-based teaching modules, focusing on the profiles and perceptions of teachers regarding the development of these modules. The study also seeks to identify ethnophysics themes that emerge from workshop participants, providing a deeper insight into how teachers view the integration of local wisdom into physics education. The findings are expected to identify specific needs of teachers, which can serve as a basis for the development of more structured mentoring and training programs, making high school physics education more relevant, meaningful, and engaging for students.

2. LITERATURE REVIEW

Teaching modules

Teaching modules are essential tools in the learning process, designed to facilitate students in understanding the material independently or under the guidance of a teacher (Al Mamun et al., 2020; Lau, 2014; Yusro et al., 2023). An effective teaching module must meet certain criteria, such as clear learning objectives, material relevance to the learning context, and activities that promote active student engagement (Efendi et al., 2020). Teaching modules serve as aids for teachers to present lesson content systematically and structurally, and as guides for students to comprehend and apply the concepts being taught. According to Abou El-Seoud et al., 2015, a good teaching module should be interactive, engaging, and capable of stimulating students' motivation to learn.

Community empowerment, particularly in the context of education, plays a crucial role in the development of teaching modules. Through community service programs, academics and education practitioners can provide training and support to teachers in developing teaching modules that align with local needs and curriculum demands. Such programs not only help improve the quality of teaching modules used in schools but also strengthen teachers' capacity to develop innovative and contextual learning materials.

Ethnophysics

Ethnophysics is an educational approach that integrates local wisdom and cultural traditions into the teaching of physics (Batlolona et al., 2022; Festiyed et al., 2024). This approach enables students to grasp physics concepts through phenomena found in their everyday lives, making learning more relevant and easier to understand (Supriyono & Dewi, 2017). Ethnophysics utilizes various aspects of local culture, such as traditional technologies, customs, and arts, to explain physics concepts that are often perceived as abstract by students. Consequently, ethnophysics plays a crucial role in strengthening students' cultural identity while facilitating their understanding of scientific concepts (Festiyed et al., 2024).

Community empowerment in the context of ethnophysics involves the active participation of various stakeholders, including teachers, students, and the local community. Community service programs focused on ethnophysics typically include training for teachers to identify and integrate local cultural elements into physics

education. This approach not only enriches students' learning experiences but also contributes to the preservation of local culture through education. Additionally, collaboration between academics, teachers, and local communities in developing ethnophysics can create learning models that are contextual and relevant to local needs.

Ethnophysics-based Teaching Modules

Ethnophysics-based teaching modules represent an innovative approach in education that combines the module-based teaching method with ethnophysics concepts (Pela et al., 2023). These modules are designed to integrate local wisdom into physics instruction, allowing students to understand physics concepts within the cultural context (Kasi et al., 2021; Midroro et al., 2022). Developing ethnophysics-based teaching modules requires a deep understanding of both fields and the skills to connect physics concepts with local cultural elements.

Creating ethnophysics-based teaching modules is often supported through community service programs that empower communities, where teachers receive training and support to develop these modules. Such programs usually involve collaboration between universities, schools, and local communities to ensure that the resulting modules are not only scientifically relevant but also culturally appropriate. Additionally, these programs aim to enhance teachers' capacity to develop innovative and contextual teaching materials and to reinforce their role as change agents in education.

Overall, the literature suggests that ethnophysics-based teaching modules have significant potential to improve the quality of physics education in schools, especially in regions with rich cultural heritage. However, the success of implementing these modules relies heavily on the support and active participation of various stakeholders, as well as the presence of sustainable community empowerment programs to support the development and implementation of these modules.

3. MATERIALS AND METHOD

This study employs a descriptive qualitative approach to describe the process of conducting a workshop on developing ethnophysics-based teaching modules, focusing on teachers' profiles and perceptions regarding module development. The workshop took place across four meetings from July 27, 2024, to September 7, 2024. However, this research specifically examines the first meeting (July 27, 2024) and the second meeting (August 3, 2024). The workshop participants were high school physics teachers from various regions in Indonesia, including West Java, Central Java, East Java, West Nusa Tenggara, Riau, West Sumatra, and South Sumatra. The sample consisted of 97 high school teachers, providing diverse insights based on their backgrounds and geographical contexts. This geographic diversity aims to offer a more comprehensive view of the application of ethnophysics across different areas. The age range of participants in the workshop also varied widely, as illustrated in Figure 1.

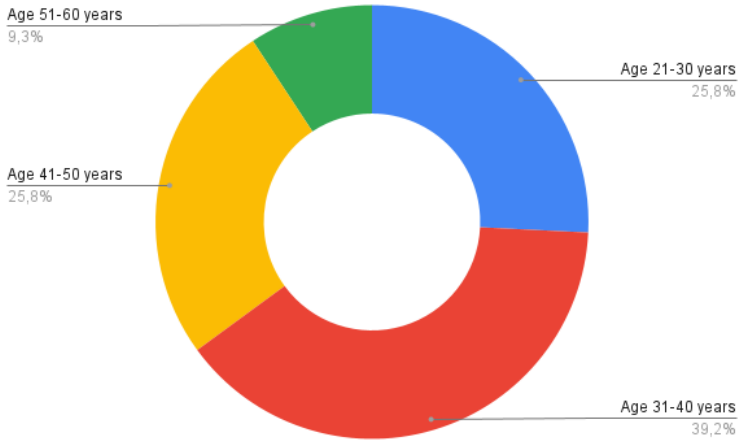


Figure 1. Percentage Distribution of Workshop Participants' Age Range

The instruments used in this study include a survey questionnaire consisting of 16 items (11 closed-ended questions and 5 open-ended questions). The closed-ended questions are designed to collect structured quantitative data regarding challenges and general perceptions of integrating ethnophysics into physics education. Meanwhile, the open-ended questions are aimed at exploring in-depth perspectives and personal experiences of teachers in applying ethnophysics.

Data analysis employs a descriptive quantitative approach. Data from closed-ended questions are analyzed using descriptive statistics to provide an overview of teachers' profiles and perceptions related to the needs in developing ethnophysics-based teaching modules for physics education. The results are presented in terms of percentages, averages, and frequency distributions to identify general trends and patterns emerging from the teachers' responses. For data obtained from open-ended questions, content analysis is used to identify recurring themes and patterns in the teachers' answers. Each response is coded and grouped into relevant categories, which are then further analyzed to explore teachers' views and personal experiences in the development and implementation of ethnophysics-based teaching modules. The combination of descriptive statistical analysis and content analysis allows for a comprehensive understanding of teachers' needs and their perspectives on strengthening and supporting the application of ethnophysics.

