JPPIPA 11(12) (2025)

Jurnal Penelitian Pendidikan IPA

http://jppipa.unram.ac.id/index.php/jppipa/index

Integrating STEM-Qur'an Approach into Digital Flipbook-Based Teaching Materials: A Validation Study

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Received: September 10, 2025
Revised: November 15, 2025
Accepted: December 25, 2025
Published: December 31, 2025

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DOI: 10.29303/jppipa.v11i12.12819

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Abstract: This study addresses the limited availability of instructional media that integrate scientific content with spiritual values in physics education. It aims to develop and validate digital flipbook-based teaching materials for Basic Physics using the STEM-Qur'an (STEMQ) approach. The objective is to produce educational content that combines scientific accuracy, interactive digital design, and the integration of Qur'anic principles to foster ethical and holistic learning. A descriptive validation method was applied involving expert judgment to evaluate two main dimensions: content validity and media quality. Content evaluation focused on curriculum alignment, conceptual accuracy, language clarity, instructional structure, and STEMQ integration. Media validation assessed digital layout, implementation practicality, and technological functionality. Data were analyzed using the Gregory Index, resulting in a coefficient of 0.90 for content and 0.83 for media, indicating high validity. The findings confirm that the flipbook is pedagogically sound, technologically usable, and culturally relevant for Islamic science education. This validated model supports the integration of empirical inquiry with Qur'anic values and offers a framework for future development and classroom application.

Keywords: Basic physics; Index Gregory; STEMQ approach; Teaching material.

Introduction

The rapid digitalization of educational environments has transformed how instructional materials are designed, distributed, and experienced, particularly in science education. As networked devices, learning management systems, and cloud-based resources become ubiquitous, teachers are increasingly expected to use technology-enhanced materials that can sustain attention, differentiate instruction, and support self-regulated learning. Recent studies have indicated that well-designed digital resources can enrich classroom interaction, expand flexible access to content, and improve learning outcomes across diverse student populations (Behera, 2023; Cui et al., 2023; Gosain, 2024). At the same time, research on innovative instructional design has emphasized that the mere presence of technology is insufficient; digital media must be pedagogically grounded, aligned with curriculum standards, and responsive to learners' cognitive and affective needs (Afrashtehfar et al., 2023; Burrell, 2024; Sri Verawati et al., 2023; Timotheou et al., 2022).

Within this context, multimedia-based tools such as digital flipbooks, interactive modules, and enriched e-texts have received growing attention as promising vehicles for science learning. Digital flipbooks can combine text, images, animations, hyperlinks, and audio narration within a familiar book-like interface, thereby making abstract ideas more concrete and providing opportunities for students to revisit key explanations at their own pace. Empirical studies have reported that digital flipbooks support conceptual understanding, procedural fluency, and retention by presenting content in multiple representations and encouraging exploratory engagement (Anas & Hasibuan, 2023; Elfina et al., 2024; Sabitri et al., 2024). Multimedia integration has also been shown to enhance motivation, enjoyment, and task persistence, especially when activities are framed around meaningful problems and authentic contexts (Budiarto & Jazuli, 2021; Hamzah & Aman,

How to Cite:
Handayani, Y., Rahmawati, R., Rufaida, S., Fahrunnisa, F., & Widiasih, W. (2025). Integrating STEM-Qur'an Approach into Digital Flipbook-Based Teaching Materials: A Validation Study. *Jurnal Penelitian Pendidikan IPA*, *11*(12), 1178–1193. https://doi.org/10.29303/jppipa.v11i12.12819

2023; Herianto & Wilujeng, 2021; Muliandi et al., 2021). Furthermore, interactive platforms—including virtual and augmented reality environments—have been found to sustain cognitive engagement more effectively than static resources by enabling learners to visualize dynamic phenomena and manipulate key parameters in real time (Guo et al., 2023; Laskey, 2022; Richards, 2023; Wang et al., 2024).

Basic Physics occupies a central position in science and engineering curricula, yet it has remained a persistent source of difficulty for many learners. The subject is heavily grounded in mathematical formalism, symbolic representations, and idealized models, which can appear disconnected from students' everyday experiences and prior knowledge. Research has documented wide-ranging challenges in students' conceptual understanding of fundamental topics such as mechanics, energy, and electricity, as well as persistent alternative conceptions that have resisted traditional instruction (Brahmia et al., 2020; den Eynde et al., 2020; Hinko et al., 2016; Juhásová, 2025). These cognitive difficulties are often accompanied by negative attitudes, low self-efficacy, and anxiety toward physics and mathematics, which in turn reduce participation and achievement (Madu & Okoye, 2020; Özkan & Topsakal, 2020; Ozuho et al., 2021; Topsakal et al., 2022). Studies in various educational settings have highlighted that limited opportunities for active inquiry, insufficient contextualization, and an overemphasis on rote problem solving contribute to these outcomes, particularly for students from under-resourced schools or first-generation backgrounds (Achor et al., 2022; Azis & Cantafio, 2023; Hidaayatullaah, 2022).

