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Analysis of the Need for E-LKPD Based on the Ethnoscience of Gula Cakar Majalengka to Improve Science Literacy

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Abstract

This study aims to analyse the needs for the development of ethnoscience-based E-LKPD in science education on the topic of matter and its changes to improve students' science literacy. The research method employed was descriptive with a mixed-methods approach, utilising questionnaires for students and interviews with teachers. The research instruments comprised a Likert-scale questionnaire and an interview guide, both of which had been validated by experts. Data were analysed using percentage calculations and qualitative descriptive analysis. The research results showed that the learning conditions aspect (70.11%) was in the high category, indicating that learning still tended to be teacher-centred. The teaching materials needs aspect (68.75%) was in the high category, indicating a lack of innovative teaching materials and a continued dominance of conventional teaching materials. The ethnoscience aspect (64.40%) fell into the high category, indicating that the potential for ethnoscience integration has not yet been optimally utilised. The E-LKPD requirement aspect (67.39%) fell into the high category, indicating a strong need for interactive and contextual digital teaching materials. Meanwhile, science literacy (58.15%) falls into the moderate category, indicating that students' science literacy skills have not yet developed optimally. Interview results revealed that teaching is still dominated by the lecture method, teaching materials are limited to textbooks and printed worksheets, and the integration of ethnoscience is not yet optimal. These findings indicate a gap between learning needs and current classroom practices. The development of ethnoscience-based E-LKPDs is required as a solution to support interactive, contextual, and meaningful learning, and has the potential to improve students' science literacy.

INTRODUCTION

Science education plays a vital role in equipping students with the ability to understand natural phenomena and make science-based decisions in daily life (Strachan & Markwick, 2025; Tasquier et al., 2022). . This ability is known as science literacy, which is one of the key competencies of the 21st century (Roy et al., 2025). However, results from the Programme for International Student Assessment (PISA) indicate that Indonesian students' science literacy remains relatively

low compared to other countries. This finding is also supported by research showing that science literacy is influenced by contextual learning design and science-based activities (Imron et al., 2025; Li et al., 2021). This situation highlights the need for innovation in science education capable of optimally developing students' science literacy. Various studies also confirm that low science literacy is linked to a lack of context-based learning and meaningful scientific activities (Fayzullina et al., 2023; Gungor et al., 2023).

Science literacy encompasses not only conceptual understanding but also the ability to explain scientific phenomena, interpret data, and use scientific evidence in decision-making. (Almeida et al., 2023; Andriani et al., 2025) . Therefore, science education needs to be designed contextually so that students can relate the concepts they learn to real life. Research indicates that the integration of ethnoscience significantly enhances students' conceptual understanding and scientific literacy (Fianti & Neratania, 2024). Contextual learning approaches also enhance student engagement and strengthen understanding of scientific concepts (Lu et al., 2024). One approach to contextual learning is ethnoscience. Ethnoscience integrates local community knowledge with modern scientific concepts, making learning more relevant to students' lives (Sari et al., 2023). This approach enables students to understand scientific concepts through the cultural practices they encounter in their daily lives. Research indicates that the ethnoscience approach can enhance learning engagement and conceptual understanding through the integration of local culture (Fitria et al., 2025; Sudirman et al., 2025).

The integration of ethnoscience into science education has the potential to improve science literacy by enabling students not only to learn concepts but also to understand their application in real-world contexts. Learning becomes more meaningful and helps develop critical thinking and problem-solving skills (Hikmah et al., 2025). The integration of ethnoscience into science education can improve scientific reasoning skills and evidence-based decision-making (Sparks et al., 2022). The implementation of ethnoscience-based learning still faces various challenges in the field (Damayanti et al., 2024). Teachers find it difficult to integrate local wisdom into their teaching due to a lack of relevant teaching materials (Fathurrochman et al., 2025). Teaching is still dominated by the use of conventional textbooks and worksheets, which tend to be theoretical and lack contextual relevance (Nurrahmah & Afnita, 2025). Research indicates that the scarcity of innovative teaching materials is one of the factors hindering the implementation of learning based on local context and culture. The use of less innovative teaching materials results in learners being less actively engaged in learning and struggling to understand concepts in depth (Feng & Xiao, 2024).

The development of teaching materials that integrate technology and local context has become a necessity (Assefa & Mohammed, 2022; Dewi et al., 2025). In addition, the development of Ethno-STEM-based digital teaching materials has been shown to improve students' chemical literacy and sustainability awareness by integrating scientific concepts with local cultural knowledge and real-life contexts (Harianto, B., Pursitasari, I. D., Heliawati, L., & Syarpin, 2026). Electronic Student Worksheets (E-LKPD) can be used as an alternative, as they enable the presentation of material interactively and contextually (Rahmayani & Atmazaki, 2025). Research indicates that the use of digital-based E-LKPDs is capable of enhancing student engagement, motivation, and learning outcomes (Ghaisani & Setyasto, 2023). In line with this, the development of innovative digital media based on Ethno-STEM has been identified as a key factor in equipping students with the creativity needed to bridge traditional knowledge and scientific concepts (Sudarmin et al., 2024). In a local context, the process of making Majalengka cakar sugar can serve as a contextual learning resource as it involves the concepts of phase changes and chemical reactions.

