



Development and Validation of a Newton's Laws E-Module Integrated with Muhammadiyah Values

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DOI: <http://dx.doi.org/10.15294/usej.v13i1.44955>

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Article Info

Submitted 2026-06-12

Revised 2026-07-01

Accepted 2026-08-29

Keywords

E-module; Muhammadiyah values; Newton Law

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Abstract

The cultivation of religious character is essential in shaping students who not only understand academic content but are also able to internalize and implement Islamic values in their daily lives. Accordingly, teachers are expected to produce human resources who are not only academically competent but also religiously grounded. This study aimed to develop a Newton's Laws e-module integrated with Muhammadiyah values. The research employed a descriptive design to describe the validity of the developed e-module. The research instrument consisted of an expert validation sheet used to evaluate the Newton's Laws e-module integrated with Muhammadiyah values. The validation findings demonstrate that the developed e-module meets the validity criteria and is considered appropriate for use in physics learning. All assessed indicators obtained Aiken's V coefficients above the minimum validity standard of 0.75. Specifically, the coefficient values were 0.88 for curriculum and learning outcome alignment, 0.85 for the accuracy of Newton's Laws content, 0.76 for the integration of Muhammadiyah values, 0.79 for media and visual design as well as learning features, and 0.87 for Indonesian language conventions. In addition to the quantitative results, the validators provided several recommendations to improve the quality of the e-module. These recommendations included strengthening student activity feedback, adding one relevant Qur'anic verse to each subtopic, revising the background color composition, and refining the feedback system embedded in the e-module. Considering these findings, subsequent studies may focus on developing an offline version of the Newton's Laws e-module integrated with Muhammadiyah values to enable broader use in schools with limited internet access.

How to Cite

Nurfadilah, N., Fahrunnisa, F., Riskawati, R., Darmawan, W., & Noor, P. F. Z. B. M. (2026). Development and Validation of a Newton's Laws E-Module Integrated with Muhammadiyah Values. *Unnes Science Education Journal*, 15(2), 247-256.

INTRODUCTION

Contemporary advances in education are increasingly reflected in the extent to which technology is integrated into instructional practices. The use of technology-based teaching materials is not merely a technical innovation, but also a pedagogical strategy for creating learning environments that are more flexible, interactive, and responsive to students' needs. Technological development has become one of the main driving forces behind the transformation of learning resources from conventional printed materials into digital formats that can support independent and meaningful learning (Manzano Pérez et al., 2023; Okoye et al., 2023). In educational practice, digital teaching materials have been developed in various forms, including instructional videos, educational games, simulations, interactive multimedia, e-books, digital comics, and e-modules (Amalia & Pilendia, 2022; Amelia et al., 2023; Febriani et al., 2020; Nasution & Harahap, 2020; Paramita et al., 2021). The implementation of digital teaching materials has also been reported to contribute positively to students' learning outcomes, particularly when the materials are designed systematically, visually engaging, and aligned with learning objectives (Kadarisman et al., 2022; Lubis & Yudhi, 2021; Nurlina et al., 2023; Setyo et al., 2023).

Among various digital teaching materials, e-modules have received considerable attention because they combine instructional content, learning activities, multimedia elements, and assessment components in one structured learning resource. An e-module allows students to access materials independently, review explanations repeatedly, and engage with learning tasks according to their own pace. Unlike conventional modules, e-modules can present concepts through text, images, animation, video, interactive questions, and immediate feedback. This makes e-modules relevant for science learning, especially in topics that require conceptual visualization and repeated practice. E-modules are considered effective in reducing monotonous learning experiences because they provide concise yet meaningful explanations supported by attractive visual design and interactive learning features (Ambiyar et al., 2023; Dewantara et al., 2021). Previous studies have shown that e-modules are well received by students and can improve motivation, self-efficacy, conceptual understanding, and learning outcomes (Delita et al., 2022; Holisoh et al., 2025).

In physics education, the need for well-designed digital learning materials becomes more urgent because many physics concepts are abstract, mathematical, and counterintuitive for students. One of the most fundamental topics in physics is Newton's Laws. Newton's Laws provide the conceptual basis for understanding motion, force, interaction, acceleration, inertia, and equilibrium. These laws explain how objects move and interact under the influence of forces, and they serve as an essential foundation for later topics such as momentum, energy, circular motion, gravitation, and mechanical systems. From a theoretical physics perspective, Newton's Laws form a logical framework for analyzing natural phenomena and technological applications, ranging from everyday motion to engineering systems and planetary dynamics (Giancoli, 2016; Mansfield & O'Sullivan, 2020). Therefore, students' understanding of Newton's Laws is crucial because misconceptions in this topic may affect their comprehension of more advanced physics concepts.

