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Development of an Ethno-STEM Learning Module Based on the Acehnese Rapai Geleng Dance

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Abstract: This research aims to develop a science learning module that is valid, practical, and effective by integrating the Ethno-STEM approach with Acehnese local wisdom, specifically the Rapai Geleng dance. The developed module is intended for junior high school students and focuses on the science topics of vibration, sound, and waves, which are closely related to the rhythmic movements and musical elements of the Rapai Geleng tradition. By embedding local cultural contexts into science learning, the module is designed to provide meaningful and contextual learning experiences for students.This study employed a modified 4D development model consisting of three stages: define, design, and develop. The define stage involved analyzing learning needs, student characteristics, curriculum requirements, learning materials, and learning objectives relevant to Ethno-STEM integration. The design stage focused on structuring the module content, selecting appropriate illustrations and cultural representations, and preparing research instruments, including validation sheets, student response questionnaires, and learning outcome tests. The develop stage involved expert validation, revision based on validators' feedback, and field testing of the module.The developed module was evaluated through a small-group trial involving 10 seventh-grade students, followed by a class-level trial with 25 seventh-grade students at SMPN 3 Sakti. Data were analyzed using descriptive analysis techniques. Module validity and practicality were determined using percentage calculations, while effectiveness was measured through N-gain analysis based on students' pretest and posttest results. The findings indicate that the Ethno-STEM-based science learning module achieved a validity score of 81.76%, a practicality score of 92.86%, and an N-gain score of 0.83, which falls into the high category. These results demonstrate that the developed module meets the criteria of being valid, practical, and effective for use in junior high school science learning. The integration of the Rapai Geleng dance into Ethno-STEM learning is therefore recommended as an alternative approach to strengthening culture-based science education and enriching contextual learning resources.

Keywords: Development; Ethno-STEM; Module; Rapai Geleng

Introduction

Science learning at the junior high school level should be implemented in an integrated manner, as mandated by the Ministry of National Education Regulation (Permendiknas) Number 22 of 2006. In the science learning process, it is essential to provide students with learning experiences directly related to their daily lives (Nurwahidah et al., 2020). Therefore, teachers should not only focus on developing students' cognitive abilities but also foster problem-solving skills that are relevant to their life contexts. These specific skills are known as 21st-century skills (Widana et al., 2018). The 21st-century skills encompass various abilities that support individuals in facing the challenges of the modern era, as described by the Partnership for 21st Century Learning (P21) in the United States. These skills are commonly referred to as the "4Cs": Critical Thinking, Creativity, Collaboration, and Communication (Azmi et al., 2024).

One learning approach that has been proven to effectively foster 21st-century skills is STEM education

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(Science, Technology, Engineering, and Mathematics), which emphasizes interdisciplinary integration and contextual problem-solving (Zulirfan et al., 2020; Ridwan et al., 2024). STEM learning supports the development of logical, critical, and systematic reasoning, equipping students with the competencies required to face global challenges and future career demands (Rahmi et al., 2022; Nurwahidah et al., 2020). However, despite its strengths, STEM learning often remains abstract and culturally detached when implemented without contextual relevance, particularly in regions rich in local wisdom (Annam et al., 2024).

To address this limitation, the integration of STEM education with ethnoscience—commonly referred to as Ethno-STEM—has emerged as an innovative learning framework. Ethno-STEM connects scientific concepts with local cultural knowledge, enabling students to construct meaningful understanding while simultaneously preserving cultural identity (Sudarmin et al., 2020; Azis et al., 2022). Previous studies have demonstrated that Ethno-STEM can enhance students' engagement, conceptual understanding, and higher-order thinking skills, including critical and creative thinking (Le et al., 2021; Oladejo et al., 2025). Moreover, the integration of local wisdom into STEM learning has been shown to promote environmental awareness and sustainable problem-solving skills, which are essential for addressing contemporary global challenges (Sumarni & Kadarwati, 2020).