Majalengka cakar sugar has considerable potential to be utilised as a foundation for ethnoscience-based learning because its production process involves various scientific concepts related to matter and its changes, including heating, melting, crystallisation, and chemical reactions. The integration of local cultural practices into science learning enables students to connect scientific concepts with real-life experiences in their surrounding environment, thereby making learning more contextual and meaningful. Ethnoscience-based learning has been shown to improve students' science literacy through the integration of scientific concepts and local wisdom into learning activities (Heliawati et al., 2022; Fatihatussa'adah et al.,2024). Furthermore, the development of Ethno-STEM-based digital teaching materials has been reported to enhance students' chemical literacy and sustainability awareness by connecting scientific knowledge with local cultural contexts (Harianto, B., Pursitasari, I. D., Heliawati, L., & Syarpin, 2026). Previous studies have also demonstrated that contextual learning based on local culture can increase students' engagement, critical thinking skills, and ability to interpret scientific phenomena in everyday life (Dou, R., & Cian, 2022). Therefore, the ethnoscience of Majalengka cakar sugar provides a relevant opportunity to support the development of ethnoscience-based E-LKPDs aimed at improving students' science literacy. Utilising this context helps learners understand concepts concretely and supports science literacy (Oktaviani & Faizah, 2024). A local context-based approach has been shown to enhance the relevance of learning and the connection between scientific concepts and real life (Chowdhury et al., 2022). Previous research has largely focused on the development of teaching materials and testing their effectiveness, whilst studies on needs analysis remain limited. This situation indicates a gap between the need for science literacy-based learning and the availability of relevant teaching materials. Research confirms that needs analysis is a crucial stage in the development of teaching materials that align with learners' characteristics. This study aims to analyse the needs for the development of an E-LKPD based on the Majalengka sugarcane ethnoscience to support learners' science literacy.

METHODS

This study is a descriptive study employing both quantitative and qualitative approaches, aimed at analysing the needs for the development of E-LKPDs based on ethnoscience regarding the topic of substances and their changes to enhance students' science literacy (Creswell, 2018). The quantitative approach was used to analyse questionnaire data, whilst the qualitative approach was used to describe the results of interviews with teachers. The methods used in this study were surveys and interviews. The data collection instruments consisted of a questionnaire on students' needs and an interview guide for science teachers. The questionnaire was used to identify students' needs regarding learning conditions, teaching materials, science literacy, ethnoscience, and the development of E-LKPDs. Meanwhile, interviews were used to obtain more in-depth information regarding learning conditions, the use of teaching materials, and the challenges faced by teachers in integrating ethnoscience into science lessons. The type of interview used was an open-ended interview, allowing respondents to provide free-flowing and in-depth answers. The subjects of this study were students who had studied the topic of matter and its changes at one junior high school and one Islamic junior high school, as well as science teachers teaching the subject of Natural Sciences at several schools in Majalengka Regency. The sample was determined using purposive sampling, taking into account that the subjects had studied the topic of matter and its changes

The questionnaire was designed using a four-point Likert scale: strongly agree, agree, disagree, and strongly disagree. Scores were assigned sequentially from 4 to 1 for positive statements and vice versa for negative statements. The use of the Likert scale aimed to measure

students' perceptions and needs in a more structured and quantitative manner. Prior to use, the research instrument was validated by experts comprising science education lecturers and science teachers. Instrument validation aims to assess the content, construct, and linguistic validity of each statement item. The validation results were used as the basis for revising the instrument so that it was suitable for data collection. The data obtained from the questionnaire were analyzed using quantitative descriptive analysis techniques by calculating the percentage of each aspect using the formula:

$$P = \frac{f}{N} \times 100\% \quad (1)$$

Explanation:
P = percentage
f = total score obtained
N = maximum score

The percentage results were then categorised into specific criteria to determine the level of need. Meanwhile, the interview data were analysed using qualitative descriptive analysis techniques through the stages of data reduction, data presentation, and drawing conclusions.