However, learning Newton's Laws is often challenging. Students frequently interpret force and motion based on everyday experience rather than scientific principles. For example, some students assume that a continuous force is always required to maintain motion, that heavier objects always fall faster, or that action-reaction forces act on the same object. These alternative conceptions indicate that students do not automatically develop scientific understanding simply by receiving verbal explanations or solving mathematical problems. Physics education research emphasizes that students need learning experiences that connect conceptual explanations, visual representations, real-life contexts, and reflective activities. In this regard, e-modules can become an important instructional medium because they can present Newton's Laws through multiple representations, such as verbal descriptions, diagrams, simulations, videos, contextual examples, and formative assessments. Such features may help students construct a more coherent understanding of the relationship between force and motion.

In addition to conceptual understanding, science education is also expected to contribute to character formation. Physics learning should not only help students master scientific concepts but also guide them to recognize the ethical, spiritual, and social meanings embedded in scientific knowledge. This perspective is particularly relevant in Islamic educational institutions, where the learning process is expected to integrate in-

tellectual development with religious and moral values. The integration of values into science learning does not mean replacing scientific explanations with religious doctrine. Rather, it aims to create meaningful connections between scientific concepts and students' worldview so that science is understood as part of a broader educational process that develops reason, responsibility, spirituality, and social awareness. Studies on religious value-based instructional materials suggest that such integration can support students' academic achievement while also strengthening their moral and spiritual development (Andrei, 2023; Aseery, 2024; Hidayati et al., 2022).

Within the context of Muhammadiyah education, the integration of Islamic and Muhammadiyah values into learning materials is highly relevant. Muhammadiyah education emphasizes the development of knowledgeable, faithful, independent, socially responsible, and progressive individuals. Several core Muhammadiyah values that are important to cultivate in students include tolerance, independence, competing in goodness or *fastabikhul khairat*, social care for the marginalized through the spirit of *Al-Ma'un*, and the commitment to ground social and educational life in the Qur'an and Sunnah (Dewantoro & Susilo, 2025; Riskawati et al., 2025). These values are not separate from learning activities; rather, they can be contextualized through scientific topics. For example, Newton's Third Law can be connected with the idea that every action has consequences, both in physical interaction and in social life. The concept of force and interaction can also be related to social responsibility, cooperation, and care for others. Through this approach, physics learning may become not only cognitively meaningful but also morally and spiritually relevant for students.

As an initial stage of this study, interviews were conducted with physics teachers and students from seven Muhammadiyah senior high schools in Makassar. The interview results showed that five schools had implemented digital physics materials in the form of e-modules, e-books, and interactive videos, whereas two schools still relied mainly on printed textbooks. The existing physics e-modules were mostly developed using flipbook applications and generally contained physics explanations, example problems, exercises, and illustrative images. In-depth interviews with 15 students who had used these e-modules revealed that students preferred e-modules to conventional textbooks and presentation-based media because e-modules were considered

more practical, accessible, and suitable for independent learning. Nevertheless, the available digital physics materials had not yet systematically integrated Newton's Laws with Muhammadiyah values. This indicates a need to develop a more contextual and value-oriented physics e-module for Muhammadiyah schools.

Several previous studies have developed physics e-modules and religious value-based science learning materials. For instance, physics e-modules have been developed to improve students' conceptual understanding, scientific literacy, and critical thinking skills (Fadillah et al., 2024; Rachmayani et al., 2023). Other studies have integrated religious values into science learning through Islamic literacy-based e-modules, STEM-based religious value materials, Qur'an-based physics modules, and religious moderation-based curriculum modules (Diani et al., 2021; Kosim et al., 2024; Masykur et al., 2024; Prihatiningtyas et al., 2025; Zohdi & Azmar, 2023). However, studies that specifically develop and validate an e-module on Newton's Laws integrated with Muhammadiyah values remain limited. Most previous studies focus either on digital physics learning materials or on general Islamic value integration, but they have not explicitly addressed how Muhammadiyah values can be embedded into Newton's Laws learning in a structured and valid e-module. This gap is important because Muhammadiyah schools require instructional materials that are not only scientifically accurate and pedagogically feasible, but also aligned with their institutional values and educational mission.

