Sastri, M et al. GHAITSA: Islamic Education Journal (2026) Vol. 7 No. 3
DOI : https://doi.org/10.62159/ghaitsa.v7i3.2830

GHAITSA
Islamic Education Journal

RESEARCH

Received: May 30, 2026 Revised: July 14, 2026 Accepted: August 5, 2026

Development of the Minangkabau Ethnoscience-Based LDER Learning Model and Preliminary Evaluation of Its Potential to Support Junior High School Students' Scientific Literacy

Mai Sastri[1]*, Alwen Bentri[2], Fetri Yeni[3] and Rahmi Pratiwi[4]

***Correspondence:**
Mai Sastri
maisastri115@gmail.com

[1234]Department of Educational Technology, Universitas Negeri Padang, Sumatera Barat, Indonesia

Abstract

This study aimed to develop a Minangkabau ethnoscience-based LDER (Ethnoscience Literacy, Discussion, Explanation, and Reflection) learning model to enhance the scientific literacy of junior high school students. The study employed a Research and Development (R&D) approach using the ADDIE model, consisting of the Analysis, Design, Development, Implementation, and Evaluation phases. The developed model was evaluated through expert validation involving learning model, subject matter, and language and media experts. Its practicality was assessed through teacher evaluations and students' responses, while its effectiveness was determined using the Normalized Gain (N-Gain) score. The results indicated that the LDER learning model achieved a validation score of 77.50% for the learning model (feasible), 95.45% for content validity, and 95.23% for language and media validity (both categorized as highly feasible). The practicality evaluation yielded scores of 85.31% from teachers and 84.80% from students, indicating that the model was highly practical for classroom implementation. Furthermore, an improvement in students' scientific literacy was observed, as indicated by an N-Gain score of 0.67 (moderate). However, because the study did not include a control group, this improvement should be interpreted with caution and cannot be attributed exclusively to the LDER learning model. The proposed model offers a contextual and culturally responsive learning framework that bridges indigenous Minangkabau knowledge with scientific knowledge through the stages of Ethnoscience Literacy, Discussion, Explanation, and Reflection.

Keywords: Ethnoscience, LDER Learning Model, Science Literacy, Science Learning, Junior High School Students

Introduction

Students' ability to use scientific knowledge to explain phenomena, evaluate evidence, and make data-based decisions remains a major challenge in science education in various countries (Zhang et al., 2023; Coppi et al., 2024). This problem is no longer seen as a mere lack of conceptual mastery, but rather as a failure of learning to develop scientific literacy that connects scientific knowledge to the realities of life. This condition is reflected in the achievements of the Programme for International Student Assessment (PISA), which shows that Indonesian students' scientific literacy performance remains at the bottom of the scale, even though various curriculum policies have positioned literacy as one of the core competencies of science learning (Abdul Kadir et al., 2025; Ayu et al., 2025).

This problem is not entirely due to the complexity of science material, but rather to learning characteristics that still position scientific concepts as knowledge detached from students' life experiences. Preliminary studies indicate that most students understand the existence of various cultural practices in their environment but have difficulty explaining the scientific reasons behind these practices (Zidny et al., 2020; Agustina et al., 2026). As many as 41.9% of students are still hesitant to explain cultural phenomena scientifically, while only 43.3% are familiar with using science concepts to explain phenomena around them. These findings demonstrate a gap between students' existing cultural knowledge and their ability to construct scientific knowledge systematically.

Ethnoscience offers an opportunity to bridge this gap because it views cultural practices as sources of knowledge that can be reconstructed into scientific concepts. The integration of ethnoscience not only enriches the learning context but also provides a more authentic learning experience so that students can connect scientific concepts with the social and cultural realities they experience (Ogegbo & Ramnarain, 2024; Kurdiati et al., 2026). Minangkabau is a region rich in ethnoscience with great potential for integration into science learning, ranging from Rumah Gadang architecture and disaster mitigation systems based on local wisdom to traditional food processing technologies such as rendang, which represents the application of natural additives. This wealth of local knowledge has not been optimally utilized as a foundation for developing scientific literacy learning models (Latip et al., 2024; Matindike & Ramdhany, 2025).

Various studies have demonstrated that integrating ethnoscience can improve learning outcomes, critical thinking, and scientific literacy (Fadilah et al., 2024; Rifa'i et al., 2025). However, most studies still use ethnoscience as a context within existing learning models, such as Project-Based Learning, Problem-Based Learning, or Discovery Learning. This approach demonstrates that innovation occurs more in the learning materials than in the design of the learning model itself. Research on learning models designed from the outset based on scientific literacy characteristics while simultaneously utilizing ethnoscience as the foundation of each learning syntax remains relatively limited.

Previous studies have demonstrated that ethnoscience has been successfully integrated into a variety of science learning approaches, including inquiry-based, problem-based, project-based, and culturally responsive learning, to contextualize scientific concepts through local cultural knowledge and improve students' scientific literacy (Mulyono et al., 2024). More recent evidence also indicates that these approaches primarily employ ethnoscience as a contextual resource to enhance students' engagement, inquiry, problem solving, collaboration, and cultural awareness rather than as the central organizing principle of the instructional process (Nur Hikmah et al., 2025). Although these pedagogical approaches have significantly advanced culturally contextualized science education, explicit instructional guidance for systematically transforming indigenous knowledge into scientific knowledge remains limited.

Consequently, the pedagogical mechanism through which local knowledge is progressively reconstructed into scientific understanding has not been clearly articulated. To address this gap, the present study developed the Minangkabau ethnoscience-based LDER (Literacy–Discussion–Explanation–Reflection) learning model. The novelty of LDER does not reside in introducing new instructional activities, since literacy, discussion, explanation, and reflection are well-established components of science instruction. Rather, its innovation lies in organizing these activities into an explicit epistemic sequence that positions ethnoscience literacy as the conceptual starting point of learning and systematically guides students from identifying indigenous knowledge, critically discussing cultural phenomena, constructing evidence-based scientific explanations, and reflecting on the relationship between indigenous and scientific knowledge. Accordingly, ethnoscience functions not merely as contextual enrichment but as the conceptual foundation of the instructional syntax, providing an integrated pedagogical framework for promoting scientific literacy through the systematic transformation of local knowledge into scientific understanding.

