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Content Validity of PjBL Modules with a STEM-R Approach on the Topic of Renewable Energy for MTs Students

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ABSTRACT

Science education in madrasahs requires modules that are scientifically sound and also integrated with Islamic values. However, the modules currently available generally do not systematically integrate the STEM-R approach, nor have they been validated through multidisciplinary assessment. This study aims to assess the content validity of PjBL STEM-R module on renewable energy topic for MTs students. The study uses a quantitative descriptive content validation, involving nine validators from three groups, namely science content experts, teacher practitioners, and religious experts. Data using a 1–5 Likert scale were analyzed using Aiken's V coefficient. The results showed an average Aiken's V of 0.90, with all components (content feasibility, PjBL, creative thinking, religious integration) categorized as Valid (V ≥ 0.83). The religious expert group gave the highest rating (0.92), confirming that the integration of Islamic values was carried out organically, contextually, and theologically appropriate. The findings prove that the module is suitable for use as teaching material that is valid in terms of content and context in a madrasah environment. This validation is an important foundation before wider implementation or testing of its effectiveness in improving students' creative thinking and religious attitudes.

ABSTRAK

Pembelajaran IPA di madrasah memerlukan modul yang ilmiah dan juga terintegrasi dengan nilai keislaman. Namun, modul yang tersedia umumnya belum mengintegrasikan pendekatan STEM-R secara sistematis dan tervalidasi melalui penilaian multidisiplin. Penelitian ini bertujuan menilai validitas isi modul pembelajaran berbasis PjBL STEM-R pada topik energi terbarukan untuk siswa MTs. Penelitian menggunakan pendekatan validasi konten deskriptif kuantitatif, dengan melibatkan sembilan validator dari tiga kelompok yaitu ahli konten sains, praktisi guru, dan ahli religius. Data menggunakan skala Likert 1–5 dianalisis dengan koefisien Aiken's V. Hasil menunjukkan rata-rata Aiken's V sebesar 0,90, dengan seluruh komponen (kelayakan isi, PjBL, berpikir kreatif, integrasi religius) berkategori Valid (V ≥ 0,83). Kelompok ahli religius memberikan penilaian tertinggi (0,92), mengonfirmasi bahwa integrasi nilai keislaman dilakukan secara organik, kontekstual, dan teologis tepat. Temuan membuktikan bahwa modul layak digunakan sebagai bahan ajar yang valid secara isi dan kontekstual dalam lingkungan madrasah. Validasi ini menjadi fondasi penting sebelum implementasi lebih luas atau pengujian efektivitas terhadap peningkatan berpikir kreatif dan sikap religius siswa.

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INTRODUCTION

In an effort to address the challenge of low creative thinking skills among Indonesian students, who only achieved an average score of 19 out of 60 in PISA 2022 (OECD, 2023), innovative learning solutions are needed. Learning modules are a strategic solution because they are able to integrate scientific content, pedagogical approaches, and local contexts in a structured manner. 21st-century skills, which include the 4Cs (Critical Thinking, Communication, Collaboration, and Creativity), are crucial components in education (Thornhill et al., 2023 & Supena et al., 2021). Creative thinking is a higher-order thinking skill (Akhsan et al., 2020). Creative thinking is important because it can increase in-depth understanding of concepts (Aytac & Kula, 2020), solve problems by creating unique, different, logical ideas (Leasa et al., 2021), and can also influence student learning outcomes (Mursid et al., 2022 & Siburian et al., 2019).

In response to these needs, learning modules have emerged as a strategic solution that can fully integrate scientific content, pedagogical approaches, and local contexts. However, the existence of modules alone is not enough. Their quality and suitability must be ensured through a systematic and multidisciplinary validation process. In other words, modules are the key to learning innovation, while validation is the foundation that guarantees the credibility and reliability of these modules.

To address this need, a Project-Based Learning (PjBL) module with a STEM-R (Science, Technology, Engineering, Mathematics, and Religion) approach was developed on the topic of renewable energy. The PjBL strategy was chosen because it involves students in authentic investigations, technological solution design, and moral reflection that support the development of creative thinking (Syarhil et al., 2022). This is consistent with the findings of Syamra and Suryadi (2025), who demonstrated that the integration of PjBL with the STEM approach significantly enhances students' scientific creativity, particularly when applied in the context of renewable energy. More specifically, Rizki and Suprapto (2024) demonstrate that the Project-Oriented Problem-Based Learning model, using the SR-STEM approach, effectively stimulates students' critical thinking skills in the subject of renewable energy, with significant improvements in analysis and evaluation skills through investigations based on real-world problems.