4. RESULTS AND DISCUSSION

The workshop sessions that are the focus of this study were held online via a video conferencing application on July 27, 2024, and August 3, 2024. During the first meeting,

participants were presented with information on what, why, and how to integrate local potential and wisdom into teaching modules, and how to implement these in their lessons, provided by community service facilitators. Documentation of the online workshop activities can be seen in Figure 2.

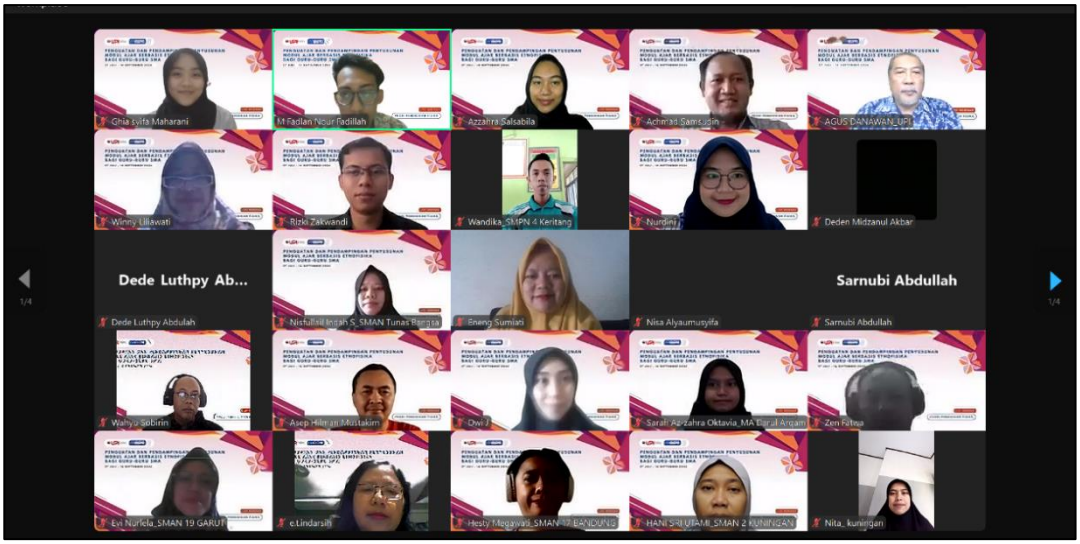


Figure 2. Implementation of the Ethnophysics-Based Teaching Module Development Workshop

The first session of the workshop, participants were provided with a questionnaire to assess their profiles and perceptions regarding ethnophysics-based teaching modules in physics education. At the end of the session, participants were also tasked with identifying local knowledge and practices relevant to physics concepts and selecting one theme to be explored and discussed in the subsequent session. Participants worked asynchronously on the provided worksheets until the next synchronous meeting via the video-conferencing application.

The focus of second session is shifted to in-depth discussions of the materials presented in the first meeting and the completed worksheets. This discussion aimed to reinforce participants' understanding of ethnophysics-based teaching modules and identify challenges and opportunities in integrating local wisdom into physics education. Participants were divided into six groups, each led by a facilitator.

The facilitators were responsible for guiding the discussions, offering constructive feedback, and ensuring that each group member understood the steps required in developing ethnophysics-based teaching modules. Additionally, facilitators assisted participants in overcoming difficulties related to identifying and integrating local potential into physics teaching materials.

Within these groups, participants presented the results of their identification of local knowledge and practices relevant to physics concepts from the previous asynchronous worksheet work (see Figure 3). Each group then discussed the chosen themes, exploring various ways to link physics concepts with existing local wisdom. This discussion also included teaching strategies to ensure that the developed teaching modules were not only

contextual but also aligned with the Learning Outcomes (LO) of the Physics curriculum from the Merdeka Curriculum (Amidi et al., 2023; Yusro et al., 2023).

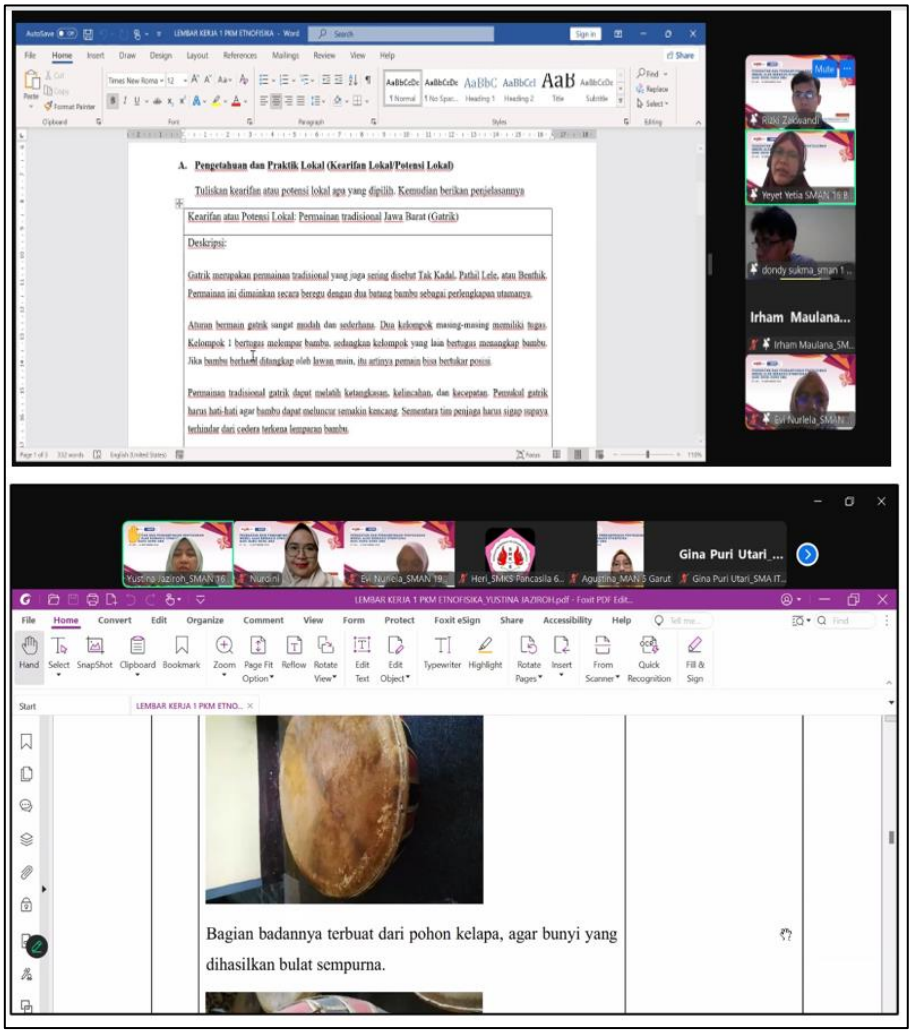


Figure 3. Presentation of Results from Identifying Local Knowledge and Practices Relevant to Physics Concepts