STEM education integrated with ethnoscience—or science learning based on local wisdom—is known as Ethno-STEM (Sudarmin et al., 2020). Ethno-STEM has emerged as an innovative framework designed to bridge modern education with cultural heritage, facilitating a holistic transfer of knowledge (Azis et al., 2022). By utilizing local cultural assets as a contextual foundation, this approach aims to deepen conceptual understanding of STEM materials through a more relevant and integrated perspective while encouraging students' engagement in appreciating and preserving their cultural identity (Sudarmin et al., 2020). Research by Le et al. (2021) revealed that high school educators in Vietnam believe the effectiveness of STEM education highly depends on the synergy between local cultural values and curriculum expectations, which enhances student engagement in learning. Empirical evidence from previous studies indicates that incorporating local cultural elements into the STEM curriculum not only increases students' interest and conceptual retention but also significantly optimizes the development of critical and creative thinking skills, including the ability to analyze, evaluate, and synthesize complex information (Oladejo et al., 2025). These skills—which encompass cognitive flexibility and originality in problem-solving—are crucial components in preparing young generations to address 21st-century global challenges such as environmental uncertainty and technological transformation (Sumarni & Kadarwati, 2020).

Local knowledge or community traditions can serve as cultural representations that enable education to function as both a primary source and an innovative medium for introducing and preserving customs and cultural values for future generations (Idrus & Suma, 2022). By integrating local knowledge into the Ethno-STEM framework, learners not only gain a deeper understanding of the application of science and mathematics in technological development but also learn to consider environmental sustainability and the practical relevance of technology to the broader community (Rahman et al., 2023). To achieve optimal learning quality—where students can develop problem-solving, critical, creative, innovative, systematic, and logical thinking skills—the Ethno-STEM approach promotes the use of technology and locally available learning resources, thereby creating a contextual and inclusive learning process. A generation equipped with ethical and responsible technology use is more likely to become environmentally conscious and motivated to design sustainable solutions (Nurfatimah et al., 2023). Furthermore, technology in education offers opportunities through interactive tools, immersive experiences, and comprehensive conceptual understanding, all of which enhance learning effectiveness. The integration of Ethno-STEM in science learning has proven effective in connecting scientific concepts with local community knowledge, enriching students' understanding of real-world scientific applications, and promoting locally grounded innovation (Fitri et al., 2025).

Aceh possesses a wealth of cultural heritage that has not been optimally utilized in formal science learning. One such cultural asset is the Rapai Geleng dance, a traditional Acehnese art form characterized by rhythmic movements and percussion patterns accompanied by the rapai drum (Zahri, 2024). Beyond its aesthetic and religious values, Rapai Geleng contains rich scientific potential that can be explored through an Ethno-STEM perspective. The dance embodies physics concepts such as vibration, sound, waves, force, and energy through body movements and rhythmic patterns. Additionally, the construction of the rapai instrument reflects traditional technological and engineering knowledge related to material selection, membrane tension, resonance, and acoustic design, while its rhythmic structure demonstrates mathematical concepts such as ratios, sequences, and symmetry (Sari et al., 2021).

One of the cultural traditions in Aceh is the Rapai Geleng dance. The Rapai Geleng is a traditional Acehnese dance featuring rhythmic movements and specific patterns, often accompanied by the beats of the

rapai drum in social and religious ceremonies (Zahri, 2024). In the context of Acehnese culture, Rapai Geleng serves as a highly potential medium to be integrated into Ethno-STEM learning.

This traditional art form not only displays aesthetic and religious elements but also contains various scientific, technological, engineering, and mathematical concepts that can be explored scientifically. From the science perspective, the body movements and head rhythms in Rapai Geleng reflect the application of mechanical physics principles such as force, momentum, vibration, and kinetic energy. From the technology aspect, the process of crafting the rapai instrument demonstrates traditional technology in material selection (goat skin, wood, and nails), membrane tension techniques, and sound resonance optimization (Hasan, 2021; Rahmawati et al., 2019). In the engineering dimension, the structure and design of the rapai highlight the Acehnese community's craftsmanship in creating ergonomically and acoustically efficient musical instruments. Meanwhile, the mathematics aspect is evident in the rhythmic patterns, beat counts, and synchronized movements, which involve concepts such as numerical sequences, ratios, and symmetry (Karina & Sunarto, 2024).

