

QR-Code Assisted PAI E-Module Design: A Development Study to Improve Learning Outcomes

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Abstract

This study focuses on the development of a QR Code-based electronic teaching module for Islamic Religious Education (PAI) aimed at improving the learning outcomes of grade VII students at SMP Negeri 16 Bandar Lampung. In line with the importance of utilizing digital learning tools within the context of the Merdeka Curriculum, this research addresses the challenges of traditional Islamic education by integrating multimedia elements and interactivity through the use of QR Codes. The QR Code in the e-module connects students to additional digital content such as videos, interactive exercises, and enrichment readings, facilitating a more engaging and flexible learning experience. This study uses a Research and Development (R&D) approach with the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). The results from the development phase show very high feasibility, with expert validation scores of 97% for content, 95% for language, and 74% for media design, all categorized as highly feasible for educational use. Additionally, the implementation phase showed positive student engagement, with a significant improvement in learning outcomes, as evidenced by an N-Gain score of 0.69 and Paired Samples T-Test results showing significant improvement ($p < 0.001$). This study contributes to the development of digital learning tools by highlighting the potential of QR Code-based modules to support independent learning and enhance understanding of Islamic teachings. The study also emphasizes the importance of context-appropriate design in the integration of digital tools in Islamic education.

Keywords: E-Module, Learning Outcomes, Merdeka Curriculum, Islamic Religious Education, QR Code.

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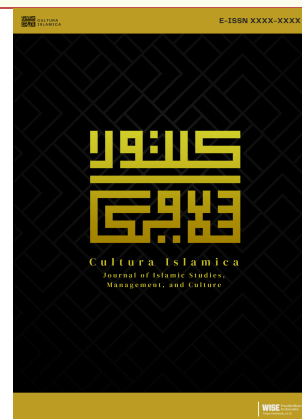
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INTRODUCTION

The development of digital technology has driven a shift in students' learning methods from teacher-centered approaches to more flexible, interactive, and personalized learning [1],[2],[3]. At the junior high school level, this transformation becomes increasingly relevant as students are in a cognitive and social transition phase that requires contextual learning experiences that are easily accessible at any time. In line with this, the implementation of the Merdeka Curriculum emphasizes the importance of independent learning, differentiation, and the utilization of learning resources that are adaptive to students' needs and school readiness [4], [5], [6]. Various studies also show that the implementation of the Merdeka Curriculum still faces challenges, such as teacher preparedness, infrastructure limitations, and varying competencies in utilizing learning technologies [7], [8].

However, in practice, Islamic Religious Education (PAI) learning still faces classic issues, such as low student engagement, a lack of media variety, and learning that tends to be textual and memorization-oriented. In fact, PAI aims not only at cognitive mastery but also at the formation of attitudes and character (affective), as well as religious skills in real-life situations (psychomotor) [9], [10], [11]. In this context, the use of digital learning media has the potential to strengthen the understanding and internalization of Islamic values through materials that are more engaging, easier to understand, and closer to students' experiences [12], [13], [14]. Several studies emphasize that digital media innovation in PAI learning opens opportunities for increased effectiveness but also presents challenges related to access, digital literacy, and appropriate learning design [14], [15].

Previous research has shown that QR Code technology in learning effectively improves learning outcomes, literacy, and higher-order thinking skills. Pratiwi [16] found that QR Code-based e-modules enhance science literacy and students' thinking skills in elementary schools. Ahmed [17] also demonstrated that integrating QR Codes in cooperative learning increases the cognitive achievements of students. Additionally, Adima [18], Ibrahim [19], and Desi [20] emphasized that QR Code-based media is effective in improving learning outcomes and critical thinking skills, particularly in science and social science subjects. QR Codes function as interactive and flexible digital learning tools that support 21st-century competencies.

However, there has been no research that develops QR Code-based teaching modules in Islamic Religious Education (PAI), particularly for improving learning outcomes. Most of the previous studies focused on science or higher education and have not integrated Islamic values into the design of digital modules. This study offers novelty by developing a PAI module that integrates QR Codes to connect teaching materials with Islamic multimedia (videos, audio recitations, infographics, interactive evaluations). This design is expected to strengthen understanding, internalize values, and improve learning outcomes holistically, as well as contribute to the development of technology-based PAI learning.