During the discussion, facilitators provided guidance and suggestions to improve and refine the teaching modules being developed by the participants. They also assisted participants in identifying additional resources that could enrich the teaching material, such as local case studies, traditional teaching aids, or relevant cultural documentation. This process is expected to encourage participants to think creatively and innovatively in developing teaching modules that are not only aligned with curriculum standards but also relevant to the local cultural context of their students (Harris & De Bruin, 2018; Rodriguez Bernal, 2017).

Profile of Teachers in the Ethnophysics Workshop

The analysis of senior high school teachers' needs for strengthening and supporting the development of ethnophysics-based teaching modules was conducted through an initial survey completed by 97 high school teachers from various regions in Indonesia. This survey was conducted online via Google Forms and included teachers from both

private and public schools (Figure 4). Among the 97 teachers participating in this community service program, 76.3% are from public schools, while 23.7% are from private schools. This indicates that the majority of participants in this community service program come from public schools. Additionally, based on the school address data (Figure 3), 64.9% of respondents are from schools located in districts, while 35.1% are from schools located in cities. Comparing the number of respondents from districts and cities, it can be concluded that most respondents are from district areas. This shows that the community service program has reached more teachers in rural areas compared to urban areas.

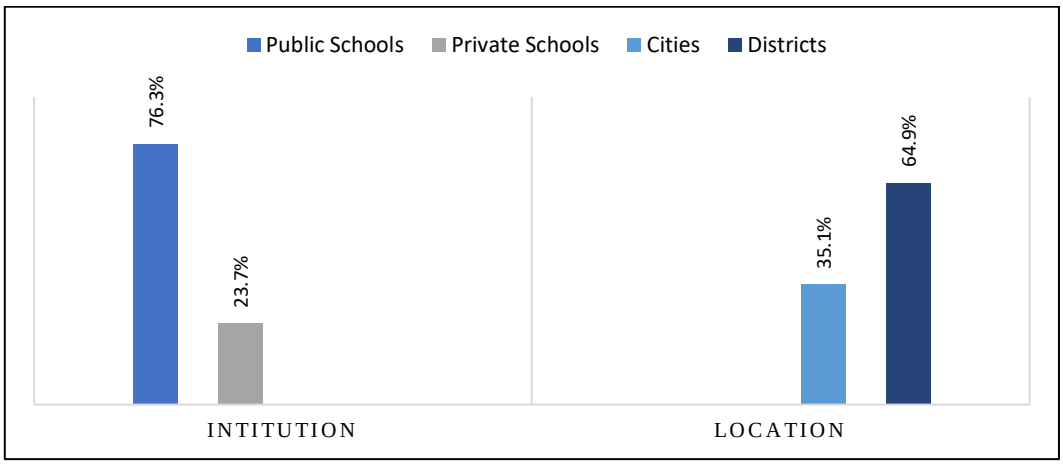


Figure 4. Profile of Workshop Participant

Preliminary Survey on Ethnophysics

This initial survey focused on teachers' understanding of ethnophysics, serving as a foundation for designing effective support and mentoring programs. The survey (Figure 5) shows that 53% of respondents had never heard of ethnophysics, while 47% had heard of it through social media (42.3%), seminars (23.7%), colleagues (11.3%), and scientific articles (9.3%). This indicates that ethnophysics is still a relatively new concept for most teachers.

Ethnophysics remains a relatively new concept for most teachers due to several factors: (a) Lack of awareness: Ethnophysics, as a teaching approach that integrates physics concepts with local wisdom, has not been widely promoted or popularized among teachers. The lack of information and learning resources on ethnophysics means that many teachers are unfamiliar with this concept. (b) Limited access: Teachers, especially in remote areas, may have limited access to information sources and training on ethnophysics (Lins et al., 2019). The lack of opportunities to learn and develop knowledge of ethnophysics makes it difficult for them to apply this concept in teaching (Batlolona et al., 2022). (c) Lack of support: Support from educational institutions and the government for the development and implementation of ethnophysics is still limited. This lack of support reduces teachers' motivation to learn and apply ethnophysics in their teaching (Festiyed et al., 2024; Walid et al., 2022). (d) Limited research and development: Research and development on ethnophysics are still limited, so there are few readily

available teaching materials and learning modules. This makes it difficult for teachers to implement ethnophysics in their teaching.

Although still relatively new, ethnophysics has great potential to improve the quality of physics education and make learning more relevant to local cultural contexts (Festiyed et al., 2024). Therefore, efforts are needed to introduce, promote, and develop ethnophysics so that it can be accessed and applied by more teachers.