By integrating the cultural elements of Rapai Geleng into the Ethno-STEM approach, learners not only study scientific concepts but also develop contextual understanding of local culture, enhance critical and creative thinking skills, and foster a sense of pride and appreciation for cultural heritage. This approach aligns with the goals of 21st-century education, which emphasizes culture-based, collaborative, and sustainable learning.

Several previous studies have explored topics related to Ethno-STEM. Sartika et al. (2022) examined Ethno-STEM-based science learning incorporating Sidoarjo's local wisdom to train students' analytical thinking skills. Another study by Sumarni & Kadarwati (2020) found that Project-Based Learning (PBL) integrated with Ethno-STEM effectively improved students' critical and creative thinking abilities across all indicators, from low to moderate levels. Furthermore, Idrus & Suma (2022) analyzed challenges in Ethno-STEM-based chemistry learning from a curriculum perspective, while Saputra et al. (2022) developed Ethno-STEM-based thematic learning materials for elementary schools in Papua. Additionally, Muhammad et al. (2019) used Borobudur Temple as an ethnic art symbol to describe geometric literacy among lower-grade elementary students. However, no previous research has specifically developed an Ethno-STEM-based learning module oriented toward Acehnese culture, particularly the Rapai Geleng art form. In fact, integrating Ethno-STEM with the cultural context of Rapai Geleng is believed to help students develop 21st-century skills such as critical, creative, collaborative, and communicative thinking (Hermansyah, 2020).

Therefore, this study aims to develop an Ethno-STEM-based learning module on the topic of vibration, sound, and waves for eighth-grade students that is feasible for use in the learning process.

Method

This research is a Research and Development (R&D) study that adapts the Thiagarajan model, commonly known as the 4D model, which consists of four stages: Define, Design, Develop, and Disseminate (Thiagarajan et al., 1974). However, due to time constraints, this study only involved three main stages—Define, Design, and Develop. The first stage of this development model is a needs analysis for the development of an Ethno-STEM learning module based on the Acehnese Rapai Geleng dance. This stage includes an analysis of needs, student characteristics, curriculum, science learning materials, and learning objectives relevant to the integration of STEM concepts and Acehnese local wisdom.

The second stage is the design stage, which involves designing the concept and content of the Ethno-STEM learning module based on the Rapai Geleng dance, as well as developing research instruments to evaluate the quality of the module. The research instruments include module validation sheets, practicality questionnaires, and test items to measure students' critical thinking skills.

The third stage is the development (or realization) stage, which involves implementing the designed module into an Ethno-STEM learning module based on the Rapai Geleng dance that is ready for testing and classroom implementation. At this stage, expert validation is conducted to obtain validity scores, along with feedback and suggestions used as the basis for product revision. The module is then tested in a small group to determine its practicality. Subsequently, a field trial is conducted involving 25 seventh-grade students to examine students' responses to the practicality and effectiveness of the developed Ethno-STEM learning module based on problem-based learning.

The fourth stage is the dissemination stage, which involves the distribution of the Ethno-STEM learning module based on the Acehnese Rapai Geleng dance that has been declared valid, practical, and effective. Dissemination is carried out on a limited scale through socialization with junior high school science teachers, provision of the module in both printed and digital formats, and publication of the research findings in academic forums and educational journals. This stage aims to enable wider utilization of the module as a local

wisdom–based science learning resource and as a means of strengthening 21st-century skills.

The data analysis techniques used in this study include qualitative and quantitative descriptive analyses. Qualitative descriptive analysis is used to process data in the form of comments and suggestions from validators. Quantitative descriptive analysis is applied to analyze data obtained from validation sheets, student response questionnaires, and test instruments in the form of scores.

The validity of the Ethno-STEM learning module based on the Rapai Geleng dance is analyzed using percentage calculations. The practicality of the module is determined based on students' response scores from the practicality questionnaire. The effectiveness of the module is reviewed based on pretest and posttest results.

The product developed in this research is an Ethno-STEM-based science learning module on the topic of vibration, sound, and waves for eighth-grade junior high school students, which was declared feasible for use in the learning process. This study was conducted during the 2025/2026 academic year, with the research subjects being eighth-grade students at SMPN 3 Sakti. The steps involved in the module development process are illustrated in Figure 1, which depicts the systematic implementation stages of the research according to the modified 4D development model.