This study aims to develop a Minangkabau ethnoscience-based LDER learning model that meets the criteria of validity, practicality, and effectiveness in improving the scientific literacy of junior high school students. The research contribution is not only the birth of a new learning model, but also a culturally responsive learning framework that connects local knowledge with modern science as a strategy to strengthen scientific literacy at the junior secondary education level.

Method

This study uses the Research and Development (R&D) method with the ADDIE development model, which includes five stages, namely Analysis, Design, Development, Implementation, and Evaluation (Branch, 2009; Reiser & Dempsey, 2017). This study aims to develop a valid, practical, and effective LDER (Ethnoscience Literacy, Discussion, Explanation, and Reflection) learning model based on Minangkabau ethnoscience to improve the scientific literacy of junior high school students. The Analysis stage is carried out through needs analysis, the Phase D science curriculum, student characteristics, and the need for models and learning resources based on Minangkabau ethnoscience (Onguko et al., 2013). The Design stage includes designing model syntax, social systems, reaction principles, support systems, model guidebooks, learning tools, and research instruments (Joyce et al., 2015).

The Development phase involved developing the LDER learning model and its supporting learning materials, followed by expert validation and product revision. Validation was conducted by four expert validators consisting of a learning design expert, a science content expert, a language and culture expert, and a media expert. The validators evaluated the model, learning materials, language, cultural relevance, and media quality using structured validation instruments. Revision decisions were based on both quantitative validation scores and qualitative recommendations provided by the validators before the product proceeded to classroom trials (Luthfi Ilham Ramdhani et al., 2025).

The Implementation phase consisted of three sequential trials. The individual trial involved one science teacher and three eighth-grade students representing high, medium, and low academic achievement to evaluate readability, clarity of instructions, language, font size, ease of understanding, and visual appearance. Based on interviews and observations, revisions were made to improve wording, layout, and technical aspects of the product before the next trial. The small-group trial involved ten Grade VIII students who were not included in the main sample and aimed to examine the initial implementation, practicality, learning activities, and time allocation. Classroom observations and students' responses identified several technical constraints, particularly regarding learning time management, which resulted in a second revision of the lesson modules and learning procedures. The field trial was subsequently conducted in three Grade VIII classes using a one-group pretest–posttest design to evaluate the practicality of the model and its association with improvements in students' scientific literacy. To ensure implementation consistency, the learning activities were carried out collaboratively by the researcher and two science teachers who had previously received orientation regarding the LDER learning procedures

(Ramdhani et al., 2025)

The Evaluation phase integrated formative and summative evaluations to determine the overall quality of the developed model. Data were collected through expert validation sheets, teacher practicality questionnaires completed by three science teachers, student practicality questionnaires completed by 75 students, classroom observation sheets, structured interviews, and scientific literacy tests administered before and after the field implementation. Quantitative data were analyzed descriptively, while improvements in students' scientific literacy were examined using the Normalized Gain (N-Gain). Qualitative feedback obtained throughout each trial served as the basis for successive revisions, ensuring that the final version of the Minangkabau ethnoscience-based LDER learning model fulfilled the criteria of validity, practicality, and potential to support improvements in students' scientific literacy (Plomp & Nieveen, 2013; Abuhassna et al., 2024).

The effectiveness of the developed model was evaluated by comparing students' scientific literacy scores before (pretest) and after (posttest) the implementation of the Minangkabau ethnoscience-based LDER learning model. Students' scientific literacy was measured using a structured test developed according to the scientific literacy indicators specified in the research instrument blueprint. The improvement in students' scientific literacy was analyzed using the Normalized Gain (N-Gain) index based on the pretest and posttest scores.

Model validity was established through expert judgment involving four validators, namely a learning model expert, a science content expert, a language and culture expert, and a media expert. Each validator independently assessed the corresponding aspects of the model using structured validation rubrics developed from the evaluation indicators presented in the instrument blueprint. Practicality was evaluated separately through teacher and student questionnaires designed to assess the ease of implementation, clarity of learning procedures, usability of the learning materials, and instructional benefits during classroom implementation.

Prior to implementation, all instruments underwent content validation through expert review to ensure their relevance, clarity, and appropriateness for measuring the intended constructs. Quantitative data from the validation and practicality instruments were converted into percentages of the maximum attainable scores and interpreted using the feasibility and practicality criteria adopted in this study, whereas the effectiveness of the model was interpreted using the N-Gain classification proposed by (Hake, 1998). Qualitative comments and suggestions obtained during the validation process and product trials served as the basis for revising the model at each stage of development. All completed validation sheets, questionnaires, observation sheets, and scientific literacy test results were returned completely; therefore, all collected data were included in the analysis without requiring missing-data treatment.

Results

Results of the Development of the Minangkabau Ethnoscience-Based LDER Learning Model

The development of the Minangkabau ethnoscience-based LDER learning model resulted in a learning model consisting of four interconnected stages: Ethnoscience Literacy, Discussion, Explanation, and Reflection. The model was designed to connect students' prior cultural knowledge and everyday experiences with scientific concepts through contextual science learning. The ethnoscience content incorporated into the model was identified through literature review, preliminary needs analysis, curriculum analysis, and the selection of Minangkabau cultural practices relevant to the science topics taught in junior high schools. To ensure the appropriateness of the cultural and scientific content, the developed model and its supporting learning materials were reviewed by subject-matter experts and a language expert during the validation stage. Within the LDER learning process, indigenous knowledge is introduced as a meaningful learning context that enables students to explore the relationships between local cultural practices and scientific concepts through literacy activities, scientific discussions, evidence-based explanations, and reflective learning. Accordingly, the model promotes dialogue between local knowledge and school science while maintaining the educational value of both knowledge systems. The model was developed using the ADDIE framework, comprising the Analysis, Design, Development, Implementation, and Evaluation stages.