Based on this gap, the present study aims to develop and validate a Newton's Laws e-module integrated with Muhammadiyah values. The product is designed to support students' conceptual understanding of Newton's Laws while also facilitating the internalization of Islamic character values relevant to Muhammadiyah education. Before being implemented in classroom learning, the feasibility of the developed e-module must be examined through expert validation. Product validation is essential to ensure that the e-module has appropriate content, accurate physics concepts, meaningful value integration, effective media design, and proper language use (Cruchinho et al., 2024; Ng et al., 2024; Zhang et al., 2025). Therefore, this study focuses on expert validation as an initial step in determining the validity and feasibility of the Newton's Laws e-module integrated with Muhammadiyah values. The findings are expected to contribute to physics education and educational technology by providing a vali-

dated model of value-integrated digital teaching material for science learning in Muhammadiyah educational contexts.

METHOD

This study employed a descriptive research design aimed at describing the validity of a Newton's Laws e-module integrated with Muhammadiyah values. The research instrument used in this study was a validation sheet designed to evaluate the Newton's Laws e-module based on Muhammadiyah values. Expert validation was applied as the primary validity approach in this research. Therefore, the main object of this study was the developed e-module, while the validation sheet served as the instrument for collecting expert judgments. Several aspects were assessed during the validation process of the Newton's Laws e-module integrated with Muhammadiyah values, including: 1) alignment with the curriculum and learning outcomes, 2) accuracy of Newton's Laws content, 3) integration of Muhammadiyah values, 4) media and visual design, and 5) adherence to Indonesian language conventions.

The subject of this study was the Newton's Laws e-module integrated with Muhammadiyah values. The e-module was evaluated and verified by seven competent experts. The rating scale used in this study ranged from 1 to 4, where 1 = strongly disagree, 2 = disagree, 3 = agree, and 4 = strongly agree. Therefore, in the Aiken's V formula, the lowest score (l_0) is 1 and the number of rating categories (c) is 4. This clarification ensures transparency in the calculation of the validity coefficient. The use of a four-point scale was intended to encourage validators to provide clear judgments without selecting a neutral midpoint. In addition to quantitative ratings, the validators were also asked to provide qualitative comments and suggestions for improvement. These comments were used as the basis for revising the e-module after the quantitative validity analysis was completed.

The data analysis technique used to determine content validity was Aiken's Validity Index. The Aiken's V formula was employed to calculate the validators' assessment scores (Aiken, 1985).

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

Description of variables where:

- s : $r - l_0$
- r : score assigned by the validator
- l_0 : lowest possible score on the rating scale
- n : number of validators
- c : number of rating categories

The results of Aiken's V analysis were interpreted quantitatively to determine the validity of the developed product. The interpretation of the Aiken's V coefficient is presented in the following Table 1.

Table 1. Interpretation of Aiken's V Coefficient

Mean Indeks	Validation Criteria
$V \geq 0.75$	Valid
$V < 0.75$	Invalid

Following the Aiken's V analysis, revisions were made to the product based on validators' suggestions and feedback to enhance the quality of the developed e-module.

RESULT AND DISCUSSION

The validation stage is a crucial component in the development of instructional materials. Determining the feasibility of the Newton's Laws e-module integrated with Muhammadiyah values must undergo an expert validation process (Khidhir & Rassul, 2023; Maxnun et al., 2024). In this study, product validation was conducted by seven competent experts. The validators assessed the developed product based on four evaluation criteria. In addition to providing quantitative ratings, the validators also offered constructive feedback aimed at improving the quality of the product to ensure its feasibility for use. This article briefly presents and discusses the results of the validation analysis of the Newton's Laws e-module integrated with Muhammadiyah values.

E-modules represent a form of instructional material that effectively utilizes technology (Holisoh et al., 2025; Suryana et al., 2024). Innovations in e-modules across various physics topics have been shown to enhance students' ability to understand abstract physics concepts (Fadillah et al., 2024; Rachmayani et al., 2023). Furthermore, the integration of instructional content with religious values has been found to support both students' academic achievement and character development (Engelina Siregar, 2024; Fikri & Rahmaniyyah, 2023). Similarly, the Newton's Laws e-module integrated with Muhammadiyah values is designed to combine conceptual understanding with character education.

