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Content Validity of an Acehnese Rapai Geleng Aceh E-Module Based on Problem-Based Learning and Ethnoscience to Improve Students' Critical Thinking Skills

Ilyas[a,1,], Mulia Rahmi[a,2], Aji Suhartoyo[b,3]*
[a] Universitas Jabal Ghafur, Jalan Gle Gapui-Sigli, Aceh, Indonesia
[b] Nicolaus Copernicus University, Jurija Gagarina 11, Toruń,87-100, Poland
[1] ilyas.daud.1965@gmail.com; [2] muliarahmi498@gmail.comr; [3] aji.suhartoyo@doktorant.umk.pl*
** corresponding author*

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ABSTRACT

Ethnoscience-based wave and sound materials are considered difficult because students must connect abstract concepts with daily phenomena and local cultural beliefs. Interactive teaching materials can improve students' understanding and critical thinking skills. Therefore, this study aimed to develop a valid and feasible ethnoscience-based e-module as a learning medium. This research employed a descriptive qualitative approach. The validation process included media, material, learning expert, and language validation conducted by experts and practitioners. Media validation covered presentation techniques, completeness, e-module size, cover design, and content design. Material validation included content completeness, scope, depth, accuracy, and contextual relevance. Learning expert validation assessed learning content, strategies, evaluation, and assessment, while language validation examined language appropriateness, communication clarity, interactivity, suitability for students' development, and language accuracy. The results showed validity scores of 0.88 for material, 0.90 for media, 0.94 for learning experts, and 0.98 for language, indicating that the Rapai Geleng Aceh e-module is valid and feasible for improving students' critical thinking skills.

I. Introduction

Student learning materials are developed as an effort to create a new paradigm in education that emphasizes the development of soft skills and the formation of students' character. Critical thinking skills are one of the 21st-century competencies that continue to be prioritized and integrated into science learning. Through these skills, students are expected to face various changes by utilizing their potential and using available information to solve problems effectively and obtain appropriate solutions.

Critical thinking skills are one of the essential competencies that students must possess because they provide significant benefits in everyday life (Zhong & Cheng, 2021; Marangio et al., 2024). Through these skills, students are better prepared to face future challenges and demonstrate greater concern for their surrounding environment. In addition, critical thinking skills contribute to improving students' academic achievement and creating broader career opportunities in the future (Bellaera et al., 2021; Hart et al., 2021).

Twenty-first-century skills include critical thinking skills (CTS), collaboration, communication, creativity, citizenship and culture, as well as character education and connectivity, which are collectively known as the 6C concept (Esquivel et al., 2022). These six competencies play an important role in the implementation and development of the Merdeka Belajar curriculum in Indonesia. The competencies encompass critical thinking, collaboration, communication, creativity, understanding citizenship and cultural values, as well as building character and social connectedness.

A study conducted by Nadiroh et al. (2021) involving pre-service teachers at Jakarta State University in the context of implementing the 21st-century curriculum revealed that critical thinking is the most difficult 6C skill for educators to master. This challenge is influenced by several factors, particularly because critical thinking requires the ability to access, evaluate, analyze, and integrate information effectively. The integration of these abilities will ultimately shape individuals with strong and well-developed critical thinking skills (Nadiroh et al., 2021; Murnaka & Sulistiawati, 2023).

The problems causing the learning process to be less than optimal, based on the results of a preliminary study conducted in January 2026 at one of the junior high schools in Pidie Regency, indicate that the use of

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technology as a medium for developing learning materials has not been implemented optimally. This condition is influenced by teachers' limited mastery of various learning technologies, particularly in the use of e-modules during the teaching and learning process. In addition, the results of the assessment of students' critical thinking skills showed an average score of 36%, which falls into the low category.

Another case study also revealed that the low level of students' critical thinking skills is influenced by several factors, including the lack of student engagement in learning due to the use of monotonous learning models, low student participation in learning activities, less varied teaching methods applied by teachers, and learning processes that still rely heavily on textbooks. Furthermore, the learning materials have not adequately integrated local culture and traditions. Therefore, further studies are needed to increase students' participation and interest in learning while also strengthening their understanding of the local cultural context.

This problem is further supported by the results of the Programme for International Student Assessment (PISA) 2022, which indicate that Indonesian students' scientific literacy and higher-order thinking skills remain below the OECD average (OECD, 2023). These findings suggest that students continue to experience difficulties in solving problems that require analysis, evaluation, interpretation, and evidence-based reasoning. Therefore, improving students' critical thinking skills remains an important challenge for science education in Indonesia.