The integration of ethnoscience was implemented by incorporating Minangkabau cultural contexts that were relevant to the junior high school science curriculum and closely associated with the scientific concepts addressed in each learning topic. The selected contexts included the *suntiang anak daro* (traditional bridal headdress) for learning about light and optical instruments, the *talempong* (traditional Minangkabau musical instrument) for learning about sound, and the *Rumah Gadang* (traditional Minangkabau house) for learning about the Earth's structure and earthquake disaster mitigation. These cultural contexts were identified through curriculum analysis, literature review, and preliminary needs analysis to ensure their relevance to the intended learning outcomes.

The accuracy of the scientific content and the appropriateness of the cultural representation were subsequently reviewed during the expert validation process involving science content experts and language and culture experts before classroom implementation. Because the study was conducted in a Minangkabau cultural setting, the selected contexts reflected cultural practices commonly encountered by students in their surrounding environment, enabling them to relate prior cultural experiences to scientific concepts while minimizing the use of cultural examples that might not be equally familiar across different regional contexts.

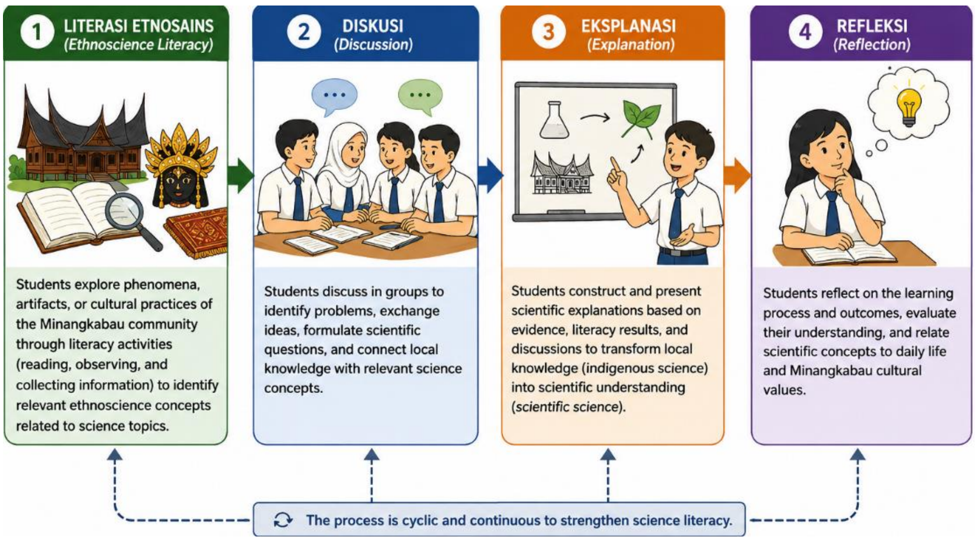

Fig. 1 Syntax of the LDER Learning Model Based on Minangkabau Ethnoscience

The LDER syntax demonstrates that the learning model is developed with a flow that connects cultural context, thought processes, and scientific understanding. The Ethnoscience Literacy stage serves as an entry point for learning through phenomena close to students' lives. Furthermore, the Discussion and Explanation stage provides space for students to construct and communicate scientific understanding. The Reflection stage strengthens the meaning-making process and connects the knowledge gained to the context of everyday life (Lin et al., 2023). Thus, the LDER structure does not position ethnoscience merely as an illustration of material, but rather makes it part of the process of scientific knowledge formation. This is the main characteristic of the model developed in this study.

Validity of the LDER Learning Model

Validation was conducted to assess the feasibility of the model and supporting tools in terms of learning model, materials, language, and media. The results of the validator's assessment are presented in Table 1.

Table 1. Validation of the LDER Learning Model Based on Minangkabau Ethnoscience

Validation Aspects	Score	Maximum score	Percentage	Category
Learning model	93	120	77,5%	Valid
Material	84	88	95,45%	Highly Valid
Language and Media	100	108	95,23%	Highly Valid

The data in Table 1 show that the model validation obtained a score of 93 out of a maximum of 120 (77.5%), placing it in the feasible/valid category. The material validation obtained a score of 84 out of 88, or 95.45%, with a very feasible category. Meanwhile, the language and media validation obtained a score of 100 out of 108, or 95.23%, with a very feasible category. The validation results indicate that the LDER model and its supporting tools have met the feasibility criteria for use in science learning. The highest percentage was obtained in the material aspect at 95.45%, indicating that the material substance and its integration with learning were considered very feasible. The language and media aspect also obtained a high score of 95.23%, indicating that the product presentation in terms of language and graphics has met the feasibility criteria.

Meanwhile, the model validation score of 77.5% indicates that the model structure is in the feasible/valid category. The model assessment includes aspects of rationale, learning objectives, syntax, social systems, reaction principles, support systems, instructional impacts, accompanying impacts, language, and implementation feasibility. These results demonstrate that the LDER model has an adequate design foundation for application in science learning. Validator input is then used to refine the product, including through strengthening the model syntax, separating teacher and student activities, and deepening the material on scientific and ethnoscience concepts.

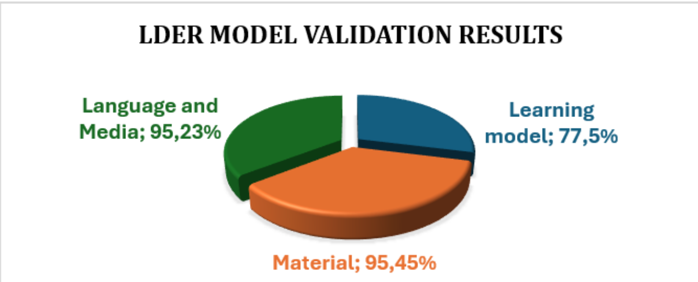

Fig. 2 Percentage of LDER Model Validation Results

The graph above shows that all validation aspects achieved high percentages. Material validation scored the highest, while model validation scored the lowest compared to other aspects, but remained in the feasible/valid category. This pattern indicates that the product's primary strengths lie in the material substance, language, and media presentation, while the model structure achieved sufficient feasibility to proceed to the implementation stage after revisions based on expert input.