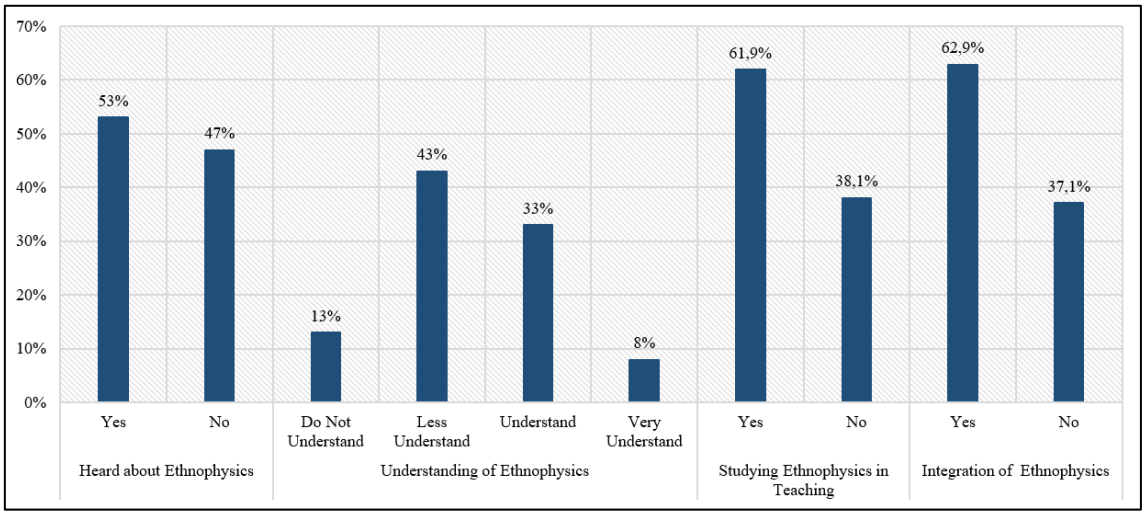


Figure 5. Percentage of Teachers' Initial Understanding of Ethnophysics

Figure 5 illustrates the level of teachers' understanding of the concept of ethnophysics in the context of physics education. Out of 97 respondents, 13% stated that they do not understand (score 1), 43% stated that they have less understanding (score 2), 33% stated that they understand (score 3), and 8% stated that they understand very well (score 4). Additionally, the survey results show that 61.9% of teachers have never studied local or cultural concepts in teaching physics. This suggests that the integration of local culture into physics teaching is still not a common practice among teachers.

In the section on the integration of ethnophysics in Figure 5, it shows that 62.9% of teachers have never integrated local or cultural concepts into their physics teaching, while 37.1% stated they have. This indicates that the integration of local culture into physics education remains uncommon among teachers.

Figure 6 shows that the majority of teachers have a positive perception of the importance of integrating local culture into physics education. No teachers indicated disagreement/that it is unimportant (score 1). These results suggest that teachers generally recognize the significance of integrating local culture into physics education. They understand that this approach can help students better grasp physics concepts and enhance their interest in learning.

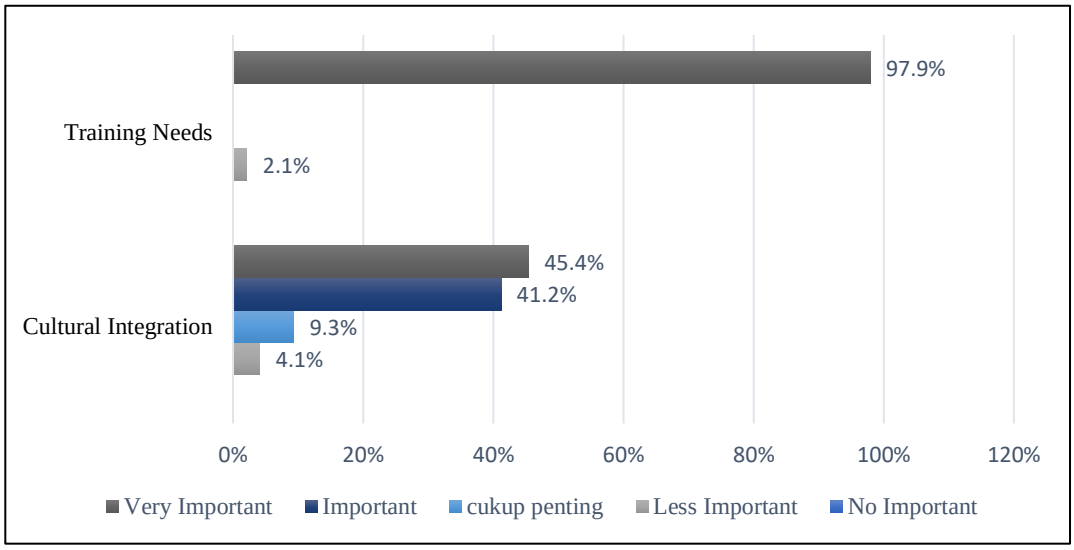


Figure 6. The Importance of Local Culture Integration and the Need for Training in Physics Education

Based on the survey results, it can be concluded that teachers have a positive perception of the importance of integrating local culture into physics education. Nevertheless, there is still a small proportion of teachers who are less supportive or disagree with this concept. The development of structured and sustainable reinforcement and mentoring programs, involving experts and practitioners in the field of ethnophysics, can assist teachers in better understanding and implementing this concept in teaching.

Figure 6 also indicates that nearly all respondents (97.9%) stated that they require specific training to develop ethnophysics-based teaching modules. Only 2.1% of respondents said they do not need training. These findings demonstrate that teachers recognize the importance of specialized training to help them develop effective ethnophysics-based teaching modules (Adam et al., 2024; Habibi et al., 2023). They understand that this approach requires specific knowledge and skills that they do not always possess. Based on the survey results, it can be concluded that teachers strongly need specialized training to develop ethnophysics-based teaching modules. This perception reflects teachers' awareness of the need to enhance their competencies in integrating physics concepts with local wisdom. The development of structured and sustainable training programs, involving experts and practitioners in ethnophysics, can help teachers gain a better understanding of and implement this concept in teaching (Festiyed et al., 2024).

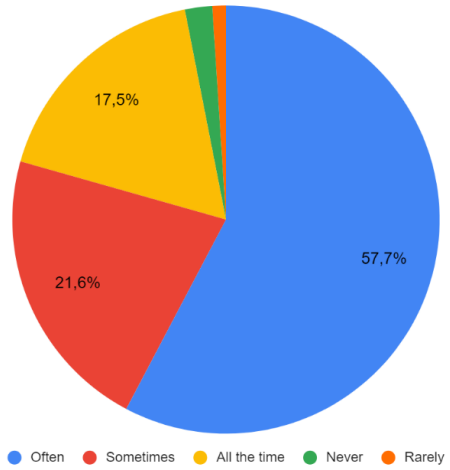


Figure 7. Use of Physics Teaching Modules

The use of teaching modules in physics instruction remains a common practice among teachers. The majority of teachers reported that they frequently or occasionally use teaching modules. However, there is still a small proportion of teachers who rarely or never use teaching modules (Figure 7).

