Development of Physics Ethnoscience-Based Teaching Materials to Enhance Student's Analytical Thinking Skills

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Abstract *- This research aimed to develop physics teaching materials based on ethnoscience by integrating local culture wisdom to enhance high school students' analytical thinking skills. The development model used was the 4D model: Define, Design, Develop, and Disseminate. The teaching materials were designed to meet students' needs and characteristics. The novelty of this research lies in the development of physics teaching materials based on the local ethnoscience of Bau Nyale, systematically designed in accordance with the Merdeka Curriculum to enhance students' analytical thinking skills, thereby fostering contextual, applicable, and culturally responsive physics learning relevant to the demands of the 21st century. Validation results from two experts in content and media indicated that the materials were feasible, with feasibility scores of 75% (valid) and 83.3% (very valid), respectively. Suggestions for improvement were provided regarding examples of ethnoscience and layout design. Practicality test showed a very positive response from the teacher (85%) and a positive response from students (84.8%), indicating that the materials are user-friendly and support meaningful learning. In terms of effectiveness, the teaching materials significantly improved students' analytical thinking skills ($p < 0.001$), with a high average N-Gain score of 0.764. The integration of local cultural context within the materials made physics concepts easier to understand, more contextual, and relevant to daily life, but also contributed to science education in general by fostering culturally responsive learning, strengthening students' ability to connect culture with physics concepts, enhancing appreciation of local wisdom, and providing a reference for the development of ethnoscience-based science education in schools and higher education.*

Keywords: *Teaching materials; Physics Ethnoscience; Analytical Thinking Skills*

INTRODUCTION

Improving the quality of education remains one of the key challenges in the 21st century, particularly in fostering higher-order thinking skills such as analytical and critical thinking. Within the framework of the Merdeka Curriculum, teachers are expected to develop learning materials that are flexible, differentiated, and contextual learning materials so that learning becomes more meaningful and relevant to students' lives (Fianti & Neratania, 2024).

However, in practice, the availability of teaching materials that meet these demands is still limited in many schools. This condition leads to less optimal learning processes, especially in physics, which is often regarded as an abstract subject with concepts that are difficult to grasp without contextual approaches. Sirnoorkar et al., (2023) emphasized that students' difficulties arise not only from the abstract nature of physics but also from weak sensemaking and modeling processes, both of which are essential for building conceptual understanding. Consequently, learning strategies that provide real-world contexts while facilitating scientific modeling are needed to help students construct meaning and strengthen their analytical thinking skills. Recent studies further confirm that the absence of authentic contexts and active student engagement contributes to weak conceptual understanding, thereby necessitating cognitive conflict–based and generative construction strategies to bridge this gap (Akmam et al., 2025). Physics, as a fundamental subject, should not only explain natural phenomena but also foster logical and analytical thinking (Adi et al., 2023).

One approach to bridging this gap is the integration of ethnoscience into the learning process. Ethnoscience involves transforming local scientific knowledge into formal science education, reflecting local wisdom and the community's understanding of their environment (Dinissjah et al., 2019). Research has shown that connecting learning with local wisdom can create a more effective and conducive learning environment because students feel more connected to the subject matter (Hartini et al., 2018). Local wisdom can also serve as a contextual resource, including in physics education. For instance, traditional culinary practices such as making *dawet* and *klepon* involve the concepts of pressure, heat, temperature, and Archimedes' principle (Elisa et al., (2022). Furthermore, Isnaniah (2022) argued that integrating ethnoscience into physics learning not only enhances conceptual understanding but also contributes to improving students' achievement and learning motivation. Contextual physics teaching materials are one concrete form of this integration, which Haryadi & Nurmala, (2021) defined as an approach that helps teachers connect subject matter with real-world situations, thereby enabling students to establish links between what they learn in school and their daily lives. Thus, systematically developed teaching materials based on contextual learning principles and incorporating local cultural phenomena as examples of physics concepts have the potential to enrich students' learning experiences while fostering appreciation for local wisdom.