To address these persistent challenges, recent scholarship has explored a range of student-centered and technology-supported pedagogical strategies in physics education. Inquiry-based, project-based, and collaborative learning designs have been shown to promote deeper reasoning, higher-order thinking, and more productive engagement with fundamental concepts (Anwar et al., 2023; Bong & Chen, 2021; Gita Dewi et al., 2024). When combined with simulations, virtual laboratories, and other interactive media, these approaches can provide safe spaces for experimentation and immediate feedback, enabling students to test ideas, confront misconceptions, and build more coherent mental models (Arymbekov et al., 2023; Chi et al., 2024; Keebaugh et al., 2024; Pasigon, 2024). At the same time, research on digital learning ecosystems highlights the importance of accessibility, usability, and learner autonomy, noting that flexible, mobile-friendly platforms can support learning beyond the classroom and accommodate diverse learning trajectories (Deák et al., 2021; Kiryakova, 2021; Saifan et al., 2021).

Within this broader landscape, STEM (Science, Technology, Engineering, and Mathematics) education has emerged as a key framework for rethinking how scientific knowledge is taught and learned. Rather than treating disciplines as isolated domains, STEM approaches foreground their interconnectedness and orient learning toward design, innovation, and real-world problem solving. Studies have reported that integrated STEM experiences can foster collaboration, creativity, and persistence, while also improving conceptual understanding and the transfer of learning to novel situations (Janssens et al., 2022; Muñiz-Rodríguez et al., 2017; Ryan et al., 2021). STEM-oriented curricula and learning environments have also been associated with gains in students' interest in science and engineering careers, as well as with the development of twenty-first-century competencies such as critical thinking, systems thinking, and digital literacy (Gao & Yang, 2023; Laurenty et al., 2024). In physics education, STEM integration has been operationalized through engineering design challenges, data-rich investigations, and technology-enhanced modeling activities that connect abstract principles to tangible artifacts and societal issues.

Digital flipbooks offer a flexible medium for embedding STEM practices directly into physics learning activities. By organizing content around real-world problems, integrating cross-disciplinary perspectives, and guiding learners through cycles of exploration, explanation, and design, STEM-based flipbooks can help students perceive physics as meaningful and relevant. Empirical work in this area has indicated that digital flipbooks designed with explicit STEM components can enhance problem-solving skills, promote scientific reasoning, and increase engagement, particularly when tasks require students to apply physics concepts in designing solutions or interpreting data (Anas & Hasibuan, 2023; Elfina et al., 2024; Gustina & Wibowo, 2020; Sabitri et al., 2024; T. Wulandari & Nurharini, 2023). Recent developments have further extended these resources through augmented reality overlays, mobile access, and collaborative features, enabling richer interaction with representations and peer feedback (Kusuma Sirait et al., 2024; Shoffa et al., 2024). Nevertheless, most existing STEM-oriented digital flipbooks have been developed within secular frameworks, with limited attention to the integration of religious or moral dimensions that are central to many learners' worldviews.

In predominantly Muslim contexts, there has been a growing discourse on the need to integrate scientific learning with Islamic values so that students can perceive coherence between their academic studies and their spiritual commitments. The STEM-Qur'an (STEMQ) approach responds to this need by explicitly connecting scientific concepts and engineering design tasks with Qur'anic verses, ethical reflections, and narratives that illustrate the harmony between scientific

inquiry and divine guidance (Nurlaelah et al., 2023; Suparjo & Hidayah, 2023). Such integration is expected to support not only cognitive outcomes but also the development of moral consciousness, environmental stewardship, and a sense of responsibility toward societal well-being. While previous studies have explored Islamic-integrated curricula and value-laden science learning, there remains a lack of systematically validated digital teaching materials that embed Qur'anic perspectives within STEM-based physics instruction and leverage the affordances of multimedia platforms such as digital flipbooks.

Against this backdrop, the present study focuses on the development and expert validation of STEM-Qur'an-based digital flipbook teaching materials for Basic Physics. The study was designed as a validation study that examined the content, language, presentation, and media aspects of the flipbook through structured evaluations by experts in physics education, instructional design, and Islamic studies. Building on prior research on digital resources, STEM pedagogy, and Islamic-integrated education (Anas & Hasibuan, 2023; Behera, 2023; Nurlaelah et al., 2023; Suparjo & Hidayah, 2023). The study posits that a carefully designed STEMQ digital flipbook can achieve high content and media validity and thus be suitable for use in Islamic higher education. The novelty of this work lies in its systematic integration of STEM and Qur'anic perspectives within a single digital flipbook for Basic Physics and in its rigorous, multidimensional validation process. The findings are expected to provide a foundation for subsequent implementation and effectiveness studies, as well as a model for the development of other value-integrated STEM learning materials.