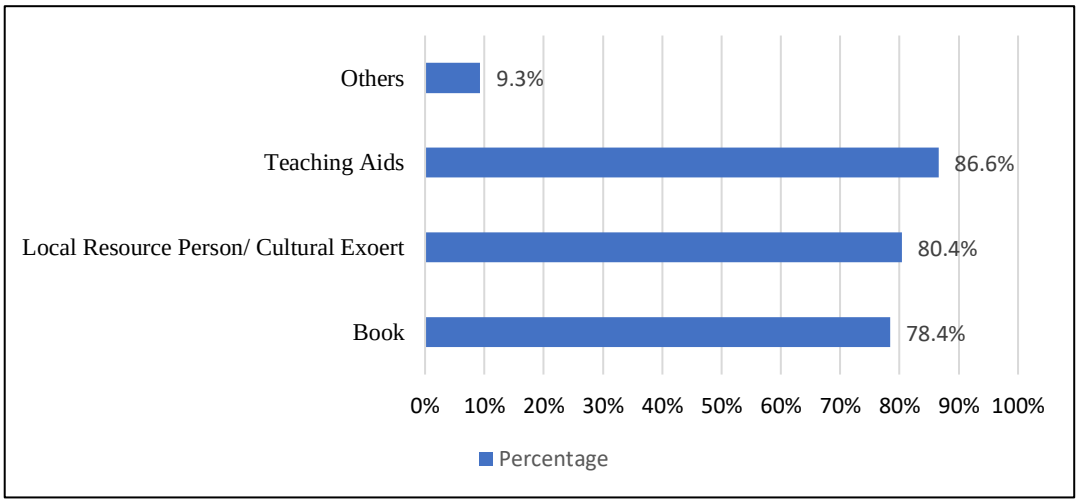


Figure 8. Resources Used in Developing Ethnophysics-Based Teaching Modules

Figure 8 shows that teachers require local resource persons or cultural experts (80.4%), teaching aids (86.6%), books (78.4%), and others (9.3%), including scientific articles, social media, and internet searches as the most important resources in developing ethnophysics-based teaching modules. This indicates that teachers are aware of the importance of incorporating local wisdom and using visual aids in teaching. Although books are also considered important, the proportion of teachers selecting them is lower than those who chose local resource persons/cultural experts and teaching aids. This suggests that teachers place more emphasis on direct interaction with local wisdom and the use of visual aids to strengthen students' understanding (Mungmachon, 2012).

Based on the survey results, it can be concluded that teachers consider local resource persons/cultural experts and teaching aids as the most important resources in developing ethnophysics-based teaching modules. This shows that teachers recognize the importance of incorporating local wisdom and using visual aids in teaching. The development of structured and continuous strengthening and mentoring programs, involving local resource persons and providing access to relevant teaching aids, can help teachers more effectively integrate physics concepts with local culture (Nielsen et al., 2016; Sari et al., 2024).

According to teachers, key elements that need to be included in ethnophysics-based teaching modules to enhance the effectiveness of learning include real-life examples of physics applications in local culture (92.8%), local wisdom-based practicum activities (80.4%), interactive learning media (79.4%), discussion and case studies (68%), and others suggested including examples of projects and ethnophysics-based assessments. This demonstrates that teachers understand the importance of connecting physics concepts to real-life contexts, actively engaging students in learning, and using engaging and interactive media. Based on the survey results, it can be concluded that teachers recognize the importance of incorporating real-life examples, practicum activities, and interactive learning media in ethnophysics-based teaching modules. This indicates that teachers understand the importance of student-centered learning that is culturally relevant and engaging (Tanase, 2020). The effective development of ethnophysics-based teaching modules requires careful consideration of these elements.

Identification of Local Knowledge and Practices Relevant to Physics Concepts

Participants successfully identified various local knowledge and practices relevant to physics concepts through a series of workshops and discussions with physics teachers from different regions in Indonesia. The participants came from provinces such as West Java, Central Java, East Java, West Nusa Tenggara, Riau, West Sumatra, and South Sumatra, each with unique local wisdom. The results of the participants' worksheets revealed numerous local knowledge and practices relevant to physics concepts, which can be seen in Table 1.

Table 1. Local Knowledge and Practices Relevant to Physics Concepts

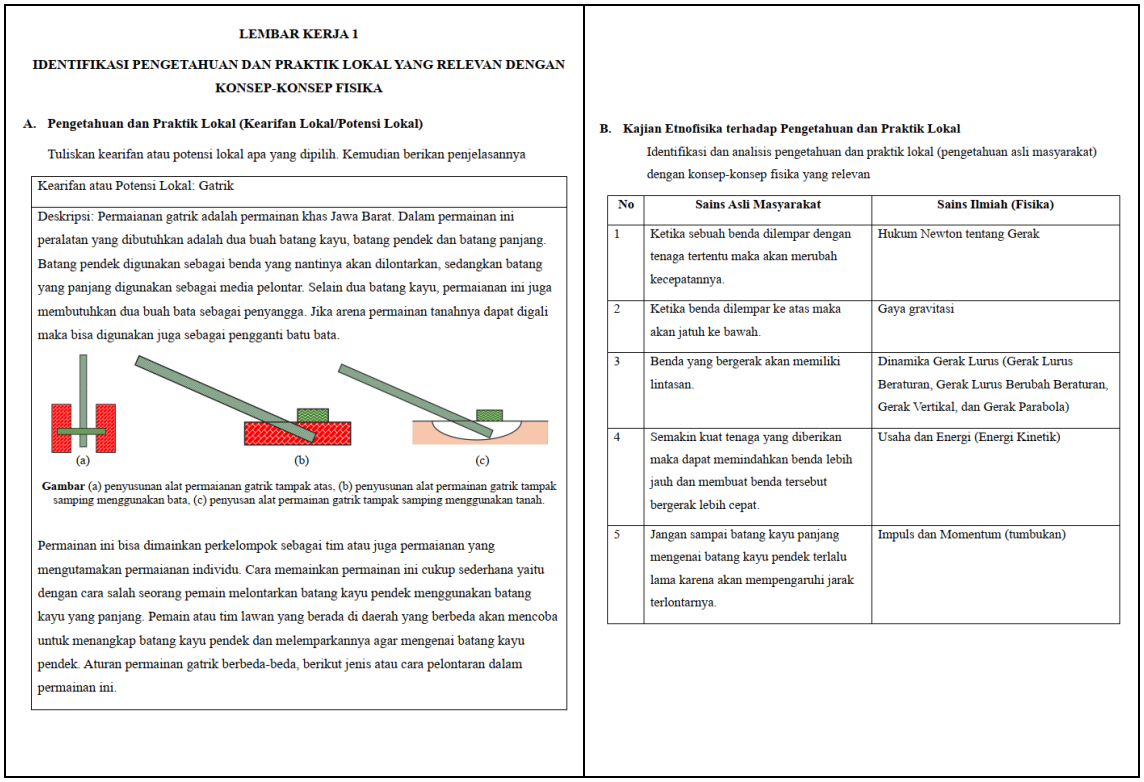
No	Physics Concepts	Local Knowledge and Practices
1	Vector	*Boy-Boyan, Kelereng*
2	Dynamics of linear motion	*Boy-Boyan, Gatrik, Pacu Jalur, Permainan Gobak Sodor*
3	Momentum and impulse	*Boy-Boyan, Gatrik, Karambol, Permainan Gobak Sodor, Kerajinan Bambu, Domba Garut, Kelereng*
4	Temperature and heat	*Rumah Tradisional Di Karanganyar, Memanaskan Air, Seni Dog Dog Lojor, Rumah Panggung Sunda*
5	Sound waves	*Angklung Dog-Dog Lojor, Lodong, Gamelan Jawa, Gendang Beleq*