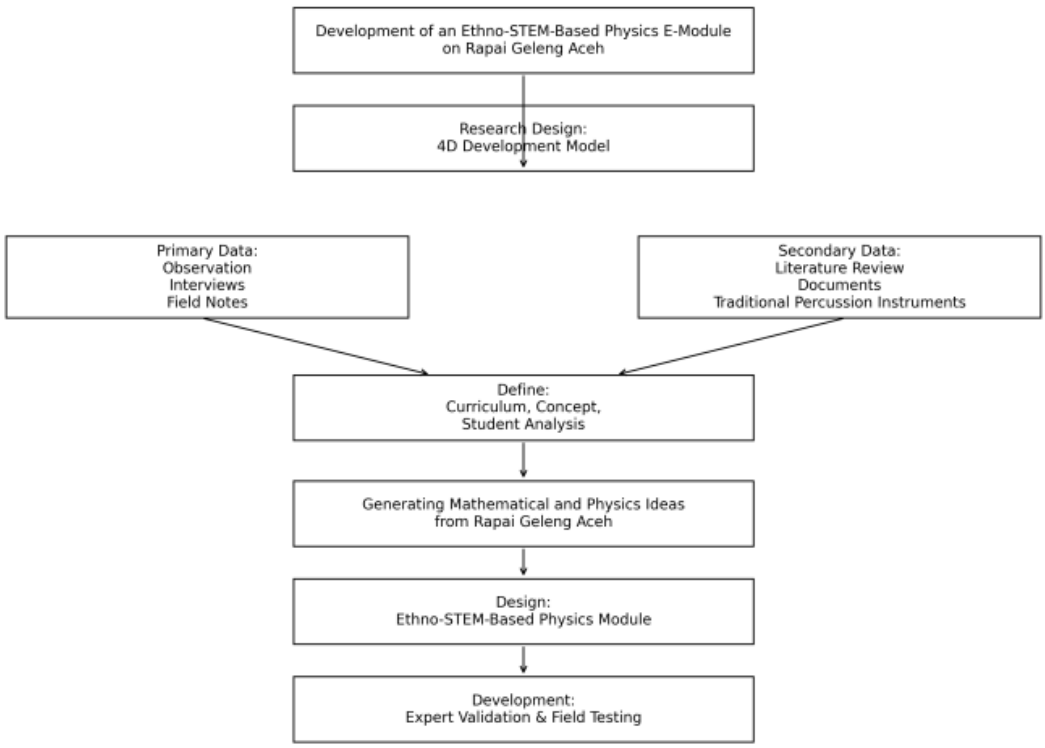

Figure 1. Flowchart of the development process of the Ethno-STEM learning module based on the Acehnese Rapai Geleng

The data collection techniques used in this study included interviews, validation tests by subject matter experts and instructional media experts, validation by science teachers, and readability tests involving students. The preliminary study was conducted through interviews with science teachers to analyze learning needs, curriculum alignment, and student characteristics. Subsequently, validation tests were carried out to assess the feasibility of the developed product. This validation process involved four expert lecturers in their respective fields and two science teachers as validators. In addition, twelve students were asked to provide feedback and evaluations of the developed learning module to determine its readability and attractiveness to learners.

The data obtained in this study were analyzed using quantitative descriptive analysis, which served as the basis for revising the learning module to produce a valid and feasible product. The validation results from the experts were tabulated according to each predetermined assessment aspect. The quantitative data were then converted into interval data using a four-point (4) scale to facilitate the interpretation of assessment results. Subsequently, the quantitative findings were interpreted qualitatively to provide a more descriptive understanding of the module's feasibility level. Quantitative data were obtained by statistically calculating the ratings given by each validator, with the average percentage score determined using Formula 1.

$$\text{Validator Assesment} = \frac{\text{Total Score Obtained}}{\text{Maximum Possible Score}} \times 100\% \quad (1)$$

(Riduwan & Akdon, 2020)

The score conversion reference on a four-point scale refers to the guidelines provided by instructional media experts, subject matter experts, and educational practitioners, as presented in Table 1.