A key competency targeted by education today is analytical thinking. This includes the ability to distinguish relevant from irrelevant information, organize components of knowledge, and draw conclusions that reflect diverse perspectives (Annisa et al., 2016). analytical thinking supports problem-solving, data analysis, and wise decision-making. However, many students still struggle to demonstrate this skill effectively (Eka et al., 2021).

One strategy to improve students' analytical thinking is through the integration of local culture into learning. For example, coastal communities in Lombok possess various rituals that illustrate the connection between culture and science. One well-known tradition is Bau Nyale, which originates from the legend of Princess Mandalika and involves the periodic appearance of sea worms (nyale) based on tidal cycles and lunar phases (Saharudin, 2016). This tradition reflects not only cultural heritage but also physics concepts such as waves, water pressure, temperature, and cyclical timing.

According to Vygotsky's social constructivism theory, the involvement of social and cultural contexts in learning processes can enhance students' mental activity through the zone of proximal development. Previous studies also indicate that ethnoscience-based teaching materials are effective in improving students' higher-order thinking skills (Fitriani & Setiawan, 2018; Risamasu et al., 2023). In line with this, a literature review by Hidayati & Julianto (2025) affirmed that the ethnoscience approach positively impacts students' critical thinking skills and learning motivation, as they become more actively engaged in connecting scientific concepts with local cultural practices.

Based on this background, this study aims to develop contextual physics teaching materials based on ethnoscience that are effective in improving students' analytical thinking skills. Although numerous studies have highlighted the importance of ethnoscience, most remain limited to conceptual reviews or general integration into learning. Few studies have specifically developed ethnoscience-based physics teaching materials derived from local traditions such as *Bau Nyale*, systematically designed to improve analytical thinking skills among high school students. The results of this study are expected to contribute to the development of physics learning models that are more culturally responsive and relevant to 21st-century demands.

RESEARCH METHODS

This study employed a research and development (R&D) method aimed at producing a valid, practical, and effective physics teaching material based on ethnoscience to enhance students' analytical thinking skills. The development model used was the 4D model (define, design, develop, and disseminate) proposed by Thiagarajan et al. (1974).

The *define* phase includes needs analysis through curriculum analysis, student characteristics, concept analysis, interviews with physics teachers, and literature review. This phase aimed to identify learning problems and the needs for teaching materials that integrate local culture, specifically the Bau Nyale tradition in Lombok.

The *design* stage involved designing the initial draft of the teaching materials. The design activities include developing test instruments for analytical thinking based on Bloom's Taxonomy, to measure analytical thinking, selecting appropriate media, structuring the teaching content, and incorporating cultural elements. The resulting prototype was then evaluated in the develop phase through expert validation and field trials. Validation was conducted by subject matter and media experts, assessing the content, language, presentation, and visual aspects. The selection of only two validators (a subject matter expert and a media expert) was based on efficiency and relevant expertise. Both possess the competencies needed for the development, ensuring the quality of the validation results, despite the limited number of validators. This practice also aligns with previous development research that used a similar number of validators. Following revision based on validation results, the materials were tested in small groups (5-10 students) and then in larger groups (10-30 students). Students' analytical thinking skills were measured through pre-test and post-test assessments that evaluated their ability to differentiate, organize, and construct problem solving based on physics concepts contextualized in local culture.

The instruments used in the study included expert validation sheets, analytical thinking test instruments, and teachers/student response questionnaires. The first validity of the teaching materials validity was assessed using a Likert scale (1–4) and analyzed descriptively to obtain the percentage of validity. The criteria for validity are shown in this table.

Table 1. Validity Criteria for Teaching Materials

Percentage (%)	Description
85-100 %	Very valid
70-84 %	Valid
50-69 %	Fair valid
≤ 50%	Not valid

The formula used to calculate the validity score is:

$$P \frac{\Sigma x}{\Sigma xi} \times 100\% \qquad (1)$$

Description:
P= validity percentage
$\sum$ x= total obtained score
Σxi = ideal maximum score

Due to the limited number of respondents, with only 16 students participating in the trial, a statistical reliability test was not conducted, as the sample size was too small to produce a stable Cronbach's Alpha value. Nevertheless, the instrument was still utilized because its validity met the established criteria and was supported by the assessments of content and media experts. Several items of the instrument were also developed by referring to previously validated instruments, which allows for the assumption of adequate internal consistency. Reliability testing will be an essential step in future studies to ensure the statistical consistency of the scores.