RESULT AND DISCUSSION

The results of the needs analysis for developing an ethnoscience-based E-LKPD were drawn from primary and secondary data sources. Primary data were collected through student questionnaires and interviews with science teachers, while secondary data were drawn from the relevant scientific literature on science literacy, ethnoscience, and digital teaching materials. Data reduction was conducted by selecting and categorizing information relevant to learning conditions, teaching materials, science literacy, ethnoscience integration, and the need for E-LKPD development. The reduction of primary data focused on identifying students' learning needs, implementing science learning, using teaching materials, and integrating local cultural contexts into classroom learning. Meanwhile, secondary data reduction was conducted by selecting literature that supported and strengthened the findings obtained from the field. The integration of these data sources was intended to provide a more comprehensive understanding of the need to develop an ethnoscience-based E-LKPD to improve students' science literacy.

Table 1. Results of the Needs Analysis for the Development of Ethnoscience-Based E-LKPD

Aspect	Indicators	Percentage %	Category
Learning Conditions	Learning methods, student participation, classroom interaction, and learning activities	70.11	High
Teaching Material Needs	Availability of teaching materials, innovation of teaching materials, use of digital materials, and contextual learning resources	68.75	High
Science Literacy	Ability to explain scientific phenomena, interpret data, analyse problems, and relate science concepts to daily life	58.15	Moderate
Ethnoscience	Integration of local culture, contextual examples, and the use of local wisdom in learning	64.40	High
Need for E-LKPD	Need for interactive digital materials, accessibility, contextual learning support, and attractiveness of learning media	67.39	High

Based on Table 1, the learning conditions fall into the high category (70.11%). The reduction of questionnaire and interview data indicates that science learning is still dominated by the lecture method and teacher-centred activities. Students stated that classroom learning activities were still focused on listening to explanations from the teacher, while opportunities for discussion and active participation remained limited. Interview results also indicate that learning is still dominated by the lecture method. Teachers stated that "learning still frequently uses the lecture method due to time constraints and the limited teaching materials available." These findings suggest that student engagement in the learning process has not yet been fully optimised.

This situation indicates that learning remains teacher-centred, meaning student engagement is not yet optimal. Effective science learning requires the active involvement of learners in constructing knowledge through meaningful activities (Ekantini & Damayanti, 2023; Hsbullah & Hassan, 2022). Active learning approaches have been shown to enhance students' conceptual understanding and thinking skills (Kestin et al., 2025; Vale & Barbosa, 2023). These findings are consistent with research showing that activity-based and contextual learning improve student engagement and learning outcomes (Anwar et al., 2025; Yani & Widiyatmoko, 2023). Student-centred learning models have a significant impact on improving learning outcomes compared to conventional learning (Soubra et al., 2022). The integration of technology into learning can also enhance student engagement more effectively (Pandita & Kiran, 2023). Contextual learning, which links concepts to real-life situations, can strengthen students' conceptual understanding and critical thinking skills (Pratiwi et al., 2025).

The teaching material needs aspect falls into the high category (68.75%). The reduction of questionnaire data shows that students require more interactive and contextual teaching materials to support science learning. Most students stated that the teaching materials used in the classroom were still limited to textbooks and printed worksheets, resulting in less engaging learning activities. Interview results also revealed that teaching materials were still dominated by textbooks and printed worksheets. Teachers stated that "the teaching materials used are still textbooks and printed worksheets; there are no interactive digital teaching materials." These findings indicate that the teaching materials currently used in science learning have not yet fully supported interactive and contextual learning experiences.

This condition indicates that the available teaching materials are not yet sufficiently innovative or contextual. Digital teaching materials such as E-LKPD have the potential to increase student engagement through more interactive content presentation (Rahmawati & Alimah, 2022). The use of multimedia in learning has also been shown to help students understand abstract concepts more concretely (Mei, 2024). Furthermore, the development of digital teaching materials supports 21st-century learning, which emphasises the integration of technology and higher-order thinking skills (Irwansah et al., 2023). Interactive digital worksheets can also encourage independent learning and increase students' learning motivation (Edwin et al., 2025). Previous studies have shown that digitally designed interactive worksheets are effective in enhancing self-directed learning and student engagement during the learning process.

Science literacy was categorised as moderate (58.15%). The reduction of questionnaire and interview data indicates that students still experience difficulties in understanding scientific concepts, interpreting data, and relating scientific concepts to everyday life. Students also demonstrated limited ability to explain scientific phenomena based on evidence and experimental results. Interview results revealed that students struggled to understand concepts and interpret data. Teachers stated that "students tend to memorise concepts but struggle when asked to explain or analyse experimental data." These findings indicate that science learning has not yet fully facilitated the development of students' science literacy skills.

This condition suggests that the current learning process has not yet optimally developed students' science literacy skills. Science literacy refers to the ability to understand scientific phenomena, interpret data, and make evidence-based decisions (Jeff, 2023). Previous studies indicate that science literacy develops through context-based learning and meaningful scientific

activities. The integration of an ethnoscience approach can help students understand concepts through cultural experiences closely related to their daily lives (Fatihatussa'adah et al., 2024). Inquiry-based learning is also capable of improving students' data analysis skills and scientific reasoning abilities. The connection between scientific concepts and real-life contexts is considered an important factor in improving science literacy (Mohzana et al., 2023).