Practicality of the LDER Learning Model

The model's practicality was tested through teacher assessments and student responses. The practicality test involved three science teachers and 75 students. The practicality instrument was used to assess the ease of use and efficiency of the learning model. The practicality results showed that the LDER learning model achieved 85.31% based on teacher assessments and 84.80% based on student responses. Both results were in the 80–100% range, making it categorized as very practical based on the practicality criteria used in the study. These results indicate that the LDER model can be used practically in science learning.

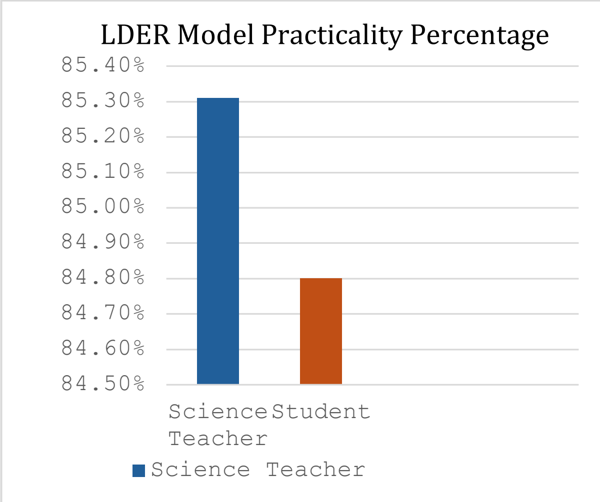

Figure 3. Percentage of Practicality of LDER Model

The teacher practicality score of 85.31% indicates that the developed learning model met the practicality criteria from the teachers' perspective, while the student response score of 84.8% indicates that the model was well received during classroom implementation. Although the difference between the two scores was only 0.51 percentage points, this numerical difference should not be interpreted as evidence of equivalent perceptions between teachers and students. Instead, the findings indicate that both respondent groups evaluated the developed model positively according to the practicality criteria adopted in this study. The teacher assessment reflects the feasibility of implementing the learning syntax and supporting materials in classroom practice, whereas the student responses reflect their learning experience when using the developed model. These findings, together with the expert validation results, demonstrate that the Minangkabau ethnoscience-based LDER learning model possesses satisfactory practicality for classroom implementation. The effectiveness of the model was evaluated separately through students' scientific literacy achievement using the Normalized Gain (N-Gain) analysis rather than the practicality assessment.

Effectiveness of Models on Scientific Literacy

The effectiveness of the LDER learning model was analyzed based on improvements in students' scientific literacy skills through pretest and posttest scores. The analysis was conducted using Normalized Gain (N-Gain) to determine students' ability improvement after participating in learning with LDER syntax. The results of the analysis showed that the LDER learning model based on Minangkabau ethnoscience obtained an N-Gain value of 0.67, which is in the moderate category. Based on the criteria used in the study, an N-Gain value between 0.3 and 0.7 is included in the moderate category. An N-Gain value of 0.67 indicates an increase in students' scientific literacy skills after applying the LDER learning model. Although the increase is in the moderate category, the value is close to the upper limit of the moderate category (N-Gain = 0.7), thus indicating a fairly strong potential for improvement after students participate in learning using the developed model.

This improvement can be attributed to the LDER syntax structure, which guides students through learning stages, from an introduction to ethnoscience phenomena to an understanding of scientific concepts. In the Ethnoscience Literacy stage, students encounter contextual cultural phenomena (Budiarti et al., 2026). Furthermore, the Discussion stage provides an opportunity to develop ideas and reasoning, while the Explanation stage directs students to explain phenomena using scientific concepts. The Reflection stage then provides an opportunity to review and strengthen the understanding that has been gained (Zheng et al., 2024).

This study developed the Minangkabau ethnoscience-based LDER (Literacy–Discussion–Explanation–Reflection) learning model as a culturally contextualized approach to science learning for junior high school students. The findings indicate that the developed model is suitable for classroom implementation and is associated with improvements in students' scientific literacy, as reflected by a moderate N-Gain score of 0.67 after the learning intervention. The contribution of the model lies in providing a structured learning sequence that connects students' cultural experiences with scientific concepts through ethnoscience literacy, discussion, explanation, and reflection, thereby supporting more meaningful and contextually relevant science learning.

These findings should be interpreted within the context of the present study. The implementation was conducted in a specific educational and cultural setting using a one-group pretest–posttest design without a comparison group; therefore, the observed improvement cannot be attributed solely to the LDER learning model. Other factors, such as teacher facilitation, repeated exposure to the test, and classroom learning experiences, may also have contributed to the observed gains. Future studies are recommended to examine the model through controlled experimental designs involving multiple schools and diverse cultural settings to provide stronger evidence regarding its generalizability and its contribution to improving students' scientific literacy.

Synthesis of Development Results

Table 2. Summary of the Validity, Practicality, and Effectiveness of the Minangkabau Ethnoscience-Based LDER Learning Model

Aspect	Indicator	Result	Category
Validity	Learning Model	77.5%	Valid
	Learning Material	95.45%	Highly Valid
	Language and Media	95.23%	Highly Valid
Practicality	Science teacher	85.31%	Highly practical
	Student	84.80%	Highly practical
Effectiveness	N-Gain Science Literacy	0.67	Moderate improvement

Overall, the study results indicate that the Minangkabau ethnoscience-based LDER learning model meets the three main criteria for product development: validity, practicality, and effectiveness. In terms of validity, the model scored 77.5%, while the supporting devices scored higher, namely 95.45% in the material aspect and 95.23% in the language and media aspect. In terms of practicality, teacher and student assessments reached 85.31% and 84.80%, respectively, both of which are in the very practical category. Meanwhile, the effectiveness of the model is indicated by an N-Gain value of 0.67, which is in the moderate category.