Table 1. Validity assessment of research instruments

Criteria	Score Range
Very Valid	81–100
Valid	61–80
Fairly Valid	41–60
Invalid	21–40
Very Invalid	1–20

(Riduwan & Akdon, 2020)

Result and Discussion

Define

The first stage of this development involved identifying problems in science learning and student needs. The analysis conducted in this initial development stage is as follows.

Need Anaysis

The needs analysis was conducted through classroom observations and preliminary studies of science learning at the junior high school level. The observations showed that science teachers predominantly used conventional teaching materials, such as textbooks and worksheets, with limited variation in instructional approaches. Learning activities were largely teacher-centered, resulting in low student engagement and limited opportunities for students to actively construct knowledge.

From the perspective of student interaction, science learning had not yet optimally facilitated active participation or contextual understanding. Learning activities were rarely connected to students' cultural environments, even though local wisdom has strong potential to support meaningful learning. Integrating ethnoscience with STEM (Ethno-STEM) in science learning offers a contextual approach that connects scientific concepts with local culture, thereby enhancing students' conceptual understanding and critical thinking skills.

Several previous studies support the effectiveness of integrating ethnoscience and STEM in science learning. Fionita & Wulandari (2024) reported that students' critical thinking skills improved when using ethnoscience-integrated teaching materials compared to conventional textbooks. Similarly, Dywan & Airlanda (2020) found that students demonstrated higher critical thinking skills when learning with STEM-integrated teaching materials than when learning without STEM integration. These findings indicate that Ethno-STEM integration plays an important role in fostering students' critical thinking abilities.

Data obtained from the research site indicate that the school does not yet have a science learning module that integrates Ethno-STEM, particularly one that incorporates Acehnese local wisdom. Specifically, the cultural tradition of the Rapai Geleng dance—which contains rich scientific concepts related to vibration, sound, waves, force, and rhythmic patterns—has not been utilized as a contextual foundation in science learning. Therefore, to address the low level of student engagement and the limited availability of contextual teaching materials, this study proposes the development of an Ethno-STEM-based science learning module grounded in the Acehnese Rapai Geleng dance. The developed module is expected to enhance students' critical thinking skills, increase learning engagement, and provide meaningful learning experiences by connecting science concepts with local cultural heritage.

Student Analysis

The researchers analyzed students' characteristics regarding science subjects through interviews conducted during the Teaching Assistant program. The interviews revealed that students perceived science as a complex subject to understand. This lack of understanding of science subjects resulted in low learning outcomes, including poor critical thinking skills.

Curriculum Analysis

This researcher conducted a curriculum analysis related to the subject matter being presented. Researchers discussed the curriculum used with educators before developing the science learning module. The curriculum used was the Independent Curriculum.

Analysis of Learning Materials

At this stage, the researcher also conducted an analysis to identify the components of the material to be presented in the learning module. The material used in the science learning module was developed based on an Ethno-STEM approach integrated with Acehnese local wisdom, particularly the art of the Rapai Geleng dance.

The learning material focuses on the concepts of vibration, sound, and waves, which are closely related to the rhythmic movements of the Rapai Geleng dance and the use of the rapai instrument. The selection of this material is based on its alignment with the Ethno-STEM approach, as these concepts can be easily connected to students' daily experiences and the local cultural context they are familiar with. Therefore, the material presented is expected to help students

understand scientific concepts in a more contextual, meaningful, and culturally relevant manner.

Analysis of Learning Objectives

The researchers conducted an analysis regarding the formulation of learning objectives as a reference for developing the science learning module. The formulation of learning objectives facilitates teachers in selecting and organizing teaching materials, conducting more focused learning activities, and supporting the assessment of students' learning outcomes.

Design

The second stage of this development involves designing the product to be developed, namely a science learning module based on Ethno-STEM that integrates Acehnese local wisdom, particularly the Rapai Geleng dance. This stage begins with designing the concept and content of the learning module. The module is specifically designed for seventh-grade students.

The design process starts with preparing material in accordance with the seventh-grade Natural Science textbook. This is followed by the design and selection of various supporting images, illustrations, and backgrounds. At this stage, research instruments are also developed, including module validation sheets, practicality questionnaires, and test items, which will be used to assess the effectiveness of the developed learning module.