The low level of students' critical thinking skills and the less optimal use of learning media indicate the importance of developing effective learning media that are appropriate to students' needs. Learning media are tools used by teachers to deliver instructional materials to students (Puspitarini & Hanif, 2019). The use of learning media can encourage the development of students' thinking patterns, increase attention, stimulate emotions, and foster learning interest, thereby making the learning process more effective (Zeng et al., 2020; Putri et al., 2024). Therefore, the quality of the media used greatly influences the success of the learning process. For this reason, teachers need to have the ability to select and evaluate learning media that are appropriate and effective for students.

Based on these conditions, innovation in science learning is needed. One effort that can be made to improve the quality of learning is through the development of learning media that can train students' critical thinking skills by connecting learning concepts, utilizing the surrounding environment as a learning resource, and creating more meaningful learning experiences for students (Yunus, 2019; Alika & Radia, 2021; Lin et al., 2024).

Problem-Based Learning (PBL) is a learning model that utilizes real-life problems as the basis of learning so that students can develop their critical thinking skills (Ismail et al., 2018; Monalisa et al., 2019; Saputra et al., 2019). This model also plays a role in helping students construct their own understanding through a learning process that integrates and connects various fields of knowledge with real situations encountered in everyday life (Ulger, 2018; Maulidiya & Nurlaelah, 2019; Aufa et al., 2021).

The low level of students' critical thinking skills can be improved through a learning process that connects students' prior knowledge and cognitive experiences with new information obtained during learning (Sholahuddin et al., 2021). This condition encourages the need to implement ethnoscience as one of the approaches in delivering learning materials (Dewi et al., 2019). Ethnoscience is considered capable of bridging education and students' cultural backgrounds, thereby helping students better understand modern scientific concepts (Suciyati et al., 2021; Wahyuni et al., 2023).

Aceh possesses rich local cultural wisdom that can be utilized as a contextual learning resource in science education. One of the cultural heritages that has educational potential is Rapai Geleng, a traditional Acehnese performing art characterized by rhythmic movements, cooperation, discipline, communication, and strong cultural values. These cultural elements can be linked to science concepts and real-life phenomena, allowing students to construct scientific understanding based on their own cultural experiences. Therefore, integrating Rapai Geleng into science learning through an ethnoscience perspective can help students connect scientific concepts with their local cultural environment.

One approach that supports the integration of local culture into learning is Culturally Responsive Teaching (CRT). CRT emphasizes the importance of recognizing students' cultural backgrounds and incorporating cultural experiences into classroom instruction (Chuang et al., 2020). Through CRT, learning becomes more meaningful because students learn scientific concepts through contexts that are familiar to them. In this study, CRT serves as the pedagogical foundation for integrating Rapai Geleng culture into a PBL-based ethnoscience e-module, enabling students to engage with scientific concepts while maintaining connections to their cultural identity and local knowledge.

Previous studies have shown that ethnoscience-based learning can improve students' critical thinking skills and scientific understanding (Zidny et al., 2020; Zubaidah & Arsih, 2021). Other studies have reported that PBL-based e-modules are effective in supporting independent learning, increasing engagement, and improving learning outcomes (Wulandari, 2022; Fahrudin et al., 2023; Bogar et al., 2024). However, most previous studies have examined PBL, ethnoscience, CRT, and e-modules

separately. Limited studies have developed science e-modules that simultaneously integrate Problem-Based Learning, ethnoscience, and Culturally Responsive Teaching using Rapai Geleng as an authentic cultural context for science learning. Therefore, a research gap still exists regarding the development of culturally responsive digital learning materials that integrate local Acehnese wisdom to improve students' critical thinking skills.

The development of Problem-Based Learning (PBL)-based e-modules integrated with ethnoscience is expected to create a more interactive learning process, enabling students to concentrate more effectively on the learning materials presented in accordance with the characteristics of the PBL model (Prosser & Kromer, 2023; Wulandari, 2022; Fahrudin et al., 2023). In addition, this development is expected to help improve students' critical thinking skills and enhance the effectiveness of science learning while preserving and promoting local cultural values.

The systematically developed e-modules, equipped with features that support independent learning, are expected to increase students' interest and motivation in learning, especially in materials that have traditionally been considered difficult and less engaging. Furthermore, the integration of Rapai Geleng cultural values into science learning is expected to strengthen students' character development while broadening their understanding of Acehnese local wisdom.

Based on the identified research gap, this study aims to develop and evaluate a Problem-Based Learning-based ethnoscience e-module integrated with Rapai Geleng culture through a Culturally Responsive Teaching approach to improve junior high school students' critical thinking skills. Accordingly, the research question addressed in this study is: "How valid, practical, and effective is a PBL-based ethnoscience e-module integrated with Rapai Geleng culture through a CRT approach in improving students' critical thinking skills?