Discussion

The research results show that the LDER learning model based on Minangkabau ethnoscience was successfully developed through the ADDIE stages and produced a model with four main syntaxes, namely ethnoscience literacy, discussion, explanation and reflection. This structure shows that science learning is designed not only to be oriented towards mastering concepts, but also to the process of connecting the knowledge that students already have with scientific knowledge (Vančugovienė et al., 2024). In this context, ethnoscience is placed as a starting point for learning that allows students to understand scientific concepts through cultural phenomena that are close to their lives (Suwandi et al., 2025).

The integration of Minangkabau cultural contexts through suntiang anak daro, talempong, and Rumah Gadang demonstrates that cultural environments can be relevant learning resources for science instruction. These cultural phenomena are not used merely as illustrations but are linked to concepts of light and optical instruments, sound, the structure of the Earth, and earthquake disaster mitigation (Kurnio et al., 2021; Rosyidah et al., 2025). This approach provides a concrete context for students to identify phenomena, develop questions, discuss ideas, and construct scientific explanations.

The advantage of the LDER model lies in the learning flow that connects the local context with the process of constructing scientific knowledge. The Ethnoscience Literacy stage provides students with the opportunity to activate prior knowledge based on cultural experiences. The Discussion stage then provides a space for exchanging ideas and testing initial understanding. Next, the Explanation stage guides students to reconstruct this understanding based on scientific concepts, while the Reflection stage helps students review their understanding and connect it to everyday life (Kulgemeyer & Geelan, 2024; Boven et al., 2025). Thus, the LDER model has characteristics that support learning and are contextual, active, and reflective.

These findings imply that integrating ethnoscience into science learning should not stop at using local cultural examples, but should be embedded within a clear pedagogical structure. The LDER model offers such a structure through four stages that systematically guide students from cultural experiences to scientific understanding. With this approach, local knowledge serves as a bridge to building scientific knowledge, rather than being positioned as knowledge separate from school science.

The validation results show that the LDER learning model achieved 77.5% and is in the feasible/valid category. Meanwhile, the material aspect obtained 95.45%, and the language and media aspects obtained 95.23%, each of which is in the very feasible category. These findings indicate that the model and its supporting tools have met the eligibility criteria for use in science learning. The high material validation results indicate that the ethnoscience context used can be integrated with science material in a relevant manner. This integration is important because the use of cultural context in science learning can be meaningless if the relationship between cultural phenomena and scientific concepts is not designed appropriately (Boven et al., 2025).

In the LDER model, cultural phenomena such as talempong, suntiang anak daro, and Rumah Gadang are positioned in direct relation to the scientific concepts being studied. Thus, the local context not only attracts students' attention but also becomes part of the process of forming conceptual understanding. The language and media validation, which reached 95.23%, also indicates that the presentation of the material and supporting devices has met the aspects of readability, clarity, and presentation. This is important because the success of ethnoscience-based learning is determined not only by the choice of cultural context, but also by the ability of the learning devices to present the relationship between local phenomena and scientific concepts clearly (Khusniati et al., 2023).

Meanwhile, the model validation percentage of 77.5% indicates that the model structure has met the eligibility criteria, although the value is lower than the validation of materials, language, and media. This difference is understandable because the learning model has more complex components, including syntax, social systems, reaction principles, support systems, and instructional and accompanying impacts. Therefore, validator input on syntactic structure, teacher and student activities, and the deepening of the relationship between scientific and ethnoscience concepts is important for model refinement. Overall, the validation results strengthen that the LDER model has an adequate basis for use in science learning. The validity obtained also shows that the integration of Minangkabau ethnoscience can be designed systematically without reducing the substance of the scientific concepts that are the learning objectives.

The LDER model achieved a practicality score of 85.31% based on teacher assessments and 84.80% based on student responses. Both scores fall into the very practical category. These results indicate that the model can be applied in learning and is acceptable to its primary users, namely teachers and students. The model's practicality can be attributed to the LDER syntax structure, which provides a systematic learning flow. Teachers not only receive guidance on the learning stages but also have a framework to guide students from the introduction of cultural phenomena to the discussion process, the development of scientific explanations, and reflection (Chang, 2013). This structure can help reduce the gap between students' existing local knowledge and the scientific concepts they must master (Hogan & Bae, 2025).

From the students' perspective, using the Minangkabau ethnoscience context provides a learning experience more closely connected to their social and cultural environment. Students can learn science concepts through phenomena that are not entirely unfamiliar to them. This situation creates a more meaningful learning process because students have prior experience that can be used as a basis for understanding scientific concepts (Karpudewan et al., 2017; Wiyarsi et al., 2024). Interestingly, the teacher and student assessment scores showed a relatively small difference. Practicality based on teacher assessment reached 85.31%, while student responses reached 84.80%, with a difference of only 0.51 percentage points.

The similarity of these assessment tendencies indicates that the model is not only easy to apply from an educator's perspective but also acceptable to students as learning users. These findings have practical implications: the development of culture-based learning needs to consider the model's real applicability. Models that have a strong cultural context but are difficult for teachers to implement or difficult for students to understand will have limitations in implementation (Iriani et al., 2024). The results of this research show that LDER can maintain cultural relevance while also having a high level of practicality in its use.

The model's effectiveness is demonstrated by the N-Gain value of 0.67, which is in the moderate category. These results indicate an increase in students' scientific literacy skills after applying the Minangkabau ethnoscience-based LDER model. Although the increase is not yet in the high category, the value is close to the upper limit of the moderate category and indicates the model's potential to support improvements in scientific literacy skills. This increase can be understood through the characteristics of LDER syntax. Scientific literacy is not only related to the ability to remember concepts, but also to the ability to use scientific knowledge to understand phenomena and make evidence-based decisions (Rahman & Mehnaz, 2024; Roy et al., 2025). The LDER model provides a learning experience that gradually directs students to observe phenomena, discuss problems, construct explanations, and reflect.