Method

This study adopts a descriptive research design aimed at validating the content and media quality of digital flipbook-based teaching materials for Basic Physics, developed under the STEM-Qur'an (STEMQ) pedagogical approach. Validation is an essential stage in educational design that ensures instructional materials meet academic, technological, and contextual standards (Allen et al., 2025; Domingo-Oslé et al., 2023; Ismiyati et al., 2023; Khairunnisa & Tatang, 2024; Suleimenova et al., 2017) The primary objective of this research is to assess the pedagogical soundness and digital usability of the materials using expert evaluation based on structured and multidimensional criteria.

The validation process focuses on two major aspects: content and media validity. These aspects are derived from a comprehensive literature review that underscores the importance of content accuracy, instructional clarity, multimedia design, and cultural relevance in developing effective educational resources (Riera et al. 2022). Moreover, the inclusion of Qur'anic values necessitates additional scrutiny to ensure that the integration of spiritual content aligns with Islamic educational principles and maintains scholarly rigor (Fathurrahman et al., 2023; Saiin et al., 2023; Septianti et al., 2021).

Content validation was conducted by two evaluators: one academic lecturer with expertise in science education and one experienced practitioner in instructional development. The validation criteria encompass four key aspects: content appropriateness, linguistic quality, presentation structure, and integration of the STEMQ approach. Each of these aspects includes five specific evaluation items, yielding a total of 20 items. Table 1 presented all aspects evaluated in the validation of the developed teaching materials.

Table 1. Evaluation Aspects for Validation of Digital Flipbook Basic Physics Teaching Materials with STEMQ

Aspects	Number of Item
Aspect 1: Content available	5
Aspect 2: language	5
Aspect 3: presentation	5
Aspect 4: STEMQ integration	5
Aspect 5: media display	5
Aspect 6: implementation	5
Aspect 7: technology and digital functionality	5
Total	35

Therefore, Table 2 presents the breakdown of the content validation aspects and their corresponding evaluation items. The number of evaluation items in the media aspect was 15 items from three aspects as shown in Table 3.

The integration of the STEMQ approach was assessed through the presence of interdisciplinary connections between science, technology, engineering, and mathematics; incorporation of Qur'anic verses; encouragement of 21st-century skills (critical, creative, collaborative, and communicative thinking); inclusion of STEMQ-based projects; and promotion of both scientific and religious attitudes.

Media validation was simultaneously performed by two experts in digital educational technology. This evaluation encompasses three aspects: media display, practical implementation, and technological functionality. A total of 15 evaluation items were used across these three categories. For instance, the media display aspect assesses layout consistency, use of relevant illustrations and graphics, colour harmony, intuitive navigation, and font readability. The implementation aspect considers the flipbook's usability in both individual and classroom settings, its support for instructors, appropriate duration for use, device accessibility, and utility in formative assessment. Lastly,

the technology and functionality aspect examines the digital compatibility of the flipbook across platforms, loading speed, reliability of links and embedded features, ease of sharing or downloading content, and the availability of offline access.

Table 2. Aspects and Items for Content Validation of Digital Flipbook Basic Physics Teaching Materials with STEMQ

Aspects	Items
Content appropriateness	a. The content aligns with the applicable curriculum. b. The physics concepts are accurate and not misleading. c. The material is up to date in accordance with the latest developments in physics. d. The scope of the material is adequate to meet the basic competencies. e. It supports the development of scientific and critical thinking skills.
Linguistic quality	a. The statements are clear, effective, and communicative. b. The use of physics terminology is precise and consistent. c. The language is appropriate to the developmental stage of the learners. d. There are no spelling or grammatical errors. e. The language is oriented toward fostering understanding rather than mere transmission.
Presentation structure	a. Chapters and subchapters are organized systematically and consistently. b. Explicit learning objectives are provided. c. The presentation of the material progresses from simple to complex. d. Concept maps, summaries, and exercises are included. e. Qur'anic values are integrated into the presentation.
integration of the STEMQ approach	a. Connections among science, technology, engineering, and mathematics (STEM) are established. b. Qur'anic verses are included to reinforce values. c. The material encourages the 4Cs: critical, creative, collaborative, and communicative skills. d. Experiments and projects are designed based on the STEM–Qur'an approach. e. The content fosters both religious and scientific attitudes.