6	Force	*Gatrik, Ketapel, Tarik Tambang, Lompat Karet, Permainan Gobak Sodor, Pacu Sampan Leper, Permainan Kelereng, Angklung, Seni Dog Dog Lojor, Domba Garut*
7	Energy	*Gatrik, Lodong, Lompat Karet, Permainan Gobak Sodor, Patok Lele, Permainan Kelereng*
8	Rigid body equilibrium	*Badawang, Seni Dog Dog Lojor, Permainan Perepet Jengkol*
9	Rotational motion	*Gasing, Membuat Batik*
10	Termodynamics	*Lodong, Rumah Panggung Sunda*

Based on Table 1, one example is the traditional game *gatrik*, popular in the West Java region, which involves two wooden sticks: a shorter stick (*gatrik*) that is thrown using a longer stick as a bat, as shown in Figure 9. This activity is relevant to various physics concepts such as projectile motion, momentum, force, and kinetic energy. The identification shows that *gatrik* is not only part of local cultural heritage but can also be used as a practical example for teaching physics concepts contextually. When the *gatrik* is hit and thrown into the air, students can observe the parabolic trajectory, understand the effect of the throwing angle on the distance, and analyze the forces at play. The concept of kinetic energy can be demonstrated through changes in the speed of the *gatrik*, while momentum and impulse are related to the force of the strike. Using *gatrik* as a teaching tool helps students understand physics concepts in a practical and contextual way, making the learning experience more engaging and relevant as it involves physical activities familiar to their culture.

The identification results indicate that integrating local knowledge and practices into physics education can serve as an alternative strategy to enhance student engagement and understanding. By using phenomena familiar to students, learning becomes more contextual, relevant, and easier to grasp (Churchill, 2018). The identified local knowledge not only serves as concrete examples of physics concepts but also provides cultural insights that enrich students' learning experiences (Azam & Goodnough, 2018) .

However, these findings also reveal the challenges faced in implementing ethnophysics-based teaching modules. One of the main challenges is the lack of teachers' understanding of how to effectively integrate local knowledge into the physics curriculum (Henke & Höttecke, 2015). Some teachers find it difficult to design lessons that align with curriculum learning objectives while maintaining the cultural values intended to be conveyed. This highlights the need for ongoing mentoring and training to improve teachers' abilities to develop ethnophysics-based teaching modules.



LEMBAR KERJA 1

IDENTIFIKASI PENGETAHUAN DAN PRAKTIK LOKAL YANG RELEVAN DENGAN KONSEP-KONSEP FISIKA

A. Pengetahuan dan Praktik Lokal (Kearifan Lokal/Potensi Lokal)

Tuliskan kearifan atau potensi lokal apa yang dipilih. Kemudian berikan penjelasannya

Kearifan atau Potensi Lokal: Gatrik

Deskripsi: Permaianan gatrik adalah permainan khas Jawa Barat. Dalam permainan ini peralatan yang dibutuhkan adalah dua buah batang kayu, batang pendek dan batang panjang. Batang pendek digunakan sebagai benda yang nantinya akan dilontarkan, sedangkan batang yang panjang digunakan sebagai media pelontar. Selain dua batang kayu, permaianan ini juga membutuhkan dua buah bata sebagai penyangga. Jika arena permainan tanahnya dapat digali maka bisa digunakan juga sebagai pengganti batu bata.

(a) (b) (c)

Gambar (a) penyusunan alat permaianan gatrik tampak atas, (b) penyusunan alat permainan gatrik tampak samping menggunakan bata, (c) penyusan alat permainan gatrik tampak samping menggunakan tanah.

Permainan ini bisa dimainkan perkelompok sebagai tim atau juga permaianan yang mengutamakan permaianan individu. Cara memainkan permainan ini cukup sederhana yaitu dengan cara salah seorang pemain melontarkan batang kayu pendek menggunakan batang kayu yang panjang. Pemain atau tim lawan yang berada di daerah yang berbeda akan mencoba untuk menangkap batang kayu pendek dan melemparkannya agar mengenai batang kayu pendek. Aturan permainan gatrik berbeda-beda, berikut jenis atau cara pelontaran dalam permainan ini.

B. Kajian Etnofisika terhadap Pengetahuan dan Praktik Lokal

Identifikasi dan analisis pengetahuan dan praktik lokal (pengetahuan asli masyarakat) dengan konsep-konsep fisika yang relevan

No	Sains Asli Masyarakat	Sains Ilmiah (Fisika)
1	Ketika sebuah benda dilempar dengan tenaga tertentu maka akan merubah kecepatannya.	Hukum Newton tentang Gerak
2	Ketika benda dilempar ke atas maka akan jatuh ke bawah.	Gaya gravitasi
3	Benda yang bergerak akan memiliki lintasan.	Dinamika Gerak Lurus (Gerak Lurus Beraturan, Gerak Lurus Berubah Beraturan, Gerak Vertikal, dan Gerak Parabola)
4	Semakin kuat tenaga yang diberikan maka dapat memindahkan benda lebih jauh dan membuat benda tersebut bergerak lebih cepat.	Usaha dan Energi (Energi Kinetik)
5	Jangan sampai batang kayu panjang mengenai batang kayu pendek terlalu lama karena akan mempengaruhi jarak terlontarnya.	Impuls dan Momentum (tumbukan)

Figure 9. Example of Workshop Participant's Response Sheet on Local Culture *Gatrik* in West Java

Overall, the results and discussion of this research show that the identification and integration of local knowledge into physics teaching modules hold great potential to improve the quality of learning and strengthen the role of education in cultural preservation. However, to achieve optimal success, continuous support in the form of training and mentoring for teachers is necessary to address the various challenges that arise in the development of ethnophysics-based teaching modules.