The Ethnoscience Literacy stage helps activate students' prior knowledge through cultural phenomena they are already familiar with (Ramdhani et al., 2025; Yasir et al., 2025). This prior knowledge is then developed through the Discussion stage, where students interact and test their ideas. This process forms the basis for the Explanation stage, where students are directed to explain phenomena using scientific concepts. Furthermore, the Reflection stage helps students connect scientific understanding with their experiences and life contexts. This sequence provides a pedagogical explanation for the increase in N-Gain obtained. Students do not immediately receive scientific concepts in abstract form, but have the opportunity to build understanding through familiar contexts. The process of moving from local experiences to scientific explanations can help students understand that phenomena they encounter in everyday life are related to scientific principles (Fortus & Krajcik, 2020; Kervinen et al., 2020).

Thus, the N-Gain value of 0.67 can be seen as initial evidence that the LDER model has the potential to support improved scientific literacy. However, because the improvement is still in the moderate category, this result also indicates that developing scientific literacy is a process that requires continuous learning. More intensive application of the model, strengthening investigative activities, and providing students with broader opportunities to use scientific evidence have the potential to strengthen scientific literacy achievements.

The main contribution of this research lies in the development of a learning model that integrates Minangkabau ethnoscience into a systematic learning structure. The LDER model not only uses local culture as an additional context, but also makes it an integral part of the learning process through four interconnected stages. The research findings indicate a relationship between three main aspects of product quality: validity, practicality, and effectiveness. The model, deemed feasible by experts, can be applied practically by teachers and students and shows an increase in scientific literacy based on the N-Gain value. This pattern shows that the development of ethnoscience-based models requires attention to the relationship between conceptual design, pedagogical applicability, and learning outcomes.

From an educational perspective, the LDER model also provides an opportunity to connect global competencies with local contexts. Scientific literacy is a crucial competency students need to face various life challenges, while ethnoscience provides learning resources derived from students' social and cultural environments. Integrating the two allows science learning to be oriented not only toward mastery of concepts but also toward understanding the relationship between science, culture, and everyday life. Thus, the LDER model based on Minangkabau ethnoscience can be seen as a pedagogical innovation that seeks to bridge two domains of knowledge: local knowledge and scientific knowledge. The success of this model lies not only in the use of the Minangkabau cultural context, but also in the way that context is integrated into the learning process, encouraging students to observe, discuss, explain, and reflect on phenomena scientifically.

The results of this study imply that the LDER model can be an alternative for science teachers who want to develop learning that is more contextual and responsive to local culture. This model can be used to strengthen the connection between student experiences and science concepts while also providing space for utilizing local cultural potential as a learning resource. However, interpretation of the effectiveness results needs to be done proportionally. The N-Gain value of 0.67 indicates an increase in the moderate category and cannot be used as a basis for stating that the model is more effective than other learning models. Furthermore, the data available in this development research does not provide a sufficient basis for concluding the model's universal effectiveness across all junior high school contexts.

Therefore, further research needs to test the LDER model on a larger and more diverse sample and use a quasi-experimental design with a comparison group. Overall, the results of this study provide evidence that the LDER learning model based on Minangkabau ethnoscience is highly feasible and practical and shows potential in improving students' scientific literacy. The model's main contribution lies in the systematic integration of local cultural context and the process of scientific knowledge construction. These findings reinforce the idea that science learning rooted in students' cultural contexts can be one approach to creating more relevant, meaningful learning that supports the development of scientific literacy.

Conclusion

This research resulted in the LDER (Ethnoscience Literacy, Discussion, Explanation, and Reflection) learning model, based on Minangkabau ethnoscience and developed through ADDIE, to address the need for a science learning model that not only contextualizes science through local culture but also systematically transforms local knowledge into scientific understanding oriented toward science literacy. The LDER model demonstrated feasibility through model validation of 77.5%, material 95.45%, and language and media 95.23%, with practicality of 85.31% based on teacher assessment and 84.80% based on student responses. The N-Gain value of 0.67 indicates an increase in science literacy in the moderate category. These findings confirm the contribution of the LDER model as a pedagogical framework that bridges indigenous science and scientific science through the stages of Ethnoscience Literacy, Discussion, Explanation, and Reflection, thus expanding the culture-based science learning approach from merely using local contexts to a more systematic knowledge reconstruction process. Further testing through experimental designs with comparison groups, larger samples, and diverse cultural contexts is needed to test the causal effectiveness and generalizability of the model.

References

Abdul Kadir, Zulqarnain T, Amiruddin Takda, Jahidin, Muhammad Shaleh Assingkily, & Mustapa Ahmad. (2025). Junior High School Students' Science Literacy Skills based on the Nature of Science Literacy Test (NOSLiT). *Jurnal Pendidikan IPA Indonesia*, *14*(1). https://doi.org/10.15294/jpii.v14i1.15739

Abuhassna, H., Alnawajha, S., Awae, F., Mohamed Adnan, M. A. B., & Edwards, B. I. (2024). Synthesizing technology integration within the Addie model for instructional design: A comprehensive systematic literature review. *Journal of Autonomous Intelligence*, *7*(5), 1546. https://doi.org/10.32629/jai.v7i5.1546

Agustina, W. N., Dewi, E. R. S., Nugroho, A. S., & Hayat, M. S. (2026). Analysis of student items and abilities on the scientific literacy and biology creativity instruments. *BIO-INOVED : Jurnal Biologi-Inovasi Pendidikan*, *8*(2), 233. https://doi.org/10.20527/bino.v8i2.26171

Ayu, G. N., Putri, C. A., Riyanto, A. R., & Koto, I. (2025). *The Scientific Literacy Competence of Students in Indonesia and Mexico Based on PISA 2022: An International Comparative Study*. *4*(5).