Previous studies have explored the integration of religious values into physics instructional materials. For instance, Kosim et al. (2024) developed curriculum modules based on religious moderation. Other studies have developed physics e-modules using a STEM approach integrated with religious values to support science learning

within the context of Islamic education (Masykur et al., 2024), as well as STEM-based physics e-modules grounded in the Qur'an to enhance scientific literacy using flipbook media (Prihatiningtyas et al., 2025). The development of physics e-modules that specifically aim to enhance Islamic literacy is expected to produce individuals who are proficient in science and technology while maintaining a strong religious awareness in response to contemporary global challenges (Diani et al., 2021).

Additionally, physics instructional materials in the form of experimental KIT modules based on Qur'anic studies have been shown to support students' scientific literacy skills (Zohdi & Azmar, 2023). The implementation of such modules demonstrated students' mastery of classical skills, which were categorized as highly proficient. Moreover, learning mastery test results indicated that experimental KIT modules based on Qur'anic studies promoted students' psychomotor, cognitive, and spiritual achievements. The interface and sample content pages of the e-module are presented in Figure 1 and Figure 2.



Figure 1. Main Interface of the Newton's Laws E-Module Integrated with Muhammadiyah Values

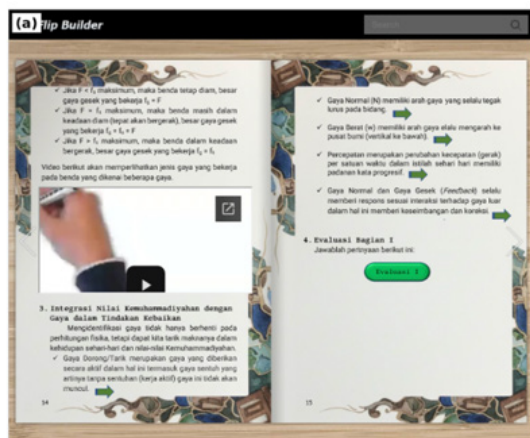


Figure 2. Sample Page of Newton's Laws Content and Muhammadiyah Values Integration

Figure 1 shows the main interface of the e-module. The interface was designed to provide clear navigation so that students can access each learning component independently. The visual organization of the menu, topic sequence, and learning instructions is intended to help students understand the structure of the module before engaging with the physics content. A clear interface is important in digital learning materials because students' interaction with the product begins from their ability to recognize where to start, how to move between sections, and how to access learning activities.

Figure 2 presents an example of how Newton's Laws content is integrated with Muhammadiyah values. The integration is not presented as a separate moral message after the physics explanation, but is embedded within the learning context. For example, the explanation of Newton's Third Law is connected with the idea that every action produces consequences, both in physical interaction and in social life. Through this design, the e-module attempts to help students understand physics concepts while also reflecting on values such as responsibility, social care, and *fastabikhul khairat*.

The content validity of the Newton's Laws e-module integrated with Muhammadiyah values was determined through expert agreement. Content validity serves as a fundamental basis for researchers in utilizing developed products, as a product is considered valid when experts agree that it meets the established criteria and is suitable for use (Cocks et al., 2023; Kania et al., 2024). This study involved seven experts as validators, and the validation data were analyzed using Aiken's Validity Index. The results of the content validity analysis of the Newton's Laws e-module integrated with Muhammadiyah values are pre-

sented in Table 2.

Table 2. Result of Aiken's V Analysis of the Newton's Laws E-Module Integrated With Muhammadiyah Values

Indicator	V _{calculated}	V _{critical}	Conclusion
Alignment with curriculum and learning outcomes	0.88	0.75	Valid
Accuracy of Newton's Laws content	0.85	0.75	Valid
Integration of Muhammadiyah values	0.76	0.75	Valid
Media and visual design	0.79	0.75	Valid
Indonesian language conventions	0.87	0.75	Valid

Table 2 presents the results of the Aiken's V analysis, which indicate the content validity values for each indicator of the Newton's Laws e-module integrated with Muhammadiyah values. Overall, all evaluation indicators of the developed e-module fall within the valid category. Among the five validity indicators assessed, two indicators obtained validation scores below 0.80, namely the integration of Muhammadiyah values and media/visual design. The Muhammadiyah values embedded in the e-module are expected to be meaningfully integrated with the developed physics content. For example, the concept of Newton's Third Law (action-reaction) is integrated with the Muhammadiyah value of *fastabikhul khairat* (competing in goodness), where every action performed by individuals will result in corresponding consequences, both physically and morally. Additionally, the concept of force and interaction is linked to the value of social care (*Al-Ma'un*), emphasizing that human actions should contribute positively to others. These integrations aim to contextualize physics concepts within students' spiritual and social lives. In addition, media and visual design aspects, particularly aesthetic value, play an important role in attracting users' attention during learning activities. This finding is consistent with the development study conducted by Wulansari et al. (2023), which emphasized the importance of visual design elements, including cover design, color selection, typography, and imagery.