Table 3. Aspects and Items for Media Validation of Digital Flipbook Basic Physics Teaching Materials with STEMQ

Aspects	Items
Media display	a. The layout is consistent and proportional. b. Illustrations, images, graphs, and diagrams support comprehension. c. The color combinations are comfortable for reading. d. The flipbook navigation is easy to use. e. The font type and size are appropriate for digital readability.
Practical implementation	a. It can be used independently or in classical (group) settings. b. It provides assistance for lecturers. c. The duration of use is appropriate. d. Device accessibility is ensured. e. It supports assessment activities.
Technological functionality	a. The flipbook can be accessed on various devices. b. The loading time is fast and lightweight. c. There are no broken links or malfunctioning features. d. Files can be easily shared or downloaded. e. An offline version or alternative without internet access is available.

Evaluation data were collected using structured validation sheets, with each item rated on a four-point Likert scale, ranging from 1 (not valid) to 4 (highly valid). This scale facilitates precise quantification of expert judgments regarding the strengths and weaknesses of the instructional materials (Table 4).

Table 4. Validation Category

Score	Categories
4	Valid
3	Fairly Valid
2	Less Valid
1	Not Valid

Quantitative analysis of the validation results was carried out using Gregory's Content Validity Coefficient (Gregory, 2007) (Table 5).

Table 5. Contingency Table for Calculating Gregory Index

Matrix 2x2		Expert 1	
		Weak Score (1-2)	Strong Score (3-4)
Expert 2	Weak Score (1-2)	A	B
	Strong Score (3-4)	C	D

This method employs a 2x2 contingency matrix to assess inter-rater agreement between validators. Each

item is categorized as having either strong or weak relevance based on whether it received high (scores 3-4) or low (scores 1-2) ratings from both validators. Four categories emerge from this matrix: both validators rate the item as weak (A), one rates it weak and the other strong (B and C), or both rate it strong (D). The formula for calculating the Gregory index was be shown by formula (1), where D represents the number of strong-strong agreements and N is the total number of items.

$$Content\ validity\ coefficient = \frac{D}{A+B+C+D} \dots (1) \quad (1)$$

The content validity coefficient is then interpreted into three categories (Gregory, 2007), expressed in the form of a validator agreement index, as follows.

Table 6. Validator Agreement Index

Coefficient	Validity
0.80 – 1.00	Hight
0.40 – 0.79	Moderate
0.00 – 0.39	Low

Digital teaching materials can be said to be valid and suitable for use or trial if the minimum level of content validity achieved is at moderate validity.

Result and Discussion

The results of this validation study were organized into two main components: (1) the validity of the material content embedded in the STEM-Qur'an (STEMQ) digital flipbook for Basic Physics and (2) the validity of the digital media design that supported its delivery. Each component was reported according to the previously defined domains and supported by quantitative and qualitative evidence from expert validators.

Results of the Validation on the material content

The validation of the content aspect comprised four specific domains: content feasibility, linguistic quality, presentation structure, and integration of the STEMQ model. Twenty indicators were used across these domains, as described in the methodology. Table 7 presents the results of expert validation for each item under the content aspect.

In terms of content feasibility, both expert validators gave high scores, consistently indicating strong relevance across all five items. The validators confirmed that the teaching materials aligned with the national curriculum and maintained scientific accuracy. The materials were evaluated as current and contextually relevant, supporting the development of scientific reasoning and critical thinking. These findings aligned with prior literature that emphasizes the need for physics education to be grounded in real-world applicability and curriculum standards (Tolentino & Sinio, 2024).

For the linguistic quality of the content, the experts agreed that the digital flipbook employed language that was clear, effective, and developmentally appropriate for students. Terminological accuracy was upheld, particularly with regard to physics-specific terminology. Spelling and grammar received positive evaluations; however, minor scoring variations were noted for items assessing how effectively the language fostered conceptual understanding, as opposed to merely conveying information. These results supported previous findings that precise and developmentally calibrated language contributes significantly to the cognitive accessibility of science content (Msipha & Mavuru, 2022).

Regarding presentation structure, the teaching materials were evaluated for logical and progressive organization. Most items in this domain received strong-strong validation; however, one item—concerning the inclusion of concept maps, summaries, or practice activities—was rated lower. One validator assigned a reduced score, citing the absence or limited inclusion of these pedagogical elements. Despite this, the general structure was considered systematic, featuring clearly defined learning objectives and a logical progression from basic to advanced content. These structural elements are considered essential in multimedia-based science instruction, as they scaffold conceptual development (Kiat et al., 2020; Ugwuoke et al., 2023; Yuningsih et al., 2022).