Secondly, practicality of teaching materials. Practicality was measured through questionnaires distributed to teachers and students regarding usability, clarity, and angagement. Responses were analyzed descriptively and converted into percentage scores interpreted as follows.

Table 2. Practicality Level Criteria

Percentage (%)	Category
85-100 %	Very practical
70-84 %	Practical
50-69 %	Fairly practical
≤ 50%	Not practical

To measure the effectiveness of the teaching materials in assessing students' analytical thinking skills, a score improvement analysis using the N-Gain test can be employed. This test is used to determine the extent of students' skill enhancement after using the developed teaching materials. The N-Gain score is calculated using the following formula:

$$N - gain = \frac{Spost - Spre}{Spmax - Spre} \quad (2)$$

Description:
Spos = Posttest score
Spre = Pretest score
Smax = Maximum score

The results of the N-Gain calculation are then interpreted using the classification that has been stated by Meltzer (in Eka et al, 2017) as in Table 3.

Table 3. N- Gain Classification

Value of g	Interpretation
$g > 0{,}7$	High
$0{,}3 < g \leq 0{,}7$	Medium
$g \leq 0{,}3$	Low

This study was conducted in May 2025 at MAN 3 Lombok Tengah, involving students as test subjects for evaluating the developed teaching materials.

RESULTS AND DISCUSSION

Results

This study resulted in the development of ethnoscience-based physics teaching materials designed to enhance the analytical thinking skills of senior high school students. The development process followed the four stages of the 4D model: Define, Design, Develop, and Disseminate.

In the Define stage, interviews and literature reviews were conducted to identify students' learning difficulties and the need for contextualized instructional materials. The findings indicated that students encountered challenges in understanding abstract physics concepts and lacked learning resources that incorporated local cultural contexts.

During the Design stage, the teaching material was developed based on local cultural traditions in Lombok, covering topics such as thermal phenomena, light refraction and reflection, hydrostatic pressure, and ocean dynamics. The material was presented in a printed module format tailored to students' needs and school conditions.

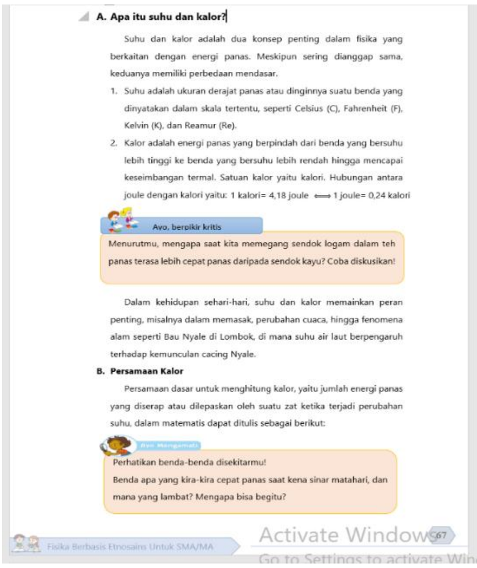
The ethnoscience-based teaching material consists of three main sections: the introduction, the core content, and the closing section.

1. The introduction section includes the cover page, preface, instructions for using the module, table of contents, list of tables, concept map or topic overview, and learning objectives. The following is an example of the cover and of the developed teaching material.

Figure 1. Cover Page and of the Teaching Material

2. Content/ Material Section

   The ore section serves as the main component of the teaching material, presenting contextual content based on the Bau Nyale culture. This section includes an introductory paragraph for each chapter/topic, presentation of the material, learning activities, and example problems. The following is an example of the content layout of the teaching material.



A. Apa itu suhu dan kalor?

Suhu dan kalor adalah dua konsep penting dalam fisika yang berkaitan dengan energi panas. Meskipun sering dianggap sama, keduanya memiliki perbedaan mendasar.