The topic of renewable energy was chosen because of its high relevance in Madrasah Tsanawiyah (MTs) environments, especially those located in remote areas or boarding schools. One example is MTs Al Ittifaqiah South OKU, which often experiences prolonged power outages. Learning about solar panels not only provides practical solutions to energy problems but also teaches the importance of renewable energy in reducing dependence on fossil fuels (Holechek et al., 2022), introduces environmentally friendly technology (Rabaia et al., 2021), and opens up opportunities to link scientific concepts with verses of kauniyah and the principle of khalifah fil ardh as emphasised in the STEM-R approach (Sarwi et al., 2024). This approach is in line with the vision of the Indonesian Ministry of Religious Affairs (2020), which emphasises the formation of religious character as well as scientific competence.

However, this potential can only be realised if the modules are valid in terms of content, scientifically accurate, pedagogically relevant, and spiritually meaningful. Unfortunately, document analysis of science teaching materials in a number of MTs in South Sumatra shows that the integration of Islamic values in science learning is still very minimal. The teaching materials used are almost no different from those used in public schools, and do not relate the material to verses from the Qur'an, the principle of environmental preservation as worship, or human responsibility as caliphs. Furthermore, research on the development of STEM-based or PjBL-based modules generally does not involve religious education experts in the validation process, so that religious aspects are often added artificially, rather than being integrated organically (Sumarni et al., 2020).

In fact, validation by triple expertise—science experts, teacher practitioners, and religious experts—is very important to ensure that the modules are not only scientific and practical, but also theological and contextual in the madrasah environment. Furthermore, most

validation studies in Indonesia still rely on subjective methods or simple agreement percentages, even though Aiken's V is a recommended statistical method for assessing content validity based on an ordinal scale that considers inter-expert consensus (Aiken, 1985).

The findings of a preliminary study (Kurnia et al., 2025) of 109 MTs students in South OKU showed that the average creative thinking score was only 41.56 out of 100, with the lowest indicator being originality (originality of ideas). A survey of 325 students also revealed that 76.3% expressed an urgent need for PjBL-STEM-R-based modules on the topic of renewable energy. Therefore, this study aims to assess the content validity of PjBL-based learning modules with a STEM-R approach on the topic of renewable energy for MTs students through systematic assessment by nine validators from three expertise groups using Aiken's V coefficient.

METHOD

This study utilised a quantitative descriptive approach with a content validation study design on PjBL modules with a STEM-R approach on the topic of renewable energy for MTs students. The main focus of the study was to assess the validity of the module content through systematic assessment by experts from three different fields of expertise. The validators consisted of science content experts, learning practitioners (teachers), and Islamic education experts (religious). Module validation used Aiken's V coefficient. Aiken's V was chosen because it can provide a more sensitive estimate of content validity for ordinal scales with a limited number of validators (<10), compared to the classic CVI method, which only calculates the percentage of agreement. The calculations were performed manually using Microsoft Excel. This study obtained informed consent from all validators, and the identities of the respondents were kept confidential.

The research subjects consisted of nine validators selected through purposive sampling. Validators were selected based on the criteria of having a minimum academic background of a master's degree and at least ten years of professional experience in their field. The validators were divided evenly into three groups: three lecturers as science content experts, three science/physics teachers as learning practitioners, and three Islamic boarding school administrators as religious experts.

The main research instrument was a module validation sheet developed based on specific guidelines for each group of validators. The three versions of the validation sheet used a 1–5 Likert scale with the following categories: (1) Very Inappropriate, (2) Inappropriate, (3) Somewhat Inappropriate, (4) Appropriate, and (5) Very Appropriate. Validators were also provided with an open comment column for qualitative input. The validation components were tailored to the expertise of each group, as summarised in Table 1.

Table 1. Module Validation Components Based on Validator Groups

No	Validator Group	Key Validation Components	Number of Items
1.	Content Experts (Lecturers)	Content suitability, presentation and learning strategies, creative thinking skills development, PjBL characteristics, graphics and design, and assessment aspects	30
2.	Practitioners (Teachers)	Ease of use of the module, suitability for MTs student characteristics, learning feasibility, assessment aspects, and STEM-R integration	15
3.	Religious Experts	Relevance and integration of material with the Qur'an and hadith, depth and accuracy of interpretation, formation of Islamic character, and clarity of language and communication of religious values	17

Quantitative data from the validation sheet was analyzed using Aiken's V coefficient with the formula:

$$V = \frac{\sum s}{[n(c-1)]} \quad (1)$$

Aiken's V value with interpretation refers to the criteria: V ≥ 0.60 = Valid and V < 0.6 = Invalid (Aiken, 1985).