The final aspect of content validation focused on the integration of the STEMQ model. Here, both validators acknowledged the effective integration of Qur'anic verses, which reinforced the ethical and spiritual dimensions of the physics topics. The material was found to foster 21st-century skills such as critical, creative, collaborative, and communicative competencies, as well as religious-scientific dispositions. However, slight scoring differences were noted for the item assessing the inclusion of STEMQ-based projects or experiments. One validator found this component underdeveloped, suggesting a need for more explicit examples of project-based learning linked to Qur'anic themes. Nonetheless, the integration of STEM elements and Islamic values was deemed effective in promoting a holistic learning experience. This supports theoretical perspectives that highlight the compatibility of science and spirituality in education.

Table 7. Tabulation Results from the Content Expert Validator

Aspects & Item	Evaluation		
	Expert 1	Expert 2	Category Of Relevance
Aspect of Content appropriateness			
a. The content aligns with the applicable curriculum.	4	4	D
b. The physics concepts are accurate and not misleading.	4	4	D
c. The material is up to date in accordance with the latest developments in physics.	4	4	D
d. The scope of the material is adequate to meet the basic competencies.	4	4	D
e. It supports the development of scientific and critical thinking skills.	3	4	D
Linguistic quality			
a. The statements are clear, effective, and communicative.	4	4	D
b. The use of physics terminology is precise and consistent.	4	4	D
c. The language is appropriate to the developmental stage of the learners.	4	4	D
d. There are no spelling or grammatical errors.	3	3	D
e. The language is oriented toward fostering understanding rather than mere transmission.	3	4	D
Presentation structure			
a. Chapters and subchapters are organized systematically and consistently.	3	3	D
b. Explicit learning objectives are provided.	3	4	D
c. The presentation of the material progresses from simple to complex.	3	3	D
d. Concept maps, summaries, and exercises are included.	3	2	B
e. Qur'anic values are integrated into the presentation.	4	4	D
Integration of STEMQ approach			
a. Connections among science, technology, engineering, and mathematics (STEM) are established.	4	4	D
b. Qur'anic verses are included to reinforce values.	4	4	D
c. The material encourages the 4Cs: critical, creative, collaborative, and communicative skills.	4	4	D
d. Experiments and projects are designed based on the STEM–Qur'an approach.	2	3	C
e. The content fosters both religious and scientific attitudes.	3	4	D

To synthesize these expert evaluations, a contingency matrix was constructed (Table 8) to categorize validator agreement using a 2x2 grid: weak–weak, strong–weak, weak–strong, and strong–strong.

Table 8. Contingency for Calculating Gregory Index from two content experts

Matrix 2x2		Expert I	
		Weak	Strong
Expert II	Weak	0	1
	Strong	1	18

The distribution showed 18 items with strong–strong agreement, one item rated as weak-strong, and another as strong-weak rating. No item received a weak–weak rating. To ensure this statement, the validity coefficient index needed to be determined. The analysis of the validity coefficient was conducted using Gregory's formula, as shown below.

$$validity\ coefficient = \frac{18}{0+1+1+18} = \frac{18}{20} = 0{,}90$$

Based on this matrix, the Gregory Index was found to be 0.90, placing the content validity within the "high" category. This indicated a high degree of expert consensus that the materials were valid and suitable for educational use in Islamic science contexts. These results aligned with earlier research highlighting the importance of rigorous validation in improving instructional quality and contextual appropriateness (Martínez Riera et al., 2022).

Results of the validation on the digital media design

The second major focus of this study *was* the validation of the media design of the digital flipbook, which included three domains: media display, implementation practicality, and technological functionality. The evaluation was based on 15 indicators, as detailed in the methodology. Expert judgments were summarized in Table 9.

Table 9 indicated that, in the media display domain, the digital flipbook had a consistent and proportional layout, used relevant illustrations, and featured color schemes conducive to readability. Navigation across pages was found to be user-friendly, and the choice of font and size was considered appropriate for digital reading environments. Both validators gave high ratings for these features, affirming the flipbook's visual coherence and ergonomic design. The quality of digital presentation has previously been linked in studies to increased learner motivation and information retention.

Table 9. Tabulation Results from the Media Expert Validator

Aspects & Items	Evaluation		
	Expert 1	Expert 2	Category of Relevance
Media display			
a. The layout is consistent and proportional.	3	3	D
b. Illustrations, images, graphs, and diagrams support comprehension.	3	4	D
c. The color combinations are comfortable for reading.	3	4	D
d. The flipbook navigation is easy to use.	3	4	D
e. The font type and size are appropriate for digital readability.	4	4	D
Practical implementation			
a. It can be used independently or in classical (group) settings.	4	4	D
b. It provides assistance for lecturers.	4	3	D
c. The duration of use is appropriate.	3	4	D
d. Device accessibility is ensured.	3	3	D
e. It supports assessment activities.	4	4	D
Technological functionality			
a. The flipbook can be accessed on various devices.	4	4	D
b. The loading time is fast and lightweight.	3	2	B
c. There are no broken links or malfunctioning features.	3	3	D
d. Files can be easily shared or downloaded.	2	3	C
e. An offline version or alternative without internet access is available.	4	4	D

Regarding implementation practicality, the flipbook received positive evaluations for its flexibility in classroom and independent learning contexts. It was found effective in supporting lecturers, adaptable in usage duration, and accessible across common devices. Validators agreed that the flipbook included features that support formative assessment, an essential element in student-centered learning. These attributes align with literature emphasizing the importance of adaptable and accessible tools in digital education.