1. Suhu adalah ukuran derajat panas atau dinginnya suatu benda yang dinyatakan dalam skala tertentu, seperti Celsius (C), Fahrenheit (F), Kelvin (K), dan Reamur (Re).
2. Kalor adalah energi panas yang berpindah dari benda yang bersuhu lebih tinggi ke benda yang bersuhu lebih rendah hingga mencapai keseimbangan termal. Satuan kalor yaitu kalori. Hubungan antara joule dengan kalori yaitu: 1 kalori= 4,18 joule ⟷ 1 joule= 0,24 kalori

Ayo, berpikir kritis

Menurutmu, mengapa saat kita memegang sendok logam dalam teh panas terasa lebih cepat panas daripada sendok kayu? Coba diskusikan!

Dalam kehidupan sehari-hari, suhu dan kalor memainkan peran penting, misalnya dalam memasak, perubahan cuaca, hingga fenomena alam seperti Bau Nyale di Lombok, di mana suhu air laut berpengaruh terhadap kemunculan cacing Nyale.

B. Persamaan Kalor

Persamaan dasar untuk menghitung kalor, yaitu jumlah energi panas yang diserap atau dilepaskan oleh suatu zat ketika terjadi perubahan suhu, dalam matematis dapat ditulis sebagai berikut:

Perhatikan benda-benda disekitarmu!
Benda apa yang kira-kira cepat panas saat kena sinar matahari, dan mana yang lambat? Mengapa bisa begitu?

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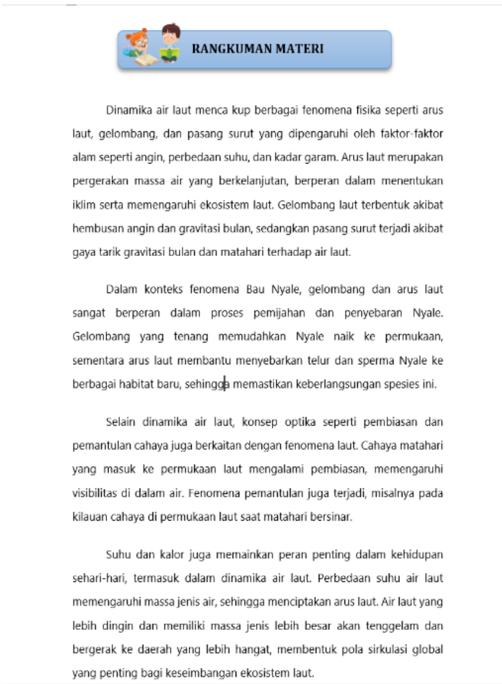
Figure 2. Content Display of the Teaching Material

3. Closing Section

   The losing section consists of a summary of the material, end-of-chapter evaluation/exercise questions, and a bibliography. The following is an example of the layout of the closing section of the teaching material.



RANGKUMAN MATERI

Dinamika air laut mencakup berbagai fenomena fisika seperti arus laut, gelombang, dan pasang surut yang dipengaruhi oleh faktor-faktor alam seperti angin, perbedaan suhu, dan kadar garam. Arus laut merupakan pergerakan massa air yang berkelanjutan, berperan dalam menentukan iklim serta memengaruhi ekosistem laut. Gelombang laut terbentuk akibat hembusan angin dan gravitasi bulan, sedangkan pasang surut terjadi akibat gaya tarik gravitasi bulan dan matahari terhadap air laut.

Dalam konteks fenomena Bau Nyale, gelombang dan arus laut sangat berperan dalam proses pemijahan dan penyebaran Nyale. Gelombang yang tenang memudahkan Nyale naik ke permukaan, sementara arus laut membantu menyebarkan telur dan sperma Nyale ke berbagai habitat baru, sehingga memastikan keberlangsungan spesies ini.

Selain dinamika air laut, konsep optika seperti pembiasan dan pemantulan cahaya juga berkaitan dengan fenomena laut. Cahaya matahari yang masuk ke permukaan laut mengalami pembiasan, memengaruhi visibilitas di dalam air. Fenomena pemantulan juga terjadi, misalnya pada kilauan cahaya di permukaan laut saat matahari bersinar.