II. Method

A. Research Design

This study employed a Research and Development (R&D) approach using the ADDIE development model proposed by Branch (2009), which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. The present article focuses on the development and content validation stages of the Acehnese Rapai Geleng E-Module based on Problem-Based Learning (PBL)-Ethnoscience. Therefore, the data reported in this study are limited to the results of expert validation of the developed product.

The research was conducted at SMPN 2 Sigli and SMPN 3 Sakti, Aceh Province. The developed e-module was designed for seventh-grade science learning. In the broader development study, the implementation stage involved 120 seventh-grade students from four classes consisting of experimental and control groups. However, the present study specifically reports the results of content validation conducted by experts before field implementation.

B. ADDIE Development Procedure

The development procedure followed the ADDIE model as follows:

1) Analysis

The analysis stage was conducted through classroom observations, interviews with science teachers and students, critical thinking skills (CTS) analysis, curriculum analysis, and literature review. This stage aimed to identify performance gaps, student learning needs, learning objectives, student characteristics, available learning resources, and challenges in science learning. The analysis revealed limited utilization of technology-based learning media and low student critical thinking skills.

2) Design

At this stage, the framework of the e-module was designed by integrating Problem-Based Learning (PBL), ethnoscience principles, and Acehnese local wisdom represented by Rapai Geleng culture. Learning objectives, learning activities, assessment instruments, module structure, and media components were systematically prepared.

3) Development

The initial prototype of the e-module was developed based on the design specifications. Subsequently, expert validation was conducted to assess the content validity of the product. Suggestions and recommendations from validators were used to revise and improve the product before implementation.

a) Implementation

The validated e-module was prepared for use in science learning activities involving seventh-grade students at SMPN 2 Sigli and SMPN 3 Sakti.

b) Evaluation

Evaluation was conducted continuously throughout each development stage to ensure that the product met quality standards and learning objectives.

Figure 1 presents the research flow based on the ADDIE development model.

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Fig. 1.Cover of the Rapai Geleng Aceh E-Module

c) Validators

The content validation process involved 10 experts, consisting of:

Table 1. Expert Validators

Validator Category	Number of Validators
Material Experts	2
Media Experts	2
Learning Experts	3
Language Experts	3
Total	10

The validators consisted of university lecturers and experienced science teachers who evaluated the developed e-module according to their respective areas of expertise.

d) Research Instrument

The research instrument consisted of validation sheets developed based on previous studies and adapted to the objectives of this research. The validation instrument used a four-point Likert scale ranging from 1 (not appropriate) to 4 (very appropriate).

The validation covered four aspects:

- Material validity
- Media validity
- Learning validity
- Language validity

b. Data Analysis

The data obtained from expert validation were analyzed quantitatively using Aiken's V coefficient to determine the content validity of the developed e-module.

The Aiken's V formula is presented as follows:

$$V=\frac{\sum s}{n\,(c-1)}$$

where:

V = Aiken's validity coefficient
S = r − lo
r = score given by validator
lo = lowest score category
c = highest score category
n = number of validators

The interpretation criteria of Aiken's V are presented in Table 2.

Table 2. Validity Interpretation Criteria

Aiken's V Value	Validity Criteria
0.81 – 1.00	Very Good
0.61 – 0.80	Good
0.41 – 0.60	Fair
0.21 – 0.40	Poor
0.00 – 0.20	Very Poor

[a.] (Source: Adapted from Arikunto, 2010)

The developed e-module was considered valid and feasible for implementation when the obtained validity coefficient was categorized as "Good" or "Very Good.

III. Results and Discussion

A. Preliminary Analysis

The preliminary analysis was conducted through classroom observations, interviews with science teachers and students, curriculum analysis, and a critical thinking skills (CTS) test. The CTS assessment involved 20 seventh-grade students representing various academic ability levels.

The results indicated that students' critical thinking skills remained low, with an average score of 36%. Interviews with teachers revealed several contributing factors: (1) science learning was still dominated by conventional teaching methods, (2) limited use of digital learning resources, (3) difficulties in selecting appropriate learning media, (4) low student engagement during learning activities, and (5) limited integration of local culture into science learning.

These findings support the need for developing innovative learning materials capable of connecting scientific concepts with students' cultural experiences while facilitating critical thinking processes.

B. Development of the Rapai Geleng Aceh PBL-Ethnoscience E-Module

Based on the needs analysis, an electronic module integrating Problem-Based Learning (PBL), ethnoscience, and Acehnese local wisdom (Rapai Geleng) was developed for the topic of Waves and Sound.