To complement the validation process, a pilot study was conducted with six Year 9 pupils from MTs Al Ittifaqiah in South OKU, selected on a heterogeneous basis according to their academic ability. This pilot study aimed to assess the module's usability from the perspective of early users, specifically to identify potential issues regarding readability, clarity of instructions, and the module's user-friendliness. The practicality instrument used was a closed-ended questionnaire designed based on a framework of student responses to the module, covering eight main indicators: (1) understanding of learning objectives, (2) ease of language comprehension, (3) clarity of activity instructions, (4) the usefulness of visuals (images/diagrams) for conceptual understanding, (5) the systematic presentation of material, (6) alignment of exercises with the material, (7) appeal of the module, and (8) ability to learn independently using the module. Each statement item was measured using a 4-point Likert scale with the following categories: 1 = Strongly Disagree, 2 = Disagree, 3 = Agree, and 4 = Strongly Practical. The percentage results were interpreted based on the following category intervals: 81–100% (Very Practical), 61–80% (Practical), 41–60% (Fairly Practical), 21–40% (Less Practical) and 0–20% (Not Practical). The findings from this trial are used exclusively for minor refinements to the readability and layout of the module, not as a basis for assessing the validity of the main content.

RESULT AND DISCUSSION

This study aims to assess the content validity of PjBL-based learning modules with a STEM-R approach on the topic of renewable energy for MTs students. The module validation score obtained an average Aiken's V of 0.90 from 62 items assessed by nine validators. All components were declared valid. The average score for each group of expert validators is shown in Figure 1.

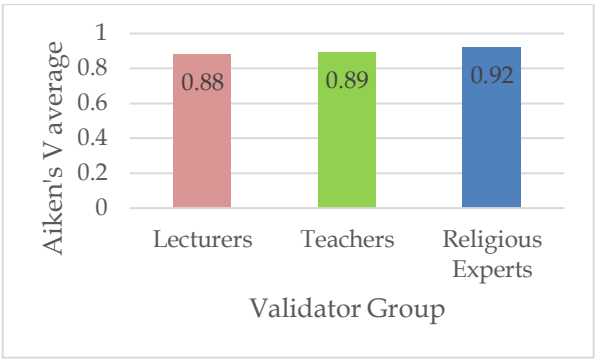

Figure 1. Average scores of the validator group

The first group of validators consisted of three lecturers with backgrounds in physics. They validated the module by assessing 30 items grouped into six main components. Overall, the average Aiken's V was 0.88, which was categorized as Valid. The Presentation and Learning Strategy component received the highest score (V = 0.92), indicating that the module structure (introduction, content, exercises, evaluation) was considered very comprehensive and capable of motivating learning. The Graphics and Design component received the lowest relative score (V = 0.83), particularly on the item 'Visual design, layout, and illustrations are attractive and professional' (V = 0.75), although it remained in the Valid category.

The second group of validators consisted of three science/physics teachers. Module validation by assessing 15 items grouped into five components resulted in an overall Aiken's V average of 0.89, which was categorized as Valid. The components of Suitability for MTs Student Characteristics and STEM-R Integration received a perfect score (V = 1.00), indicating that the material, language, and integration of religious values were considered very suitable for the madrasah context. The Learning Implementation component received the lowest score (V = 0.75), particularly on the item 'Realistic activity time allocation' (V = 0.67), indicating the need to adjust the project duration to better align with class hours.

Meanwhile, the third group of validators consisted of religious experts from an Islamic educational background. They validated the module by assessing 17 items grouped into four components with an average Aiken's V of 0.92, which was categorized as Valid. The Character

and Values Formation component received a perfect score (V = 1.00) on the items 'The module encourages students to be grateful for the blessing of unlimited energy' and 'The project is described as an effort to utilise God's blessings'. The items with the lowest scores (V = 0.83) were 'Verses/hadiths are selected according to context, not forced' and 'The project is explicitly linked to the concept of worship', although they remained in the Valid category. Overall, the integration of religious values was assessed as organic, contextual, and theologically appropriate.

Overall, the average Aiken's V scores for each validator group per component can be seen in Table 2.