In the technological functionality domain, the validators confirmed that the digital flipbook was fully compatible with various platforms, such as mobile phones, tablets, and PCs. Most items in this domain received high ratings; however, discrepancies were observed in two items—one related to loading speed and another concerning file sharing and downloadability. One validator assigned a slightly lower rating to loading speed due to potential lag on low-end devices, while another highlighted the absence of an easily shareable offline version. Nevertheless, these concerns were considered minor and did not substantially impact the overall validity.

Following the same analytical procedure as used for content validation, a contingency matrix was employed to analyze the level of agreement between media experts (Table 10).

Table 10. Contingency for Calculating Gregory Index from two media experts

Matrix 2x2		Expert I	
		Weak	Strong
Expert II	Weak	0	1
	Strong	1	10

The matrix indicated that ten items received strong–strong ratings, while two items fell into the strong–weak and weak–strong categories. No item received a weak–weak rating. The Gregory Index for media validation was found to be 0.83, also falling within the "high" validity range. These results support the conclusion that the flipbook's technological and practical aspects met high standards of usability and relevance for instructional settings.

In summary, both content and media validations indicated that the digital flipbook teaching materials developed using the STEMQ approach were valid and ready for classroom implementation. The dual validation approach—evaluating both pedagogical content and digital interface—ensured comprehensive assurance of quality, addressing the multifaceted needs of modern learners. The integration of Qur'anic values with scientific content, supported by user-friendly digital design, responded to calls for holistic educational models in Islamic learning environments (Bayu Astra et al., 2024; Kholila, 2023; A. S. Wulandari et al., 2022). These findings not only affirmed the efficacy of the developed materials but also provided a replicable model for future instructional innovations that sought to merge technological sophistication with cultural and spiritual depth.

Discussion

The present study examined the validity of digital flipbook-based teaching materials for Basic Physics education within the STEM-Qur'an (STEMQ) framework. Through a rigorous content and media validation process involving expert evaluators, the results demonstrated a high level of pedagogical and technological soundness in the developed materials.

This discussion elaborated on the implications of these findings, compared them to existing literature, and reflected on the broader significance of integrating spiritual, scientific, and technological components in science education.

The validation of content, with a Gregory Index value of 0.90, reflected a strong consensus among experts regarding the appropriateness of the materials' conceptual depth, alignment with curricular standards, and integration of scientific reasoning. This outcome confirmed the effectiveness of the instructional design in addressing core issues that have long plagued physics education—particularly its abstract nature and perceived disconnection from real-world contexts (McDermott & Redish, 1999; Redish, 1994; Steinberg et al., 1997). The inclusion of up-to-date content and curriculum coherence responded to demands from prior research advocating for more contextually grounded science teaching practices (Amrulloh & Galushasti, 2022; Nasrah et al., 2024; Picardal & P. Sanchez, 2022). Furthermore, the high validation score reflected the materials' compatibility with explicit instructional approaches, which research has shown to be effective in guiding students through complex scientific inquiry and experimentation. Sudyana and Mufida (2023) demonstrated that structured, goal-directed instruction enhances students' capacity to conduct valid experiments and draw logical conclusions—an outcome that aligned with the aims of the STEMQ-integrated design. Additionally, this study supported evidence from (Furqon, 2023), who that combining conceptual instruction with interactive tools such as PhET simulations significantly improved students' scientific consistency and conceptual grasp. These findings were further reinforced by (Marisda et al., 2023), whose meta-analysis indicated that instructional methods such as Project-Based Learning (PjBL) contributed to enhanced critical and creative thinking in physics learning. Taken together, the expert consensus measured by the Gregory Index and the supporting literature collectively affirmed that the instructional design utilized in this study was not only valid but also reflective of best practices in modern science education.