The developed e-module contains several main components:

The cover was designed by integrating visual elements of Rapai Geleng culture with wave and sound concepts to create contextual learning experiences.

Fig. 2. Problem Orientation Stage (PBL Syntax)

Students are introduced to contextual problems related to sound waves found in Rapai Geleng performances. This stage encourages students to identify problems and formulate initial hypotheses.

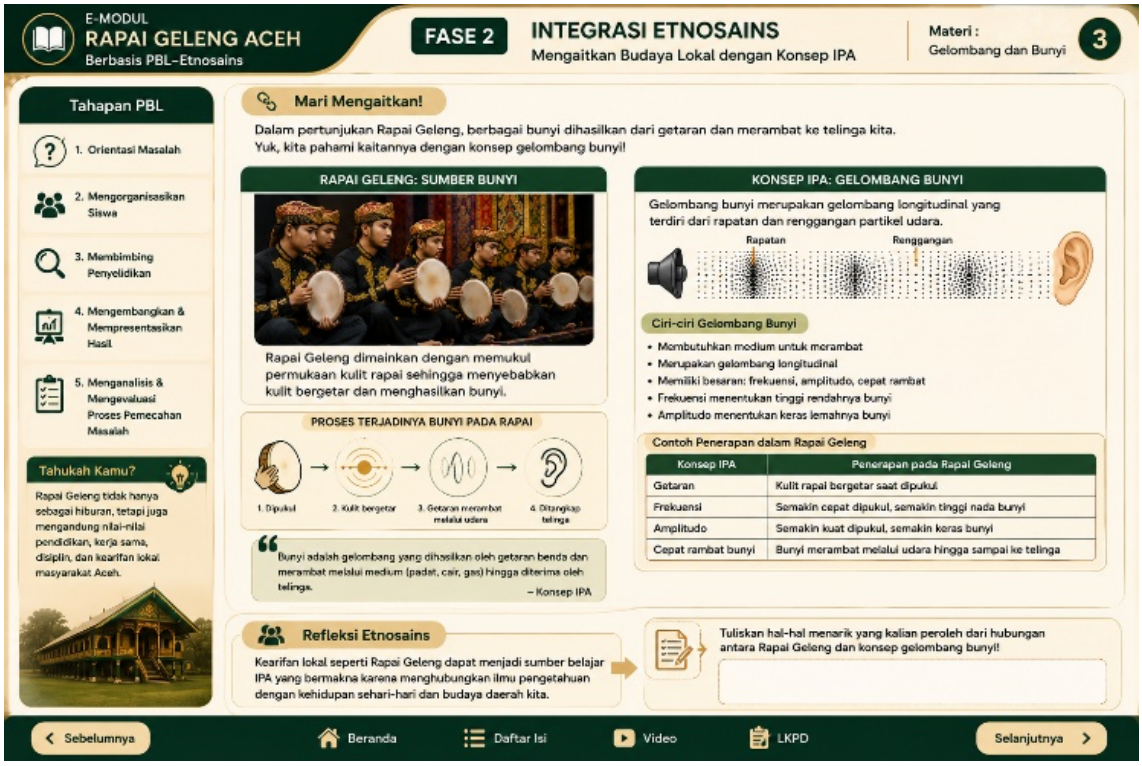

Fig. 3. Ethnoscience Integration Page

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The module integrates scientific explanations of sound waves with traditional Rapai Geleng performances. Students analyze how vibration, frequency, resonance, and sound propagation occur in cultural practices.

Fig. 4. Critical Thinking Activity Page

Students are required to analyze data, evaluate information, formulate arguments, and propose solutions based on authentic problems. The activities were designed according to critical thinking indicators.

Fig. 5. Problem-Solving and Reflection Activities

Students present solutions and reflect on the relationship between scientific concepts and local cultural practices.

The integration of PBL syntax, ethnoscience content, and CTS-oriented activities distinguish this module from conventional science teaching materials.

C. Expert Validation Results

1) Media Validation

Media validation was conducted by two media experts.

Table 2 shows that the average media validity score reached 0.88, indicating a very high validity category.

The highest scores were obtained in:

- Completeness of information (0.90)
- Appropriateness of illustrations, images, photos, and videos (0.90)

These results indicate that the multimedia components successfully support learning activities and facilitate students' understanding of abstract scientific concepts.

The lowest score was obtained in the suitability of display with the material aspect (0.88). Validator comments indicated that several visual elements required improvement, including consistency of layout design and inclusion of institutional identity.

Table 3. presents examples of revisions made based on expert suggestions.