Table 2. Average Aiken's V Score for Each Validator Group

No	Validator Group	Componen	Number of Items	Aiken's V Average	Category
1	Content Expert (Lecturer)	Content Suitability	9	0.85	Valid
		Presentation and Learning Strategy	2	0.92	Valid
		Creative Thinking Development	4	0.90	Valid
		PjBL Characteristics	5	0.87	Valid
		Graphics and Design	5	0.83	Valid
		Assessment	5	0.85	Valid
2	Practitioner (Teacher)	Ease of Use	3	0.83	Valid
		Suitability for MTs Students	3	1.00	Valid
		Learning Implementation	3	0.75	Valid
		Assessment	3	0.89	Valid
		STEM-R Integration	3	1.00	Valid
3	Religious Expert	Material Relevance	5	0.92	Valid
		Accuracy of Interpretation	4	0.83	Valid
		Character Building	4	0.96	Valid
		Language and Communication	4	0.92	Valid
		Total	62	0.90	Valid

As a complement to the validation process, limited trials were conducted on six students from MTs Al Ittifaqiah South OKU who were selected heterogeneously based on academic ability and gender. The results showed that the module obtained an average percentage of 81%, which was categorised as Very Practical. The indicators with the highest scores were clarity of activity instructions (88%) and attractiveness of the module (88%). No serious obstacles were found in understanding the instructions or implementing the project.

Content Validity of Modules from a Multidisciplinary Perspective

The validation results show that the PjBL-based learning module with a STEM-R approach on the topic of renewable energy obtained an average Aiken's V of 0.90, which is categorised as Valid. These research results are consistent with the content validity criteria according to Aiken (1985), where a value of ≥ 0.60 is considered adequate for learning instruments. More importantly, this validity does not come from just one perspective, but rather a strong consensus from three different groups of experts, namely science content experts, learning practitioners, and religious experts.

From the perspective of content experts, the module was considered highly valid in terms of scientific concept accuracy, STEM integration, and creative thinking development. This is in line with the research by Sarwi et al. (2024), which emphasises that comprehensive STEM integration, rather than simply adding components, is the key to successful 21st-century learning. This module not only presents the principles of photovoltage and electrical power calculations, but also connects them to

engineering design and the local context of power outages at MTs Al Ittifaqiah, thus fulfilling the principles of authentic STEM education through modelling and engineering design (Hallström et al., 2023).

From an educational practitioner's perspective, the highest validity of this module lies in its suitability for MTs students' characteristics and its natural integration of STEM-R. The three teacher validators gave perfect scores (V = 1.00) on the indicators of age relevance, clarity of language, and integration of religious values. These findings reinforce the concern often raised in the literature that the integration of religion in science learning can be unnatural if it is not designed contextually and epistemologically (Chanifudin & Nuriyati, 2020). This module successfully avoids this pitfall by organically linking the concept of solar energy with Islamic values such as khalifah fil ardh and the responsibility to protect the environment as a form of worship. This approach is in line with the recommendations of Mushlihin et al. (2025), which emphasise the importance of integrating religious values into STEM learning through a project-based approach and local environmental issues.

In addition to being valid according to experts, the module has also been proven to be technically feasible through limited testing with six students, who rated it as Very Practical (81%). These findings reinforce the claim that the module is not only valid in terms of content, but also understandable and implementable by end users.

The Uniqueness of STEM-R Integration in the Context of Madrasah

One of the main contributions of this module is the integration of religious values, which is not additional but rather an integration and unity. Validation by religious experts showed an average Aiken's V of 0.92, with perfect scores on indicators such as 'The module encourages an attitude of gratitude for the gift of unlimited energy' and 'The project is described as an effort to utilise God's blessings'. This shows that religious integration is carried out through spiritual reflection, not merely through quoting verses without context.

These findings reinforce the results of the study by Ardi et al (2024), which, through a meta-analysis, demonstrated that the integration of Islam and science in science education is capable of improving both the quality of learning and the religious attitudes of students. However, unlike quantitative approaches that emphasise affective aspects, this module integrates religious values comprehensively at every stage of the project, from problem identification (power cuts as a form of divine trust), solution design (solar panels as an expression of human endeavour), to final reflection (recognising science as a sign of God's greatness). This holistic approach addresses the findings of Riwanda et al (2025), which indicate that the integration of science and religion in Islamic schools often faces challenges in the form of oversimplification or selective framing, thereby risking a loss of spiritual depth.