One rapidly growing solution is the use of electronic teaching modules (e-modules) as a structured, systematic, and self-directed learning resource that can incorporate multimedia (text, images, audio, video, and quizzes). E-modules are considered capable of increasing the practicality of learning, reinforcing understanding, and promoting more active learning activities, as the materials can be revisited according to students' needs [21], [22], [23]. The development of e-modules can also be tailored to the curriculum, student characteristics, and

the school context, ensuring that they do not merely "convert" printed books into digital formats, but genuinely design meaningful learning experiences. Various development studies have proven that e-modules can achieve high feasibility and contribute to improved learning outcomes at the secondary school level [24].

Nevertheless, the main challenges of e-modules in the field are often related to access to multimedia content that requires additional links, difficulty in navigating the materials, and limited integration between print and digital materials [25], [26]. At this point, QR Code scanning technology becomes an efficient strategy, as QR Codes can quickly connect students to explanatory videos, interactive exercises, summaries, or enrichment sources with just a scan using a mobile device [27], [28]. Several studies show that QR Code-based media can increase learning interest, encourage engagement, and have a positive impact on learning outcomes, especially when QR Codes are designed as 'bridges to relevant and concise digital content' [18], [29], [30].

Although the use of QR Codes and e-modules has been extensively studied across various subjects, the development of QR Code-based electronic teaching modules specifically designed to support learning outcomes in seventh-grade PAI still requires strengthening, especially in the context of public schools and the need for varied learning. In addition to effectiveness, this innovation needs to ensure the quality of the learning design, the alignment of the material with PAI learning objectives, and the practicality of use for both teachers and students [31], [16]. In other words, the success of digital innovations cannot be measured solely by the appeal of the media but must be proven through the feasibility of content and media, user response, and measurable improvements in learning outcomes that can be replicated [32], [33].

Based on this urgency, this study focuses on the development of a QR Code Technology-based Electronic Teaching Module to support the learning outcomes of PAI students in grade VII at SMP Negeri 16 Bandar Lampung. The developed product is expected to serve as a learning resource that is (1) easily accessible, (2) structured according to PAI competencies, (3) rich in multimedia through the integration of QR Codes, and (4) promotes independent and meaningful learning. Academically, this study contributes to strengthening the development of contextual and relevant digital PAI teaching materials in line with the challenges of the Merdeka Curriculum.

METHODS

This study employs a Research and Development (R&D) approach with the development procedure based on the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) to create a QR Code Technology-based Electronic Teaching Module for PAI learning in grade VII at SMP Negeri 16 Bandar Lampung. The analysis phase involves performance analysis, needs analysis, and curriculum analysis to map the learning conditions and determine the specifications of the module to be developed. The design phase focuses on structuring the module, the flow of material presentation, the design of the interface, and the integration of QR Codes that link students to supporting content (videos, exercises, enrichment), while also preparing research instruments such as expert validation sheets and user response questionnaires as the basis for assessing the module's feasibility and practicality.

In the development phase, the module prototype is realized according to the design and then validated by subject matter experts, media experts, and language experts to ensure the accuracy of the content, presentation quality, navigation, and language suitability. All input from the validators is used as the basis for revisions until the module is deemed feasible for use in learning. The implementation phase is carried out through field trials in stages, starting with a small group trial involving 15 students to obtain initial feedback regarding the ease of use and attractiveness of the module, followed by a large group trial involving 30 students to assess the application of the module in PAI learning more broadly. In the implementation process, students use the electronic module and scan QR Codes to access relevant digital learning resources according to the activities available in the module.

The evaluation phase is carried out by analyzing the data from expert validation and user responses descriptively and quantitatively through average scores to determine the categories of feasibility, practicality, and attractiveness of the module. The impact of the module on learning outcomes is measured through a post-test conducted after the module-based learning, then analyzed using descriptive statistics to assess student learning achievements. Additionally, qualitative feedback from validators, teachers, and students is used as a basis for final reflection and improvement, ensuring that the module meets the criteria for feasibility and practicality and has the potential to support the improvement of PAI learning outcomes in grade VII students

RESULTS AND DISCUSSION

Results

This study produced a Scan QR Code Technology-based electronic teaching module for IRE learning for seventh-grade students at SMP Negeri 16 Bandar Lampung, developed through the stages of the ADDIE model, including analysis, design, development, implementation, and evaluation. The results of the study at each stage are described as follows.



Figure 1. The ADDIE Instructional Design Model Comprising the Stages of Analysis, Design, Development, Implementation, and Evaluation

Analysis

The analysis phase was conducted to identify the learning needs for PAI in grade VII. In this development research, there are three stages: performance analysis, needs analysis, and

curriculum analysis [34]. The results of the analysis revealed that PAI learning is still dominated by the use of printed books and lecture-based methods, leading to relatively low student engagement and suboptimal use of learning technologies. Additionally, the curriculum analysis indicated that the PAI materials in the Merdeka Curriculum demand learning that fosters independent study, conceptual understanding, and the contextual reinforcement of Islamic values [35], [36]. Based on these findings, there is a need for digital teaching materials that are easily accessible, interactive, and aligned with the characteristics of students, which is why the QR Code-based electronic teaching module was chosen as the development solution.