The linguistic validation results, which clarity, precision, and developmental appropriateness, were equally important. Scientific language that was both accessible and technically accurate played a critical role in shaping learners' conceptual understanding and long-term retention. Wei et al. (2024) emphasized that clarity in scientific language enhanced learners' ability to construct accurate cognitive mappings, which was essential for mastering complex concepts. Digital Learning Platforms (DLPs), such as the one employed in this study, offered a vehicle for integrating technical language with engaging, narrative-driven content, effectively bridging theoretical and applied knowledge gaps. Furthermore, research by (Yanli & Fu, 2023) affirmed that well-designed educational tools enhanced both linguistic accessibility and learner engagement. These findings were supported by Fauziah, R., & Hakim (2023), who argued that effective scientific communication fostered deeper conceptual engagement, especially when paired with intuitive user experiences. Yusuf (2022) further underlined the significance of contextually grounded language in constructing meaningful learning environments, particularly in culturally responsive educational settings. In this light, the high linguistic validation score not only confirmed the textual clarity of the materials but also underscored the strategic role of language in promoting scientific thinking and conceptual development within digital pedagogical models.

Another important aspect of content validation related to the structure and organization of the material. The flipbook's logical arrangement, progression from simple to complex topics, and clear learning objectives *supported* cognitive scaffolding, which was crucial in STEM education. Munandar, Suhardi, and Husna (2022) highlighted that STEM-based flipbooks enhanced critical thinking and problem-solving by facilitating systematic learning pathways, making them effective digital teaching tools. This approach corresponded with Rahmat, Leng, and Mashudi (2021), who found that scaffolding methods significantly improved student engagement and overall learning experiences. Further reinforcing this, Al Mamun and Lawrie (2023) demonstrated that scaffolded instruction fostered self-regulation and sustained cognitive engagement, essential for nurturing independent learners. Nugraha and Rachmadıartı (2022) also confirmed that well-designed flipbooks were both valid and practical in developing critical thinking skills. Collectively, these findings underlined the role of structured instructional design in building layered and meaningful learning environments that aligned with the goals of STEM education. Furthermore, structured presentation enhanced cognitive load management and improved conceptual integration (Akgün et al., 2016; Blayney et al., 2024; Timothy et al., 2023; Twist et al., 2024; Zhou, 2023). According to Cognitive Load Theory (CLT), reducing extraneous cognitive load and emphasizing germane load led to more effective learning. In the realm of eLearning, structured multimedia presentations that included interactive features were shown to increase engagement and facilitate better distribution of cognitive resources (Blayney et al., 2024). Furthermore, research in medical education indicated that structured sessions and preparatory activities reduced intrinsic cognitive load, thereby improved comprehension and mastery (Timothy et al., 2023; Zhang et al., 2016; Zhou, 2023). Microlearning strategies, which offered concise and focused content delivery, were also found to

support long-term retention and conceptual understanding by sustaining lower extraneous cognitive loads (Abbasalizadeh et al., 2024; Aldekhyl et al., 2018; De Gagné et al., 2019; Haghani et al., 2020). These findings validated the importance of structured instructional design in digital learning environments and underscored the value of the structured presentation approach used in this flipbook.

The integration of the STEMQ framework received strong support, especially in its alignment with ethical and spiritual learning goals. The incorporation of Qur'anic values into science education was widely endorsed in the literature as a means to cultivate holistic learners who appreciate the moral dimensions of knowledge. De Gagné et al. (2019) emphasized that embedding values into the science curriculum enhanced students' moral understanding and contributed to a more comprehensive educational approach. Specifically, integrating Qur'anic principles enabled students to appreciate both scientific inquiry and spiritual insight, promoting a balanced worldview (Alya et al., 2024; Manurung et al., 2024; Ningsih et al., 2022). Faizin (2017) further argued that synthesizing Islamic values with scientific education was essential for nurturing ethical responsibility and intellectual curiosity. In this study, the STEMQ framework not only contextualized physics concepts within real-world and spiritual dimensions but also encouraged learners to develop religious-scientific attitudes. Integration elevated science education from a purely cognitive endeavor to one that nurtured moral consciousness and purposeful learning (Assante et al., 2022; Keiler et al., 2017).

Notably, the integration of 21st-century competencies—critical thinking, creativity, collaboration, and communication—within the STEMQ-based content was affirmed by expert validators. These skills were considered indispensable in modern education and were central to the STEM philosophy (Özkan & Topsakal, 2020; Topsakal et al., 2022). The fusion of these competencies with spiritual values through Qur'anic contextualization enhanced the relevance and ethical grounding of scientific literacy. As in previous studies, learning environments that promoted both cognitive and moral development resulted in more responsible and engaged learners (Anwar et al., 2023).

In terms of media design, the high Gregory Index of 0.83 underscored the usability and digital robustness of the flipbook format. The expert evaluations demonstrated that the media components—layout, navigation, visual elements, and cross-device accessibility—were functional and supported effective learning. This supported the notion advanced by Nacaroğlu, Kizkapan, and Demir (2025) that interactive digital formats can significantly enhance student motivation and content engagement in science learning.