Develop

Validity of Science Learning Module

The result of this development research is an Ethno-STEM-based science learning module that incorporates Acehnese local wisdom, particularly the Rapai Geleng dance, for seventh-grade students. This learning module has been reviewed by two validators, namely lecturers from the Physics Education Study Program at Jabal Ghafur University, and one validator from a science teacher at SMPN 3 Sakti. The validity calculation results of the science learning module, based on the assessments of the three validators, are presented in Table 2.

Table 2. Result of the validity of the science learning module

Assesment Aspect	Validator 1	2	3	Percentage of Aspect Score (%)	Criteria
Presentation Format	74	68	69	83.73	Very Valid
Suitability Content Eligibility	56	63	58	81.94	Very Valid
Language	32	27	27	79.62	Valid
Amount	162	158	154		
Overall Score		474		81.76	Very Valid

The assessment of the science learning module was not limited to validity scores; it also included comments and suggestions from the validators. These comments and suggestions will serve as a reference for future improvements of the module. The comments and suggestions from the three validators are presented in Table 3.

Tabel 3. Validator comments and suggestions on the science learning module

Comments and Suggestions	Revision
Add questions at the end of the sub-topic so that students can relate scientific concepts to the movements and rhythms of the dance	Added questions at the end of the vibration, sound, and waves sub-topic linked to the movements and rhythms of the Rapai Geleng dance
Increase students' engagement in understanding the material	Added questions or interactive activities during learning that utilize Rapai movements and instruments to reinforce conceptual understanding

The science learning module for SMPN 3 Sakti was assessed by three validators, consisting of two lecturers from the Physics Education Study Program at Jabal Ghafur University and one science teacher from SMPN 3 Sakti. A teaching material can be considered valid if the results of the validity test align with the established criteria (Weriyanti et al., 2020). Based on the validity test calculation presented in Table 1, the developed science learning module obtained a score of 82%, categorized as very valid. Three aspects were evaluated: the feasibility of the presentation format, the feasibility of the content, and the language aspect.

The first aspect assessed by the validators was the feasibility of the presentation format. The presentation format in this science learning module received a validity score of 83.73%, with a very valid criterion. This indicates that the module's structure is in accordance with the Ethno-STEM approach and contextual learning activities. The presentation of the material in the module is considered appropriate and engaging for users.

This finding is consistent with the study by Lorenza et al. (2024), which suggests that a proper combination of text and images can more effectively capture students' interest and understanding, thereby facilitating effective learning. Furthermore, Sukma & Diyana (2024) explained that a high validity score in the presentation aspect indicates that the developed teaching material is interesting and easy for students to use.

The second aspect assessed by the validators was the content feasibility. The content feasibility of this science learning module received a validity score of 81.94%, indicating a very valid result. This shows that

the content of the developed module aligns with the Independent Curriculum, based on the appropriateness of the material in the learning process, the learning objectives, and the sequence of achieving these objectives.

Furthermore, this also demonstrates that the Ethno-STEM integration presented in the module is consistent with the concepts of vibration, sound, and waves, which are linked to the movements and rhythms of the Acehnese Rapai Geleng dance. According to Irma (2022), the alignment between teaching materials and learning content, including examples and practice questions, must be considered to make learning more efficient and ensure that learning objectives are effectively achieved.

The third aspect assessed by the validators was the linguistic aspect. The linguistic aspect of this science learning module received a validity score of 79.62%, categorized as valid. This indicates that the sentences used are clear and appropriate for the understanding of junior high school students. A teaching material must have good and clear language; the use of proper language facilitates students in understanding the learning material. This is in line with the study by Yani et al. (2023), which states that the use of communicative language in open teaching materials influences the success of learning. Students are more likely to understand the material if it uses clear and simple language.

The validity test results obtained from the three validators are consistent with previous research findings. First, the study by Sary et al. (2023) on the development of a Problem-Based Learning (PBL) module, which is also based on interactions with living things and their environment, achieved a validity score of 91%, categorized as very valid. The similarity between this study and previous research lies in the development model used, namely the 4D model, while the difference lies in the topic of the material covered. Second, the research by Farizi et al. (2023) on the development of problem-based learning modules to enhance students' metacognitive knowledge on temperature and heat obtained validity scores of 88.10% from language experts, 83.91% from learning design experts, 85.26% from media experts, and 91.07% from material experts, with a very reasonable category. The similarity between this study and that research lies in the material topic discussed, namely temperature and heat.