Suhu dan kalor juga memainkan peran penting dalam kehidupan sehari-hari, termasuk dalam dinamika air laut. Perbedaan suhu air laut memengaruhi massa jenis air, sehingga menciptakan arus laut. Air laut yang lebih dingin dan memiliki massa jenis lebih besar akan tenggelam dan bergerak ke daerah yang lebih hangat, membentuk pola sirkulasi global yang penting bagi keseimbangan ekosistem laut.

Figure 3. Closing Section of the Teaching Material

In the Develop stage, expert validation was carried out to assess content, language, presentation, and integration of ethnoscientific elements. Two physics education experts acted as validators and assessed the material using a Likert-scale-based evaluation sheet. Furthermore, a limited trial was administered involving teachers and students to assess the practicality of the teaching material as well as their responses. For a more coherent and systematic presentation of the evaluation results, a comparative table summarizing validity, practicality, and students' responses is presented below.

Table 4. Recapitulation of Validity, Practicality, and Students' Responses to the Ethnoscience-Based Teaching Material

Validator Respondents	Score (%)	Qualification	Criteria
Validator 1	75.0%	Valid	Minor revision
Validator 2	83.3%	Valid	Minor revision
Physics subject teacher	85,0 %	Very good	Easy to use and aligned with the characteristics of the learners
Grade XI Science student	84,8 %	Good	Engaging, easy to understand, and relevant to students' cultural experiences

The validation results indicate that the developed teaching material meets the criteria of validity with an average score of 79,2 %, suggesting that it is feasible for use after minor revisions. However, the validation score did not reach the optimal level (>90%), which can be attributed to several factors, including the limited number and variety of ethnoscience examples related to the Bau Nyale phenomenon, visual and layout aspects of the module that require further refinement, and the formulation of questions that have not fully stimulated students' analytical thinking skills. This critical analysis highlights that although the material is valid, further improvements in ethnoscience integration, visualization, and design are necessary to achieve a "highly valid" category in future studies. Teachers evaluated the material as very good (85%) as it supports the learning process through the use of concept maps that facilitate understanding. Students' responses were also positive (84.8%), indicating that the ethnoscience-based approach helped them to comprehend physics concepts more contextually.

In addition, the practicality assessment was reinforced by classroom observation data during the learning process. Students' participation in discussions, ability to construct scientific arguments, and capacity to relate physics concepts to local culture were rated from good to very good.

The effectiveness of the teaching material was further examined through pre-test and post-test assessments of analytical thinking skills. A summary of the results is presented as follows:

Table 5. Pre-Test and Post-Test Data on analytical thinking

Average Pre-test Score	Average Post-test Score	N-gain Score
70.3125	92.578125	0.764508929

The average N-gain score of 0.7645 falls into the high category based on Hake's (1998) criteria, indicating a substantial improvement in students' analytical thinking skills. Furthermore the descriptive statistical analysis indicated an average gain score of 22.266. The Shapiro-Wilk normality test yielded a significance value of $p = 0.323 > 0.05$, confirming that the data were normally distributed. The results of the paired samples t-test revealed a t-value of -10.442 with a significance level of $p < 0.001$, indicating a statistically significant difference between students' pretest and posttest scores.

Discussion

The findings of this study demonstrate that the integration of local culture into physics teaching materials contributes significantly to students' conceptual understanding and analytical thinking skills. Students were not merely memorizing concepts but were able to analyze, evaluate, and connect the material with real-world phenomena familiar to them. The significant improvement in posttest scores, along with a high N-gain score (0.7645), confirms the ability of the teaching materials to facilitate students' cognitive processes, including analyzing information and reasoning logically. The integration of physics concepts with local cultural contexts further enhanced student engagement and enabled more meaningful and contextualized learning.