Design

In the design phase, the researcher developed the electronic teaching module, which includes the module structure, learning objectives, core materials, summaries, exercises, and evaluations. The module was designed with a simple and systematic visual layout, along with integrated QR Codes linking to instructional videos, interactive exercises, and supplementary materials. The design of the module also took into account the alignment of the content with the learning objectives for PAI grade VII, the use of communicative language, and navigation that facilitates independent learning for students [37], [38]. The QR Code in the module serves as a link between the core content and additional learning resources, helping to better manage students' cognitive load. Students do not receive excessive information on a single page but can access supplementary materials as needed [39], [40]. This reinforces the finding that the module design is not only visually appealing but also grounded in pedagogical principles that support meaningful learning.

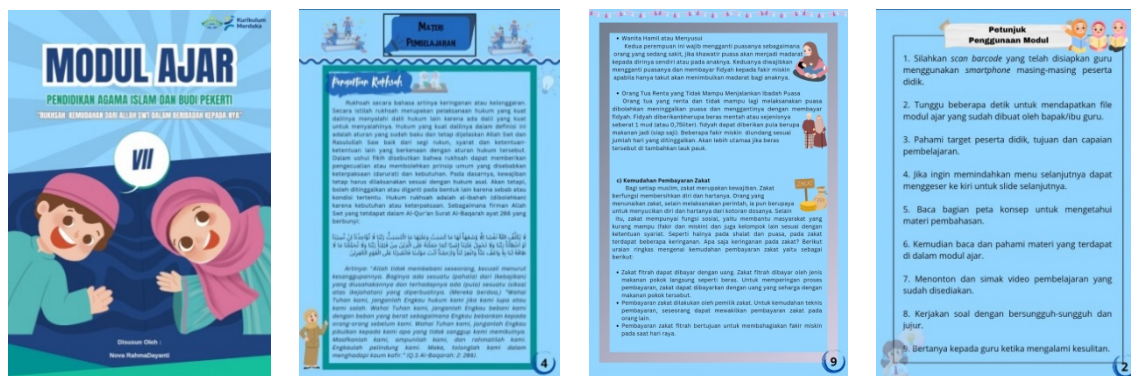


Figure 2. E-modul Design

Development

The development phase resulted in the prototype of an electronic teaching module based on Scan QR Code Technology, which was then validated by experts, including subject matter experts, language experts, and media experts. The validation results showed that the module has a very high level of feasibility. Subject matter expert validation achieved a percentage of 97% and 80%, language expert validation was 95%, and media expert validation was 74%, all of which fall within the "feasible to highly feasible" category. Expert validation is a key indicator of product quality in R&D research, as it ensures content alignment with academic standards, language accuracy, and the quality of media design and navigation [41], [42], [43]. Feedback from the validators was used as the basis for revising the module, particularly in

enhancing visual presentation, clarifying QR Code usage instructions, and adjusting sentence wording to make it more comprehensible for students.

Table 1. E-Module Validation Results by Subject Matter Experts, Language Experts and Media Experts

Perception Aspect	Total Score	Maximal Score	Percentage	Category
Subject Matter 1	70	72	97%	Very Worthy
Subject Matter 2	58	72	80%	Very Worthy
Language	38	40	95%	Very Worthy
Media	53	73	74%	Worthy
Total Average	172,25	64,25	86,5%	Very Worthy

The high validation scores from the content and language experts indicate that the PAI content in the module aligns with the learning objectives and the characteristics of junior high school students. Meanwhile, the media expert score, which falls within the "acceptable" category, suggests that while technical improvements are still necessary, the module meets the fundamental principles of effective learning media. This finding strengthens the claim that the developed product has academically credible quality before being implemented in the field.

Implementation

The trial results showed very positive responses from the students, with an attractiveness level of 86% in the small group and 89% in the large group. These findings can be explained through the learning motivation theory, particularly self-determination theory, which suggests that learning motivation will be maximized when three basic psychological needs of individuals are met: Autonomy, Competence, and Relatedness [44].