The main differences lie in the development model used and the research objectives. Based on the validity test results obtained and supported by several previous studies, it can be concluded that the Ethno-STEM-based science learning module developed in this study has a very high quality and can be effectively implemented in learning.

This module integrates science concepts with Acehnese local culture, particularly through the movements and rhythms of the Rapai Geleng dance, allowing students to understand scientific concepts in a contextual and meaningful way. The module also enables interactive learning that is relevant to students' daily experiences, making it easier to apply the material in real-world situations.

Practicality of Small Group Testing

The validated science learning module was then revised based on the comments and suggestions provided by the three validators. The revised module was subsequently subjected to a limited trial with a small group of 10 seventh-grade students at SMPN 3 Sakti. This trial aimed to determine the practicality of the module for the students, as reflected in their responses to the questions provided. The results of the small group trial on the practicality of the science learning module are presented in Table 4.

Table 4. Practical results in small group tests

Assesmeent Aspect	Amount	Percentage of Aspect Score (%)	Criteria
User Ease	280	93.00	Very Practical
Benefit	251	87.50	Very Practical
Time Efficiency	186	89.64	Very Practical
Overall Score	717	90.04	Very Practical

Tabel 5. Students' comments and suggestions on small group tests

Comments and Suggestions
The module is interesting because it incorporates cultural elements, such as the Acehnese Rapai Geleng dance.
The learning material is easier to understand when using this module.

In addition to obtaining practicality scores from student response questionnaires, the developed science learning module also received comments and suggestions from the students. These comments and suggestions aimed to provide feedback on the clarity, attractiveness, and ease of use of the module in the learning process. All student comments and suggestions are presented in Table 5.

Pretest and Posttest Small Group Test

In addition to distributing the student response questionnaire, a learning outcome test instrument was also administered during the small group trial. This test functioned as both a pretest and posttest to evaluate whether the questions used were appropriate for the junior high school level. The test instrument was administered to 10 students from Class VII D at SMPN 3 Sakti. The results of the pretest and posttest from the small group trial are presented in Table 6.

Table 6. Pretest and posttest results of small group tests

Average Pretest Score	Average Posttest Score	Average N-gain Score	Criteria
49	80	0.71	High

Based on the pretest and posttest results presented in Table 5, there was an increase in students' scores before and after using the developed science learning module. This indicates that the test instruments were appropriate for the junior high school level, meaning that the questions were neither too easy nor too difficult for the students. Therefore, the test instruments were able to provide valid information regarding students' learning outcomes after the implementation of the science learning module based on Ethno-STEM integrated with Acehnese Rapai Geleng culture.

Practicality of Class/Field Testing

Science learning implemented through the module developed in small-group trials has met the efficiency criteria. At this stage, no suggestions or revisions were provided by the students. Furthermore, the developed science learning module was tested in a classroom trial involving 25 seventh-grade students of SMPN 3 Sakti. This trial aimed to determine the practicality and effectiveness of the module, as measured by the calculation of student responses to the questionnaire, as presented in Table 7.

Table 7. Results of the practicality of the science learning module

Assesmeent Aspect	Amount	Percentage of Aspect Score (%)	Criteria
User Ease	655	93.43	Very Practical
Benefit	755	94.13	Very Practical
Time Efficiency	476	91.00	Very Practical
Overall Score	1886	92.86	Very Practical

The validated and revised science learning module was subsequently implemented with students. This trial aimed to examine the outcomes of the developed science learning module. The initial stage involved a limited trial conducted with a small group of 10 seventh-grade students. The results of the small group trial indicated that the developed science learning module achieved a good category, with a feasibility score of 90%. Following the small group trial, a class trial was conducted involving 25 seventh-grade students of SMPN 3 Sakti. At this stage, student responses were collected using a questionnaire consisting of three aspects: ease of use, benefits of the module, and time efficiency in learning.

The first aspect analyzed in the practicality questionnaire was ease of use. Based on student responses, this aspect obtained a score of 92.86%, which falls into the very practical category. These results indicate that the developed science learning module facilitated students' understanding of the learning materials. This finding is consistent with the study by Apriani et al. (2024), which reported that well-structured and systematically organized learning materials can enhance students' comprehension and support the achievement of learning objectives.