5. CONCLUSIONS

Based on the research findings, it can be concluded that the workshop on strengthening the development of ethnophysics-based teaching modules has enabled teachers to identify and plan teaching modules that align with the local wisdom of their respective regions. The findings indicate that while most teachers have a positive perception of ethnophysics, they still face challenges in implementing it, particularly in integrating local knowledge and practices into teaching modules that meet curriculum standards. The identification of relevant local knowledge, such as traditional games, cultural arts, and handicrafts, demonstrates significant potential for making physics concepts more contextual and easier to understand.

The implications are that structured and ongoing training and support are essential to help teachers overcome obstacles in developing ethnophysics-based teaching modules. Enhancing teachers' competencies in this area will not only enrich the teaching material

but also bridge the gap between the physics concepts taught and the cultural context of students. Collaboration among teachers, facilitators, and local cultural experts should be continuously strengthened to ensure that the developed teaching modules meet curriculum standards while preserving deep local cultural values.

Therefore, there is a need to develop advanced training programs involving more local experts and ethnophysics specialists to support teachers in deepening their understanding. Providing additional resources, such as traditional teaching aids and interactive learning media based on local wisdom, will also be highly beneficial in the learning process. Additionally, continuous evaluation of the developed teaching modules is necessary to ensure that this ethnophysics approach is effective and positively impacts the quality of physics education across various regions.

6. ACKNOWLEDGEMENT

The author expresses gratitude to Universitas Pendidikan Indonesia for the support and facilities provided during the implementation of this research. Appreciation is also extended to the Community Service Team of the Ethnophysics-Based Teaching Module Workshop for their assistance, advice, and contributions to this research. We also acknowledge the contribution of the Faculty of Mathematics and Natural Sciences Education at UPI. This financial support greatly assisted in the completion of this research.

7. REFERENCES

Abou El-Seoud, M. S., El-Khouly, M., & Taj-Eddin, I. A. T. F. (2015). Strategies to enhance learner's motivation in e-learning environment. *2015 International Conference on Interactive Collaborative Learning (ICL)*, 944–949.

Adam, U. A., Onowugbeda, F. U., Islami, N., & Ogolo, K. G. (2024). Testing the potency of ethnoscience instruction on biology students' critical thinking ability. *The Journal of Educational Research*, *117*(4), 218–227.

Agustinasari, A., & Fiqry, R. (2023). An exploratory study of the ethnophysics concept in the spiritual dance of mpa'a toja-kalero donggo to identify physics learning content as a learning resource. *JIPI (Jurnal IPA Dan Pembelajaran IPA)*, *7*(4), 335–344.

Al Mamun, M. A., Lawrie, G., & Wright, T. (2020). Instructional design of scaffolded online learning modules for self-directed and inquiry-based learning environments. *Computers & Education*, *144*, 103695.

Amidi, Prasetyo, B., Yuwono, C., Mubarok, D., & Praneswari, P. M. (2023). Optimalisasi Implementasi Kurikulum Merdeka SMP Darul Ihsan Muhammadiyah Sragen. *Prosiding Seminar Nasional Pengabdian Kepada Masyarakat*, *4*(1 SE-Pendidikan). https://journal.unj.ac.id/unj/index.php/snppm/article/view/39540

Azam, S., & Goodnough, K. (2018). Learning together about culturally relevant science teacher education: Indigenizing a science methods course. *International Journal of*

Innovation in Science and Mathematics Education, *26*(2).

Batlolona, J. R., Leasa, M., Papilaya, P. M., Jamaludin, J., & Taihuttu, J. (2022). Exploration of Students' Conceptual Understanding and Ethnophysics: A Case Study of Tifa In The Tanimbar Islands, Indonesia. *Jurnal Penelitian Pendidikan IPA*, *8*(6), 2717–2727.

Bennett, T. (2015). Cultural studies and the culture concept. *Cultural Studies*, *29*(4), 546–568.

Chan, C. S. (2022). Culture and identity. *Hong Kong History: Themes in Global Perspective*, 157–180.

Churchill, S. D. (2018). Explorations in teaching the phenomenological method: Challenging psychology students to "grasp at meaning" in human science research. *Qualitative Psychology*, *5*(2), 207.

Efendi, R., Rustaman, N. Y., Liliawati, W., & Suhara. (2020). Penguatan dan Pendampingan Kompetensi Asesmen Autentik Penalaran Tingkat Tinggi pada Guru Sains MTS Jawa Barat. *Prosiding Seminar Nasional Pengabdian Kepada Masyarakat*, *1*(01 SE-Pendidikan). https://journal.unj.ac.id/unj/index.php/snppm/article/view/19674

Festiyed, F., Asrizal, A., Mufit, F., Tanjung, Y. I., Gunawan, R. G., Ilwandri, I., & Zulherman, Z. (2024). Ethnophysics Studies in Various Indonesian Cultures: A Systematic Literature Review. *Journal of Innovation in Educational and Cultural Research*, *5*(1), 170–180.

Govender, N., & Mudzamiri, E. (2022). Incorporating indigenous artefacts in developing an integrated indigenous-pedagogical model in high school physics curriculum: views of elders, teachers and learners. *Cultural Studies of Science Education*, *17*(3), 827–850.

Gunawan, Y. Y., Sarwanto, S., & Nurosyid, F. (2019). The analysis of students' critical thinking skill through ethnoscience instruction integrated on the topic of magnetic field. *AIP Conference Proceedings*, *2194*(1).

Habibi, H., Herayanti, L., & Sukroyanti, B. A. (2023). Development Of Ethnophysics-Based Teaching Materials To Improve The Self-Regulatory Skills Of Prospective Physics Teachers. *Jurnal Penelitian Pendidikan IPA*, *9*(SpecialIssue), 724–731.

Harris, A., & De Bruin, L. R. (2018). Secondary school creativity, teacher practice and STEAM education: An international study. *Journal of Educational Change*, *19*, 153–179.