Statistical evidence, including normally distributed data and significant results from the paired samples t-test, provides strong empirical support for the effectiveness of the developed teaching materials. In addition, the practicality assessment based on teachers' and students' responses indicated that the materials were user-friendly and applicable in real classroom settings. Teachers particularly appreciated the inclusion of concept maps, while students noted that the content was clear and easy to understand.

These results are consistent with the findings of Fianti and Neratania (2024), who reported that physics teaching materials based on the Independent Curriculum with a contextual approach integrated with ethnoscience were feasible for use in learning. The validation process, which involved expert validators and practitioners, resulted in an average feasibility score of 91.3%, categorized as very high.

Classroom observations also revealed that the teaching materials not only supported individual learning but also fostered active and contextual classroom engagement. Students were able to relate the physics content to cultural phenomena in their environment, which helped them develop deeper understanding and apply scientific concepts in real-life contexts.

Accordingly, the product trial confirmed that the ethnoscience-based physics teaching materials met the criteria of validity, practicality, and effectiveness. These materials are considered suitable for classroom implementation and can serve as an innovative and locally relevant alternative in physics education. The study was conducted up to the "Develop" stage of the 4D development model, focusing on producing pedagogical and contextual teaching materials prior to broader application.

Nevertheless, this study has several limitations that should be acknowledged. First, the scope of the trial was limited to a single school, namely MAN 3 Lombok Tengah, which restricts the generalization of the findings to schools with different characteristics and requires further investigation. Second, the implementation of the teaching materials was carried out within a relatively short period and did not include long-term observation of students' analytical skill development. Third, technical constraints, such as time limitations during the research process and limited digital facilities, also posed challenges in the development process. Therefore, further studies involving larger samples and longer implementation periods are needed to obtain more comprehensive results.

CONCLUSION

This study developed a physics teaching material based on ethnoscience using the 4D model (Define, Design, Develop, Disseminate) by integrating the local tradition of Bau Nyale to enhance students' analytical thinking skills. The material was validated by media and content experts, receiving feasibility scores of 75% and 83.3%, indicating it is suitable for use with minor revisions. Trial results showed high practicality, with teacher and student ratings of 85% and 84.8%, respectively. The teaching material also proved effective in improving analytical thinking skills, as evidenced by a statistically significant increase in post-test scores ($p < 0.001$) and a high N-Gain score of 0.764. The incorporation of local cultural context made physics concepts more meaningful and applicable to students' daily lives.

The findings of this study provide practical implications for teachers, educational institutions, and the advancement of scientific knowledge. Teachers may employ the developed teaching materials to bridge abstract physics concepts with students' cultural contexts, thereby fostering a more meaningful and contextualized learning process. For educational institutions, this study offers a model for developing instructional materials that align with the Merdeka Curriculum while simultaneously strengthening learning rooted in local wisdom. Furthermore, the research enriches the field of physics education and ethnoscience, particularly in enhancing students' analytical skills for the 21st century. To ensure broader implementation, dissemination strategies are required, including teacher training through MGMP (Subject Teacher Working Group) communities, the utilization of open-access digital platforms, and collaboration with local education authorities to facilitate the adoption of the modules across schools, adapted to the cultural characteristics of each region.

Accordingly, it is recommended that the implementation of these teaching materials should not be confined to a single school context. Developing a digital version that can be widely accessed, along with collaboration with local education policymakers, is necessary to ensure that these teaching materials may serve as an adaptive model in the comprehensive development of curricula based on local wisdom.

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REFERENCES

Adi, M. F. N., Hakim, L., & Sulistyowati, R. (2023). Pengembangan Media Pembelajaran Fisika Berbasis Etnosains Sejarah Palembang di SMA. *Journal on Teacher Education*, *4*(4), 256–264. https://doi.org/10.31004/jote.v4i4.14417

Akmam, A., Ahzari, S., Emiliannur, E., Anshari, R., & Setiawan, D. (2025). Enhancing Science Literacy through Cognitive Conflict-Based Generative Learning Model: An Experimental Study in Physics Learning. *Social Science and Humanities Journal*, *9*(07), 8507–8522. https://doi.org/10.18535/sshj.v9i07.1934