Effectiveness of Class/Field Table 7. Students' Tests

The effectiveness of the developed science learning module can be determined based on the results of the N-gain score calculation from students' pretest and posttest scores. These results indicate the extent of students' learning improvement after using the Ethno-STEM-based science learning module. The data regarding the effectiveness of the developed science learning module are presented in Table 8.

Table 8. The effectiveness of the developed science learning module

Average Pretest Score	Average Posttest Score	Average N-gain Score	Criteria
38.6	89.3	0.83	High

The effectiveness of the Ethno-STEM–based science learning module integrating Acehnese local wisdom, particularly the Rapai Geleng dance, was examined based on the results of the pretest and posttest scores analyzed using the N-gain calculation. The results of the effectiveness analysis of the developed science learning module are presented in Table 8.

Based on the pretest results conducted before students used the science learning module, the average score obtained was 38.6. After the implementation of the Ethno-STEM–based science learning module, the posttest results showed a substantial improvement, with an average score reaching 89.3. These findings indicate that the developed science learning module is effective in improving students' learning outcomes through contextual learning that is closely connected to local cultural practices.

The developed science learning module integrates an Ethno-STEM approach with Acehnese local wisdom, particularly the Rapai Geleng dance, as a contextual foundation for learning. The research results indicate that the developed module meets the criteria of validity, practicality, and effectiveness for use in junior high school science learning.

In terms of validity, the science learning module was declared feasible based on expert evaluations. The alignment of the content with the curriculum, the clarity of presentation, the integration of science concepts with elements of the Rapai Geleng dance, and the use of language appropriate to students' characteristics demonstrate that the module has strong content and design quality. This finding is consistent with previous studies showing that the integration of

ethnoscience and STEM into teaching materials enhances the relevance and meaningfulness of learning (Fionita & Wulandari, 2024; Dywan & Airlanda, 2020).

Regarding practicality, the module was considered easy to use by students. Its systematic structure, contextual presentation of materials, and the inclusion of illustrations and learning activities related to everyday life enable the module to be used both independently by students and with teacher guidance. Students' responses indicate that the module helps them understand science concepts more effectively by connecting learning materials with familiar local cultural contexts.

In terms of effectiveness, the learning outcomes show a noticeable improvement after students used the Ethno-STEM–based science learning module. This improvement indicates that the module supports the learning process effectively through contextual and meaningful material presentation. By linking science concepts to the cultural practice of the Rapai Geleng dance, students gain learning experiences that are more relevant and easier to comprehend.

Based on these findings, it can be concluded that the Ethno-STEM–based science learning module grounded in the Acehnese Rapai Geleng dance is suitable for use as an alternative learning resource at the junior high school level. The module not only aligns with curriculum requirements but also promotes contextual, engaging, and meaningful science learning through the integration of local wisdom.

Conclusion

Based on the results of the research and development process, the Ethno-STEM-based science learning module grounded in the Acehnese Rapai Geleng dance is feasible for implementation in junior high school science learning, particularly on the topics of vibration, sound, and waves. The developed module demonstrates a high level of quality, as reflected in its validity score of 81.76%, indicating that the content, presentation, and language aspects are appropriate for classroom use. In addition, the module shows a very high level of practicality, as evidenced by a practicality score of 92.86% obtained from classroom trials, which suggests that the module is easy to use, beneficial, and time-efficient for both teachers and students. Furthermore, the effectiveness of the module is supported by the improvement in students' learning outcomes based on pretest and posttest results, with an N-gain score of 0.83 in the high category. These findings indicate that integrating Ethno-STEM with local cultural elements such as the Rapai Geleng dance provides meaningful and contextual science learning experiences for students. Therefore, further research is recommended to develop similar Ethno-STEM-based learning modules by utilizing other forms of Acehnese local wisdom to enrich science learning resources and support culture-based science education.

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Conceptualization, methodology, validation, formal analysis, investigation, Z., H., and M.; resources, data curation, writing—originaldraft preparation, M.R.; writing—review and editing, visualization, M.S. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest
The authors declare no conflict of interest.

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