Henke, A., & Höttecke, D. (2015). Physics teachers' challenges in using history and philosophy of science in teaching. *Science & Education*, *24*, 349–385.

Hidaayatullaah, H. N., Suprapto, N., Hariyono, E., Prahani, B. K., & Wulandari, D. (2021). Research trends on ethnoscience based learning through bibliometric analysis: Contributed to physics learning. *Journal of Physics: Conference Series*, *2110*(1), 12026.

Hidayati, F., Sahyar, S., Derlina, D., Sinaga, B., & Ginting, E. (2019). Improve Students' Generic Science Skill and Self-Regulated Learning Using Cooperative Learning

Model Based on Malay Culture. *Proceedings of The 5th Annual International Seminar on Trends in Science and Science Education, AISTSSE 2018, 18-19 October 2018, Medan, Indonesia*.

Hikmawati, H., Suastra, I. W., & Pujani, N. M. (2021). Ethnoscience-based science learning model to develop critical thinking ability and local cultural concern for junior high school students in Lombok. *Jurnal Penelitian Pendidikan IPA*, *7*(1), 60–66.

Kasi, Y. F., Samsudin, A., Widodo, A., & Riandi, R. (2021). A thematic review on exploring ethnoscience in science education: a case in Indonesia. *Tadris: Jurnal Keguruan Dan Ilmu Tarbiyah*, *6*(2), 229–241.

Lau, K. H. V. (2014). Computer-based teaching module design: principles derived from learning theories. *Medical Education*, *48*(3), 247–254.

Lins, L. D., Coelho, M. C., Lins, S. V. S., & Messeder, M. L. L. (2019). Conceptions of interculturality in Physics Education in Bahia. *International Journal of Advanced Engineering Research and Science*, *6*(5), 82–86.

Midroro, J. N., Prastowo, S. H. B., & Nuraini, L. (2022). The development of an integrated interactive digital physics module for the larung sesaji culture of the coastal community of jember regency. *Journal of Natural Science and Integration*, *5*(1), 136.

Morales, M. P. E. (2016). Exploring indigenous game-based physics activities in pre-service physics teachers' conceptual change and transformation of epistemic beliefs. *Eurasia Journal of Mathematics, Science and Technology Education*, *13*(5), 1377–1409.

Mungmachon, M. R. (2012). Knowledge and local wisdom: Community treasure. *International Journal of Humanities and Social Science*, *2*(13), 174–181.

Ng, W., & Nguyen, V. T. (2006). Investigating the Integration of Everyday Phenomena and Practical Work in Physics Teaching in Vietnamese High Schools. *International Education Journal*, *7*(1), 36–50.

Nielsen, N., Schweingruber, H., & Wilson, S. (2016). *Science teachers' learning: Enhancing opportunities, creating supportive contexts*. National Academies Press.

Pela, S. O., Le, N. N., Kaboro, P. G., & Nurjamil, A. (2023). Innovation of Physics E-Module: Utilizing Local Wisdom of Lampung's Handwritten Batik in Teaching Heat and Temperature Material to Foster Students' Scientific Attitude. *Schrödinger: Journal of Physics Education*, *4*(4), 132–138.

Pieter, J., & Risamasu, P. V. M. (2024). Integrating Ethnoscience in Physics Teaching Materials and its Impact on Student's Science Process Skills and Mastery Concept. *Jurnal Penelitian Pendidikan IPA*, *10*(6), 2948–2955.

Rodriguez Bernal, C. M. (2017). Student-centred strategies to integrate theoretical knowledge into project development within architectural technology lecture-based modules. *Architectural Engineering and Design Management*, *13*(3), 223–242.

Sari, M. P., Muttaqiin, A., Putri, R. E., & Oktavia, R. (2024). Integrating Ethnoscience on Critical-Thinking Oriented Web-Based E-Module of Secondary School Science.

Jurnal Penelitian Pendidikan IPA, *10*(1), 371–384.

Setiawan, B., Innatesari, D. K., Sabtiawan, W. B., & Sudarmin, S. (2017). The development of local wisdom-based natural science module to improve science literation of students. *Jurnal Pendidikan IPA Indonesia*, *6*(1).

Shore, C., & Black, A. (2021). Citizens' Europe and the construction of European identity. In *The Anthropology of Europe* (pp. 275–298). Routledge.

Supriyono, Y., & Dewi, N. S. N. (2017). English Language Immersion Berbasis Kearifan Lokal Bagi Siswa Sekolah Dasar. *Sarwahita*, *14*(02), 140–144.

Tanase, M. (2020). Is good teaching culturally responsive? *Journal of Pedagogical Research*, *4*(3), 187–202.

Utaminingsih, S. (2021). Improving Critical Thinking Ability Through Discovery Learning Model Based on Patiayam Site Ethnoscience. *Journal of Physics: Conference Series*, *1823*(1), 12104.

Verawati, N. N. S. P., Harjono, A., Wahyudi, W., & Gummah, S. (2022). Inquiry-creative learning integrated with ethnoscience: Efforts to encourage prospective science teachers' critical thinking in Indonesia. *International Journal of Learning, Teaching and Educational Research*, *21*(9), 232–248.

Walid, A., Oktaria, S. D., Putra, R. E., & Susanto, E. (2022). Development of an ethnophysic-based module in the Mandailing Tribe, West Pasaman Regency as science teaching materials. *Journal of Physics: Conference Series*, *2165*(1), 12030.

Weller, S. (2019). *Academic practice: Developing as a professional in higher education*.

Yusro, M., Yuliatmojo, P., Triwardana, D., Wiyantoro, H., Sulistiyo, C., Ismaninggar, & Haryanto, M. (2023). Pendampingan Penyusunan Modul Ajar pada Kurikulum Merdeka Menuju Sekolah Menengah Kejuruan Pusat Keunggulan. *Prosiding Seminar Nasional Pengabdian Kepada Masyarakat*, *4*(1 SE-Pendidikan). https://journal.unj.ac.id/unj/index.php/snppm/article/view/39565

Zidny, R., Sjöström, J., & Eilks, I. (2020). A multi-perspective reflection on how indigenous knowledge and related ideas can improve science education for sustainability. *Science & Education*, *29*(1), 145–185.

Zubaidah, S. (2016). Keterampilan abad ke-21: Keterampilan yang diajarkan melalui pembelajaran. *Seminar Nasional Pendidikan*, *2*(2), 1–17.