Annisa, N., Dwiastuti, S., & Fatmawati, U. (2016). Peningkatan Kemampuan Berpikir Analitis Siswa Melalui Penerapan Model Pembelajaran Inkuiri Terbimbing. *Journal of Biology Education*, *5*(2), Article 2. https://doi.org/10.15294/jbe.v5i2.7153

Dinissjah, M. J., Nirwana, N., & Risdianto, E. (2019). Penggunaan Model Pembelajaran Direct Instruction Berbasis Etnosains Dalam Pembelajaran Fisika Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa. *Jurnal Kumparan Fisika*, *2*(2 Agustus), Article 2 Agustus. https://doi.org/10.33369/jkf.2.2.99-104

Eka, I., Irawan, E., Ekapti, R. F., & Faizah, U. N. (2021). Efektivitas Penerapan Model Pembelajaran Problem Based Learning terhadap Peningkatan Keterampilan Berpikir Analitis. *Jurnal Tadris IPA Indonesia*, *1*(2), 108–117. https://doi.org/10.21154/jtii.v1i2.142

Elisa, E., Prabandi, A. M., Istighfarini, E. T., Alivia, H., Inayah H., L. W., & Nuraini, L. (2022). Analisis Konsep-Konsep Fisika Berbasis Kearifan Lokal Pada Jajanan Tradisional Dawet Dan Klepon. *ORBITA: Jurnal Pendidikan dan Ilmu Fisika*, *8*(2), 194. https://doi.org/10.31764/orbita.v8i2.10197

Fianti, F., & Neratania, A. (2024). Developing Physics Teaching Materials Based on Differentiated Merdeka Curriculum Using an Ethnoscience-Integrated Contextual Approach. *Jurnal Inovasi Pendidikan IPA*, *10*(2), Article 2. https://doi.org/10.21831/jipi.v10i2.76663

Fitriani, N. I., & Setiawan, B. (2018). Efektivitas Modul Ipa Berbasis Etnosains Terhadap Peningkatan Keterampilan Berpikir Kritis Siswa. *Jurnal Penelitian Pendidikan IPA*, *2*(2), 71. https://doi.org/10.26740/jppipa.v2n2.p71-76

Hartini, S., Firdausi, S., Misbah, M., & Sulaeman, N. F. (2018). The Development of Physics Teaching Materials Based on Local Wisdom to Train Saraba Kawa Character. *Jurnal Pendidikan IPA Indonesia*, *7*(2), 130–137. https://doi.org/10.15294/jpii.v7i2.14249

Haryadi, R., & Nurmala, R. (2021). Pengembangan Bahan Ajar Fisika Kontekstual Dalam Meningkatkan Motivasi Belajar Siswa. *SPEKTRA: Jurnal Kajian Pendidikan Sains*, *7*(1), 32. https://doi.org/10.32699/spektra.v7i1.168

Isnaniah, N. (2022). *Pembelajaran Fisika Berbasis Etno-STEM melalui Permainan Tradisional Kalimantan Selatan*. *02*(01), 116–121. https://doi.org/10.18592/alkawnu.v1i1.7418

Risamasu, P. V. M., Pieter, J., & Gunada, I. W. (2023). Pengembangan Bahan Ajar IPA SMP Tema Perpindahan Kalor Berkonteks Etnosains Jayapura Papua. *Jurnal Ilmiah Profesi Pendidikan*, *8*(1b), 948–958. https://doi.org/10.29303/jipp.v8i1b.1322

Saharudin, S. (2016). Perilaku Liminal Masyarakat Sasak-Lombok Dalam Bêkayaq Bau Nyalé Dan Pataq Paré. *SASDAYA: Gadjah Mada Journal of Humanities*, *1*(1), 87. https://doi.org/10.22146/sasdayajournal.17036

Sirnoorkar, A., Laverty, J. T., & Bergeron, P. D. O. (2023). *Sensemaking and Scientific Modeling: Intertwined processes analyzed in the context of physics problem solving* (No. arXiv:2207.03939). arXiv. https://doi.org/10.48550/arXiv.2207.03939