Particular strengths included the flipbook's intuitive design and readability, both crucial for maintaining student focus and reducing cognitive load. Accessibility features were vital for ensuring equity in digital education, especially in diverse classroom settings (Bong & Chen, 2021). Moreover, research highlighted that technology integration in multicultural classrooms significantly enhanced self-efficacy among preservice teachers, contributing to enriched teaching and learning experiences (Pradana et al., 2024). Expanding access to digital tools not only fostered institutional and pedagogical innovation but also improved digital competence and academic performance among both teachers and learners (Reis-Andersson, 2022; Solehudin, 2024). Foundational digital literacy played a critical role in promoting social inclusion and preparing students for future workforce participation. Studies by Eden, Chisom, and Adeniyi (2024) confirmed that equitable access to digital resources ensured that all students, regardless of socio-cultural background, could fully engage in high-quality educational experiences.

Another salient point from the media validation was the flipbook's flexibility in both individual and classroom-based learning scenarios. This aligned with trends in blended and personalized learning, which prioritized student autonomy and differentiated instruction (Aldhafeeri & Alotaibi, 2022). The flipbook's ability to support formative assessment, as it was also significant, as it allowed instructors to adapt instruction based on real-time student feedback. Farooq, Zaidi, and Ali Shah (2024) noted that adaptive learning technologies including feedback loops were key to improving learning outcomes in digital settings.

A unique strength of the present study was its successful synthesis of scientific, technological, and spiritual pedagogical principles into a coherent instructional model. While existing research highlighted the efficacy of digital tools (Kang et al., 2024), STEM integration (Anwar et al., 2023), and the value of religious contextualization (Husni, 2020), few studies attempted to unite these domains into a singular, validated educational product. This study thus filled a critical gap in the literature and served as a model for future research in interdisciplinary instructional design.

The comprehensive validation process adopted, based on both content and media dimensions—confirmed the robustness and applicability of the developed materials. It affirmed that rigorous, expert-driven validation was not merely a procedural formality but an essential aspect of educational design research (Suastika & Istri Utami, 2023). The high levels of inter-rater agreement observed in this study, especially within the strong–strong category of Gregory's matrix, validated the reliability of the evaluation instrument and reinforced confidence in the instructional materials.

The results of this study demonstrated that the digital flipbook-based Basic Physics teaching materials, developed under the STEMQ framework, were valid in both content and media aspects. They presented a holistic, technologically supported, and pedagogically robust approach to science education in Islamic contexts. The validation process affirmed the potential for such materials to enhance cognitive learning, foster ethical awareness, and support 21st-century skill development. These findings provided compelling evidence for the broader adoption and iterative refinement of STEMQ-integrated digital resources, particularly in settings where the alignment of scientific and spiritual education was a cultural and educational priority.

Conclusion

This study concluded that the digital flipbook-based Basic Physics teaching materials developed within the STEM-Qur'an framework were highly valid in terms of both content and media. The findings revealed that the materials were pedagogically sound, technologically functional, and culturally appropriate for Islamic educational settings. The content was evaluated as scientifically accurate, aligned with the curriculum, and effective in integrating Qur'anic values, while the digital format was user-friendly, visually engaging, and accessible across devices. The integration of 21st-century competencies and spiritual elements within a single instructional design marked a significant contribution to interdisciplinary educational innovation. These results supported the premise that science learning could be enhanced through holistic approaches that combine empirical reasoning with ethical and spiritual dimensions. This research contributed to the growing body of literature advocating for value-integrated STEM education and offered a practical, validated model for its implementation. Future research should assess student learning outcomes through classroom trials and explore further digital enhancements for broader applicability.

Acknowledgments
We thank the participants, both students and lecturers, for their enthusiastic participation in this study. We are also grateful to the Lembaga Penelitian Pengembangan dan Pengabdian kepada Masyarakat Universitas Muhammadiyah Makassar (LP3M Unismuh Makassar) for their moral support, which made the successful completion of this study possible.

Author Contributions
Conceptualization, Y.H., and R.R.; data collection, Y.H., S.R., and F.F.; analysis, F.F.; writing—original draft preparation, R.R., and Y.H.; writing and editing, Y.H., S.R., and W.W.; supervision, F.F. and W.W. All authors have read and agreed to the published version of the manuscript.

Funding
This research received financial support from Direktorat Penelitian dan Pengabdian kepada Masyarakat (DPPM), Direktorat Jenderal Riset dan Pengembangan, Kementerian Pendidikan Tinggi, Sains, dan Teknologi, Republik Indonesia through the Regular Fundamental Research funding scheme in 2025.

Conflicts of Interest
The authors declare no conflict of interest.

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