No	Aspects	Average Score	criteria
1	Suitability of the display with the material	0,85	Valid
2	Completeness of information	0,90	Valid
3	Appropriateness of font usage	0,88	Valid
4	Appropriateness of illustrations/images/photos/videos	0,90	Valid
5	Ease of use of the Rapai Geleng Aceh e-module	0,89	Valid
	Average Score	0,88	Valid

The findings are consistent with Fahrudin et al. (2023), who reported that attractive visual presentation and multimedia integration improve the usability and acceptability of electronic learning resources.

2) Material Validation

The material validation results produced an average score of 0.90.

The highest score was obtained in the currency and contextual relevance aspect (0.91), indicating that the learning materials successfully connected scientific concepts with students' cultural experiences through Rapai Geleng ethnoscience content.

The contextualization of science concepts through local culture is important because students tend to understand abstract concepts more easily when learning is related to familiar environments.

The material scope and accuracy aspects obtained slightly lower scores (0.89). Validators suggested strengthening several explanations related to wave characteristics and adding more examples connecting scientific principles with Rapai Geleng performances.

These findings support Fitri (2023) and Asnidar et al. (2024), who found that ethnoscience-based learning materials become more meaningful when cultural phenomena are explicitly connected with scientific explanations.

3) Learning Expert Validation

Learning expert validation achieved an average score of 0.94.

The highest score was found in the learning evaluation aspect (0.95), indicating that the assessment activities were aligned with critical thinking indicators and learning objectives.

This high score may be attributed to the systematic implementation of PBL syntax throughout the module. Students are guided through problem orientation, investigation, analysis, solution development, and evaluation activities.

The learning experts particularly appreciated:

- Alignment between learning objectives and activities.
- Integration of CTS indicators.
- Use of authentic problems.
- Availability of assessment rubrics.

These findings are consistent with studies by Fahrudin et al. (2023), which reported that PBL-based e-modules facilitate higher-order thinking processes when learning activities are systematically structured.

4) Language Validation

Language validation achieved the highest average score among all validation aspects (0.98).

The highest score was found in the interactive and dialogic aspect (0.99). Validators indicated that the language used was communicative, easy to understand, and suitable for junior high school students.

The language score was higher than the media score because language revisions generally involve improving sentence structure, readability, and terminology consistency, whereas media revisions require more extensive adjustments related to visual design and multimedia integration.

These findings support Arisandy et al. (2019), who emphasized that language quality significantly influences students' comprehension of learning materials.

The overall validation results demonstrate that the Rapai Geleng Aceh PBL-Ethnoscience E-Module possesses a high level of content validity, with average validity scores ranging from 0.88 to 0.98.

The highest validity score was obtained in the language aspect (0.98), indicating that the module is highly communicative and appropriate for students' cognitive development. Meanwhile, the media aspect obtained the lowest score (0.88), suggesting that visual presentation remains an area requiring continuous refinement despite already meeting validity standards.

The findings also indicate that integrating Problem-Based Learning, ethnoscience, and Acehnese cultural contexts is considered appropriate by experts. The use of Rapai Geleng as a contextual learning resource provides opportunities for students to connect scientific concepts with their cultural experiences.

Compared with previous studies (Fitri, 2023; Asnidar et al., 2024; Fahrudin et al., 2023), the novelty of this study lies in the simultaneous integration of:

- Problem-Based Learning (PBL),
- Ethnoscience,
- Culturally responsive local wisdom,
- Rapai Geleng cultural context,
- Digital e-module format, and
- Critical thinking-oriented learning activities.

However, it is important to note that this study only evaluated content validity through expert judgment. Therefore, the results cannot yet demonstrate actual improvement in students' critical thinking skills.

The validation results indicate that the developed e-module has the potential to facilitate the development of critical thinking. Future studies should conduct implementation and effectiveness testing using pretest-posttest designs, N-gain analysis, and effect size calculations to determine the actual impact of the module on students' critical thinking skills."

IV. Conclusion

The Problem Based Learning (PBL)-based Rapai Geleng Aceh e-module has been declared valid and effective as a medium for improving students' critical thinking skills, as indicated by the high validity scores in the aspects of media, material, learning, and language. Based on these results, the e-module is feasible to proceed to the effectiveness testing stage. This study is still focused on the culture of Rapai Geleng Aceh; therefore, future research may further develop the e-module by integrating other Acehnese cultural elements, such as Acehnese traditional houses and various other traditional Acehnese dances. In addition, this study contributes to cultural preservation efforts through the integration of local wisdom with scientific concepts, thereby helping to introduce Acehnese local culture to the younger generation.

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