Although the validation scores for these two indicators were lower compared to the other three indicators, they can still be classified as valid, as both values exceeded the minimum threshold of 0.75. However, in comparison with the remaining indicators, these aspects demonstrated relatively lower validity levels. The lower validation scores for these two indicators are consistent with the feedback and suggestions provided by the validators. Several of the validators' recommendations are presented in Table 3.

Table 3. Validators' Suggestions for Each Evaluation Indicators

Indicator	Suggestions
Alignment with curriculum and learning outcomes	-
Accuracy of Newton's Laws content	Minor typographical corrections
Integration of Muhammadiyah values	Addition of one Qur'anic verse for each subtopic
Media and visual design	Improve background color selection for the e-module
Media and features	Add student feedback features
General recommendation	Develop offline version

Table 3 presents the validators' suggestions obtained during the validation of the Newton's Laws e-module integrated with Muhammadiyah values for each validity indicator. These suggestions primarily focused on the integration of Muhammadiyah values within the Newton's Laws content as well as the media and visual design aspects. Based on the validators' feedback, the research team revised and improved the developed e-module by adding several components to enhance the quality of the product. The suggestions and comments provided by the validators constitute critical input that must be considered to ensure the appropriateness and completeness of the developed instructional material (Daryanes et al., 2023; Wang & Sahid, 2024). Expert feedback is recognized as one of the key factors determining the quality and feasibility of developed products (De León et al., 2023; Masuwai et al., 2024). The final stage of the validation process involves determining the quality and feasibility of the product prior to field testing and implementation.

The Newton's Laws e-module integrated

with Muhammadiyah values was designed to ensure that students not only comprehend the physics content but also internalize its scientific essence. Another strength of the developed e-module lies in the inclusion of several features that provide a dynamic, measurable, and meaningful learning experience. These features include streaming video, computer-based test (CBT) quizzes with instant feedback, and the integration of Muhammadiyah values complemented by selected Qur'anic verses. During the initial design phase of the e-module, the research team encountered limitations related to the availability of Newton's Laws content that could be meaningfully integrated with Muhammadiyah values. Consequently, collaboration with lecturers specializing in Al-Islam Kemuhammadiyahan was required to ensure conceptual and theological accuracy.

This finding confirms that integrating religious values into science learning not only enhances conceptual understanding but also supports holistic education by fostering students' moral and spiritual development. Furthermore, the implementation of this e-module is currently limited to schools with reliable internet access. Therefore, this study recommends that future research focus on developing a more flexible version of the e-module that can be used in both offline and online modes. Such an approach would enable the Newton's Laws e-module integrated with Muhammadiyah values to be implemented more broadly across schools with varying technological infrastructures.

CONCLUSION

The descriptive study conducted in this research produced expert validation results for the developed Newton's Laws e-module integrated with Muhammadiyah values. Based on the findings, it can be concluded that the content validity of the developed product was established through the agreement of seven competent experts using Aiken's Validity Index analysis, with a validity threshold value of 0.75.

The Newton's Laws e-module integrated with Muhammadiyah values was declared valid across all evaluated indicators, including alignment with the curriculum and learning outcomes, accuracy of Newton's Laws content, integration of Muhammadiyah values, media and visual design, and adherence to Indonesian language conventions. In addition, two indicators namely the integration of Muhammadiyah values and media/visual design received suggestions for improvement from the validators. These suggestions

were subsequently addressed through revisions and refinements to enhance the quality of the developed product.

ACKNOWLEDGMENT

The authors would like to express their sincere gratitude to the Majelis Pendidikan Tinggi, Penelitian, dan Pengembangan of the Central Executive Board of Muhammadiyah for providing financial support for this research through the Hibah Riset Nasional Muhammadiyah Batch IX Tahun 2025 under Contract Number 0259.380/I.3/D/2025. The authors also extend their appreciation to the expert validators who provided constructive assessments and suggestions for improving the Newton's Laws e-module integrated with Muhammadiyah values. Special thanks are addressed to the Al-Islam and Kemuhammadiyahan lecturers who contributed to reviewing the relevance and accuracy of the Muhammadiyah values integrated into the e-module. The authors are also grateful to the physics teachers, students, and student research assistants, for their support during the needs analysis, product development, and validation process of this study.

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