Boven, L., De Schrijver, J., Pinxten, R., & Van Petegem, P. (2025). Explicating explicit reflection in nature of science education: A systematic literature review. *Frontiers in Education*, *10*, 1577021. https://doi.org/10.3389/feduc.2025.1577021

Branch, R. M. (2009). *Instructional Design: The ADDIE Approach*. Springer US. https://doi.org/10.1007/978-0-387-09506-6

Budiarti, I. S., Lumbu, A., Boy, B. Y., & Wabiser, Y. D. (2026). Looking through Ethnoscience in Rural Areas of Jayapura: A Perspective Study in Science Learning. *Tadris: Jurnal Keguruan Dan Ilmu Tarbiyah*, *11*(1), 135–145. https://doi.org/10.24042/tadris.v11i1.30111

Chang, H.-Y. (2013). Teacher guidance to mediate student inquiry through interactive dynamic visualizations. *Instructional Science*, *41*(5), 895–920. https://doi.org/10.1007/s11251-012-9257-y

Coppi, M., Fialho, I., & Cid, M. (2024). Assessing scientific literacy: A study with 9th grade students in Portugal. *Frontiers in Education*, *9*, 1433919. https://doi.org/10.3389/feduc.2024.1433919

Fadilah, A. M., Muhlisin, A., & Ismawati, R. (2024). Development of an Ethnoscience-Based Integrated Science Module with RIAS Learning Model to Improve Students' Critical Thinking Ability. *Phenomenon : Jurnal Pendidikan MIPA*, *13*(2), 264–282. https://doi.org/10.21580/phen.2023.13.2.16931

Fortus, D., & Krajcik, J. (2020). Supporting Contextualization: Lessons Learned from Throughout the Globe. In I. Sánchez Tapia (Ed.), *International Perspectives on the Contextualization of Science Education* (pp. 175–183). Springer International Publishing. https://doi.org/10.1007/978-3-030-27982-0_9

Hake, R. R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics*, *66*(1), 64–74. https://doi.org/10.1119/1.18809

Hogan, E., & Bae, C. (2025). Bridging Student Funds of Knowledge With Science Discourse: An Examination of the Organizational Context That Shaped Teachers' Sense of Agency for Instructional Change. *Science Education*, *109*(4), 1090–1113. https://doi.org/10.1002/sce.21941

Iriani*, R., Risna, R., Bakti, I., Saadi, P., Abrori, F. M., & Leny, L. (2024). Development of E-Modules To Improve Students' Problem Solving Abilities on Ethnoscience Integrated Colloidal Material with the Problem Based Learning Model. *Jurnal Pendidikan Sains Indonesia*, *12*(3), 509–529. https://doi.org/10.24815/jpsi.v12i3.37850

Joyce, B. R., Weil, M., & Calhoun, E. (2015). *Models of Teaching*. Pearson. https://books.google.co.id/books?id=eG7hnQEACAAJ

Karpudewan, M., Zain, A. N. Md., & Chandrasegaran, A. L. (2017). Introduction: Misconceptions in Science Education: An Overview. In M. Karpudewan, A. N. Md Zain, & A. L. Chandrasegaran (Eds.), *Overcoming Students' Misconceptions in Science: Strategies and Perspectives from Malaysia* (pp. 1–5). Springer Singapore. https://doi.org/10.1007/978-981-10-3437-4_1

Kervinen, A., Roth, W.-M., Juuti, K., & Uitto, A. (2020). The resurgence of everyday experiences in school science learning activities. *Cultural Studies of Science Education*, *15*(4), 1019–1045. https://doi.org/10.1007/s11422-019-09968-1

Khusniati, M., Heriyanti, A. P., Aryani, N. P., Fariz, T. R., & Harjunowibowo, D. (2023). Indigenous science constructs based on Troso woven fabric local wisdom: A study in ethnoscience and ethnoecology: Research Article. *Journal of Turkish Science Education*, *20*(3), 549–566. https://doi.org/10.36681/tused.2023.031

Kulgemeyer, C., & Geelan, D. (2024). Towards a constructivist view of instructional explanations as a core practice of science teachers. *Science Education*, *108*(4), 1034–1050. https://doi.org/10.1002/sce.21863

Kurdiati, L. A., Susiloningsih, E., & Fathurohman, A. (2026). Mapping Indigenous Knowledge in Science Education: A Systematic Literature Network and Bibliometric Analysis. *Journal of Educational Science and Technology (EST)*, *11*(3), 122. https://doi.org/10.26858/est.v11i3.82309

Kurnio, H., Fekete, A., Naz, F., Norf, C., & Jüpner, R. (2021). Resilience learning and indigenous knowledge of earthquake risk in Indonesia. *International Journal of Disaster Risk Reduction*, *62*, 102423. https://doi.org/10.1016/j.ijdrr.2021.102423

Latip, A., Hernani, & Kadarohman, A. (2024). Local and indigenous knowledge (LIK) in science learning: A systematic literature review. *Journal of Turkish Science Education*, *21*(4), 651–667. https://doi.org/10.36681/tused.2024.035

Lin, X.-F., Hwang, G.-J., Wang, J., Zhou, Y., Li, W., Liu, J., & Liang, Z.-M. (2023). Effects of a contextualised reflective mechanism-based augmented reality learning model on students' scientific inquiry learning performances, behavioural patterns, and higher order thinking. *Interactive Learning Environments*, *31*(10), 6931–6951. https://doi.org/10.1080/10494820.2022.2057546

Luthfi Ilham Ramdhani, Arianda, Y. D., Awaluddin Tjalla, & Lussy Dwiutami Wahyuni. (2025). DEVELOPMENT OF INSTRUMENT FOR UNDERSTANDING THE CONCEPT OF WRITING SCIENTIFIC ARTICLES FOR LECTURERS USING THE ADDIE MODEL: EMPIRICAL VALIDITY AND RELIABILITY. *Indonesian Journal of Educational Development (IJED)*, *5*(4), 429–443. https://doi.org/10.59672/ijed.v5i4.4324