Integration of PjBL and Creative Thinking Development

This module is designed based on the PjBL principle, which emphasises authentic investigation, collaboration, and presentation of results. Validation shows that the PjBL components received high scores (V = 0.87), with the indicators 'Providing space for presenting work results' (V = 1.00) and 'Encouraging simple investigation' (V = 0.92) being the most prominent. These findings are in line with the results of a meta-analysis by Zhang and Ma (2023), which shows that PjBL is effective in improving higher-order thinking skills, including creative thinking. An international study by Chen et al. (2022) confirms that project-based learning provides students with the opportunity to develop creative thinking through a process of exploration, experimentation and the presentation of solutions to real-world problems. The empirical findings of Astawan et al. (2023) indicate that STEM-based science learning significantly contributes to the development of students' critical and creative thinking skills, particularly when the subject matter is linked to everyday contexts. In addition, a systematic review by Undari et al. (2023) also confirmed that PjBL is capable of comprehensively training 21st-century skills, particularly in the 4Cs: critical

thinking, communication, creativity, and collaboration.

More specifically, the module is systematically designed to develop the four core dimensions of creative thinking outlined by Torrance (1966). Fluency is cultivated through tasks that prompt students to generate a wide variety of renewable energy sources. Flexibility is encouraged by requiring learners to explore multiple alternative applications for solar panel technology. Originality is fostered through project-based challenges, such as designing unique mini study lamps that demand novel problem-solving approaches. Finally, elaboration is strengthened by activities that guide students in detailing technical specifications while integrating structured moral reflection, thereby ensuring a comprehensive development of both cognitive and reflective competencies. These findings reinforce the research by Nazhifah et al. (2023), which shows that a project-based STEM approach can increase the originality of students' ideas. However, this module goes further by linking the elaboration of ideas not only to technical aspects but also to religious and spiritual dimensions, in line with the vision of madrasah education.

Theoretical and Practical Implications

Theoretically, this validation provides empirical evidence that the content validity of learning modules can be achieved through a multidisciplinary approach that involves experts in science, pedagogy, and religion equally. This approach is in line with the Educational Design Research (EDR) framework (Plomp & Nieveen, 2013), which emphasises the importance of cross-disciplinary collaboration and expert judgement in the learning design and evaluation process. Validation by experts from various backgrounds not only strengthens the quality of the content, but also supports the principle of iterative design, which is at the core of EDR.

In practical terms, this module addresses the gap between the madrasah curriculum vision and the reality of learning. As preliminary studies have shown, science teaching materials in MTs are generally no different from those in public schools, without the integration of Islamic values. This module provides a concrete model of how science and religion can be taught in an integrated manner without sacrificing scientific rigour or spiritual depth.

Limitations

Although the results of the validation and pilot study indicate promising potential, the findings must be interpreted with caution. Initial validation of content and practicality does not automatically guarantee the module's effectiveness in enhancing students' creative thinking or religious attitudes in a real classroom setting. Generalisation of the findings must also be restricted, given that the validators and trial respondents were drawn from a single geographical region with relatively homogeneous socio-cultural characteristics. Consequently, claims regarding readiness for widespread implementation cannot yet be substantiated at this stage, and the findings are more appropriately positioned as an empirical foundation for further iterative development. Operationally, this study has several limitations is:

1. The limited number of validators (n=9) and their exclusive origin from South Sumatra mean that multidisciplinary perspectives from madrasah contexts in other regions are not represented;
2. The practicality trial involved only six students, which is sufficient for identifying design issues but does not yield strong statistical generalisations.

Based on this, the following recommendations are made for further research:

1. Conduct a controlled effectiveness trial (quasi-experimental) across various MTs with differing characteristics to measure the module's impact on creative thinking and religious attitudes.
2. Conduct cross-validation by experts from outside South Sumatra to strengthen the objectivity of the content.
3. Develop a digital version or interactive module to enhance accessibility and appeal for 21st-century learning.

CONCLUSION

Based on the validation results by nine validators from three expertise groups, namely science content experts, learning practitioners

(teachers), and religious experts, it was found that the PjBL-based learning module with a STEM-R approach on the topic of renewable energy was declared to be highly valid in terms of content. This is evidenced by an average Aiken's V coefficient of 0.90, which far exceeds the minimum threshold (0.60). Each component of the module, from content feasibility, STEM-R integration, creative thinking development, PjBL characteristics, to the relevance of Islamic values, received high validity scores. The religious expert group gave the highest rating (0.92), indicating that the integration of religion was carried out organically, contextually, and theologically appropriate.

Furthermore, a pilot study involving six students at MTs Al Ittifaqiah in South OKU indicated that the module is also highly practical (average score of 81%), particularly in terms of the clarity of activity instructions and visual appeal. These findings reinforce that the module has met strong initial criteria for content validity and practicality, making it worthy of further development towards controlled effectiveness testing within a broader learning context. These validation results form a crucial foundation before the module is extensively piloted as an alternative teaching resource in science education at madrasahs.

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