The ethnoscience aspect falls into the high category (64.40%). The reduction of questionnaire data indicates that students showed interest in learning activities related to local culture and daily life experiences. Students felt that learning became easier to understand when examples were connected to their surrounding environment and local culture. However, interview findings revealed that teachers rarely utilised examples rooted in local culture due to limited references for teaching materials. Teachers stated that "examples based on local culture are rarely used due to a lack of teaching resource references." These findings indicate that the integration of ethnoscience into science learning has not yet been implemented optimally.

This condition suggests that the implementation of ethnoscience in learning has not yet been fully realised. Ethnoscience integrates local knowledge with modern science, making learning more contextual and meaningful (Sihombing et al., 2025). Previous studies have shown that the ethnoscience approach can improve students' conceptual understanding and science literacy. Integrating local culture into learning can also increase students' engagement and learning motivation (Rashed et al., 2025). This approach enables students to understand scientific concepts through real-life experiences encountered in their daily lives. The integration of culture and science also contributes to the development of students' identity and character (Dou & Cian, 2022).

The ethnoscience of Majalengka cakar sugar was considered relevant in this study because its production process reflects several scientific concepts related to matter and its changes, such as heating, melting, crystallisation, and chemical reactions. In addition, the process of making cakar sugar represents local wisdom that is closely connected to students' daily lives in Majalengka Regency, making it a contextual learning resource for science learning. The integration of the cakar sugar ethnoscience into learning can help students relate scientific concepts to real-life experiences, thereby facilitating more meaningful learning processes. Furthermore, contextual learning based on local culture has been shown to improve students' engagement, conceptual understanding, and science literacy through the integration of scientific knowledge and local wisdom (Heliawati et al., 2022; Dou, R., & Cian, 2022). Therefore, the ethnoscience of Majalengka cakar sugar provides a relevant foundation for the development of ethnoscience-based E-LKPDs aimed at improving students' science literacy.

The need for E-LKPDs falls into the high category (67.39%). The reduction of questionnaire data indicates that students require digital teaching materials that are interactive, accessible, and capable of supporting contextual learning activities. Students expressed that digital learning materials could increase their learning interest and make science learning more engaging. Interview results also revealed that teachers required contextual digital teaching materials. Teachers stated that "E-LKPD based on local contexts is greatly needed so that students can understand the material more easily and become more interested in learning." These findings indicate a strong need for innovative teaching materials capable of integrating technology with local contexts.

Digital-based E-LKPDs have been proven to improve student engagement and learning outcomes through interactive material presentation (Ramli et al., 2025). The development of ethnoscience-based E-LKPDs also has the potential to improve science literacy by connecting scientific concepts with local cultural contexts. Context-based teaching materials can further develop 21st-century skills, such as critical thinking and problem-solving. The use of interactive digital media provides students with more engaging and meaningful learning experiences. In addition, the integration of ethnoscience into E-LKPDs strengthens contextual learning, enabling students to understand scientific concepts more easily. Therefore, the development of

ethnoscience-based E-LKPDs offers a relevant solution for improving the quality of science education and supporting the enhancement of students' science literacy.

This study has several limitations that should be acknowledged. First, the study was conducted only in a limited number of schools in Majalengka Regency; therefore, the findings cannot yet be generalised more broadly. Second, the data obtained were limited to needs analysis through questionnaires and interviews without direct implementation testing of the developed E-LKPD in classroom learning. Third, the instruments used focused primarily on students' and teachers' perceptions and therefore did not fully represent students' actual science literacy skills through performance-based assessment. Therefore, further studies are recommended to develop and experimentally test the effectiveness of ethnoscience-based E-LKPDs by involving broader research samples to obtain more comprehensive findings.

CONCLUSION

Based on the research findings, it can be concluded that the need for the development of ethnoscience-based E-LKPD in science education is relatively high. This is indicated by the results of the student questionnaire, which show that most aspects—namely, learning conditions, teaching materials, ethnoscience, and the need for E-LKPD—fall into the high category, whilst science literacy is in the moderate category. This finding is reinforced by the results of teacher interviews, which indicate that teaching is still dominated by conventional methods, the teaching materials used are not yet fully innovative, and the integration of ethnoscience is not yet optimal. These conditions indicate a gap between learning needs and classroom practice, particularly in improving students' science literacy. Therefore, the development of ethnoscience-based E-LKPDs is a relevant solution for creating more interactive, contextual, and meaningful learning. The integration of local wisdom into teaching materials is expected to optimally enhance student engagement and science literacy skills.

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