Matindike, F., & Ramdhany, V. (2025). Incorporating indigenous knowledge perspectives in integrated STEM education: A systematic review. *Research in Science & Technological Education*, *43*(3), 1022–1042. https://doi.org/10.1080/02635143.2024.2413675

Mulyono, Y., Sapuadi, S., Department of Tarbiyah, IAIN Palangka Raya, Palangkaraya, Indonesia, Yuliarti, Y., Department of Information Systems, STMIK Palangka Raya, Palangkaraya, Indonesia, Sohnui, S., & Department of Oriental Languages, Chiang Mai University, Chiang Mai, Thailand. (2024). A framework for building scientific literacy through an inquiry learning model using an ethnoscience approach. *International Journal of ADVANCED AND APPLIED SCIENCES*, *11*(8), 158–168. https://doi.org/10.21833/ijaas.2024.08.017

Nur Hikmah, Yohandri, Fitri Arsih, Minda Azhar, & Abdul Razak. (2025). Uncovering the Potential of Ethnoscience in Science Learning to Improve Students' Literacy: A Systematic-Literature Review (2014–2024). *Jurnal Pendidikan IPA Indonesia*, *14*(3). https://doi.org/10.15294/jpii.v14i3.19591

Ogegbo, A. A., & Ramnarain, U. (2024). A Systematic Review of Pedagogical Practices for Integrating Indigenous Knowledge Systems in Science Teaching. *African Journal of Research in Mathematics, Science and Technology Education*, *28*(3), 343–361. https://doi.org/10.1080/18117295.2024.2374133

Onguko, B., Jepchumba, L., & Gaceri, P. (2013). "For us it was a learning experience": Design, development and implementation of blended learning. *European Journal of Training and Development*, *37*(7), 615–634. https://doi.org/10.1108/EJTD-10-2012-0052

Plomp, T., & Nieveen, N. (2013). *Educational design research. Part A: An introduction*. SLO.

Rahman, P., & Mehnaz, S. (2024). International Journal for Multidisciplinary Research (IJFMR). *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.5054029

Ramdhani, L. I., Arianda, Y. D., Tjalla, A., & Wahyuni, L. D. (2025). DEVELOPMENT OF INSTRUMENT FOR UNDERSTANDING THE CONCEPT OF WRITING SCIENTIFIC ARTICLES FOR LECTURERS USING THE ADDIE MODEL: EMPIRICAL VALIDITY AND RELIABILITY. *Indonesian Journal of Educational Development (IJED)*, *5*(4), 429–443. https://doi.org/10.59672/ijed.v5i4.4324

Reiser, R. A., & Dempsey, J. V. (2017). *Trends and Issues in Instructional Design and Technology*. Pearson. https://books.google.co.id/books?id=zOcyvgAACAAJ

Rifa'i, M., Taufik, L. M., & Novianawati, N. (2025). The Ethnoscience-Based Project Based Learning Model on Learning Outcomes and Scientific Literacy. *ETDC: Indonesian Journal of Research and Educational Review*, *4*(4), 1533–1546. https://doi.org/10.51574/ijrer.v4i4.3843

Rosyidah, F., Susantini, E., Yuliani, Y., & Nisa', K. (2025). Local Wisdom and STEM in Science Education to Support SDG-4: A Systematic Review. *Jurnal Pendidikan IPA Indonesia*, *14*(4). https://doi.org/10.15294/jpii.v14i4.34450

Roy, G., Sikder, S., & Danaia, L. (2025). Adopting scientific literacy in early years from empirical studies on formal education: A systematic review of the literature. *International Journal of STEM Education*, *12*(1), 26. https://doi.org/10.1186/s40594-025-00547-1

Suwandi, S. Y. P. A., Sukarmin, S., Cahyaningrum, S. E., Satriawan, M., & Soraya, F. (2025). Ethnoscience Approach to Improve Science Literacy on Chemical Bonding: A Thematic Synthesis. *Jurnal Pendidikan MIPA*, *26*(3), 1909–1931. https://doi.org/10.23960/jpmipa.v26i3.pp1909-1931

Vančugovienė, V., Södervik, I., Lehtinen, E., & McMullen, J. (2024). Individual differences in secondary school students' conceptual knowledge: Latent profile analysis of biology concepts. *Learning and Individual Differences*, *111*, 102436. https://doi.org/10.1016/j.lindif.2024.102436

Wiyarsi, A., Çalik, M., Priyambodo, E., & Dina, D. (2024). Indonesian Prospective Teachers' Scientific Habits of Mind:A Cross-Grade Study in the Context of Local and Global Socio-scientific Issues. *Science & Education*, *33*(5), 1257–1283. https://doi.org/10.1007/s11191-023-00429-4

Yasir, M., Hartiningsih, T., & Rahma, A. A. (2025). Bridging Sustainable Science Education and Culture: The Role of Educational Augmented Reality Media in Ethnoscience and Cultural Literacy. *Journal of Physics: Conference Series*, *3148*(1), 012022. https://doi.org/10.1088/1742-6596/3148/1/012022

Zhang, L., Liu, X., & Feng, H. (2023). Development and validation of an instrument for assessing scientific literacy from junior to senior high school. *Disciplinary and Interdisciplinary Science Education Research*, *5*(1), 21. https://doi.org/10.1186/s43031-023-00093-2

Zheng, Y., Sun, S., Yang, Y., & Xu, C. (2024). Exploring the effect of directive and reflective feedback on elementary school students' scientific conceptual understanding, epistemological beliefs, and inquiry performance in online inquiry activities. *Research in Science Education*, *54*(6), 1095–1116. https://doi.org/10.1007/s11165-024-10171-8

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. https://doi.org/10.1007/s11191-019-00100-x