Table 2. Results of Teacher and Student's Interest Analysis

Respondents	Total Score	Maximal Score	Percentage	Category
Teacher	59	72	82%	Very Interesting
Large group of students	1.599	1.800	89%	Very Interesting
Small group of students	773	900	86%	Very Interesting

The use of QR Code allows students to independently access materials through familiar devices, fostering a sense of control over their learning process. Furthermore, the integration of videos and interactive exercises makes Islamic Religious Education (PAI) learning no longer monotonous and textual, but more contextual and relatable to students' lives. Thus, the implementation results reinforce the argument that QR Code-based electronic learning modules can enhance students' interest and engagement in learning.

Evaluation

The evaluation phase was conducted to assess the effectiveness of the QR Code-based electronic learning module on student learning outcomes [45]. The analysis results indicate an improvement in learning outcomes after using the module, as evidenced by an N-Gain score of 0.69, which falls within the moderate category. Additionally, the Paired Samples T-Test results show a t-value of 10.613 with a significance level of $p < 0.001$, indicating a significant

difference in learning outcomes before and after using the module. Based on the validation assessments, responses regarding the attractiveness of the educators and students, as well as the product's effectiveness, it was concluded that the developed electronic learning module is highly suitable and effective as teaching material for Islamic Religious Education on the topic of *Rukhsah: Allah's Ease in Worshipping Him*.

The summary diagram of the research results illustrates the logical connection between product feasibility, user responses, and learning effectiveness. Expert validation ensures the product's initial quality, the attractiveness test shows positive reception from students, and the effectiveness test demonstrates the empirical impact on learning outcomes. This pattern shows that the success of the module is not coincidental, but rather the result of a systematic, theory-based development process. Therefore, this research strengthens previous findings about the effectiveness of e-modules and QR Codes, while also expanding the empirical evidence in the context of Islamic Religious Education. The developed module is not only feasible and engaging but also pedagogically relevant and empirically effective.

Discussion

The research findings show that the Scan QR Code Technology-based electronic teaching module developed has a very high feasibility level based on expert assessments. Content expert validation received percentages of 97% and 80%, language expert validation was 95%, and media expert validation was 74%, all falling within the "acceptable to highly acceptable" category. These findings indicate that the module meets the standards of academic substance, language clarity, and the quality of learning media. Additionally, the student interest test results showed a very positive response, with 86% for the small group and 89% for the large group, confirming that the module's design, integration of visual media and videos, and easy access via QR Code significantly enhanced student engagement in Islamic Religious Education learning.

In terms of effectiveness, the N-Gain test results of 0.69 show a moderate improvement in learning outcomes after the use of the electronic teaching module. This finding is supported by the Paired Samples T-Test results, which showed a t-value of 10.613 with a significance level of < 0.001 , indicating a statistically significant difference in average learning outcomes between the pretest and posttest. Therefore, empirically, the Scan QR Code Technology-based electronic teaching module has proven effective in improving student learning outcomes [30], although the improvement has not yet reached a high category. This indicates that the module functions effectively as a supplementary learning resource [46], particularly in the context of Islamic Religious Education at the junior high school level [47], [48].

Compared to the research by Najma Andzar Rumaysa [49], who developed a QR Code-based module for Biology, the feasibility level of the module in this study shows a relatively similar alignment [50]. That study reported validation of the content and design experts falling under the "excellent" category, as found in this research. However, the main difference lies in the subject matter and the characteristics of the students, where this study focuses on Islamic Religious Education, which has a conceptual and normative character [51], [52]. This indicates that QR Code technology is not only effective in science education but also adaptable for subjects based on values and religious practices [53].

When compared to the research by Rina Puspitasari [54], on the development of a HOTS-based e-module using Flipbook Marker, the effectiveness of the module in this study shows relatively similar results in terms of feasibility, but differs in its approach to accessibility. The QR Code-based module in this study is simpler to use because it does not require additional app installation and can be accessed directly through a smartphone [55], [56]. This difference suggests that choosing more practical technology can be a crucial factor in enhancing the accessibility of digital teaching materials [57], particularly in schools with limited technological facilities.

The results of this study can also be compared with the research conducted by Siti Maisaroh and Supardi, who developed a QR Code-based module for Social Studies to improve digital literacy. That study obtained an N-Gain value of 0.72 (high category), which is slightly higher than the N-Gain value of 0.69 in this study. This difference may be influenced by the focus of the learning objectives, where Maisaroh and Supardi's research emphasizes digital literacy, while this study focuses on improving cognitive learning outcomes in Islamic Religious Education. This indicates that the effectiveness of QR Code-based modules can vary depending on the learning goals to be achieved.

When compared to the research by Agung Dian Putra, who developed a Flipbook-based digital module at the elementary school level [58], the main similarity lies in the positive response from students toward digital learning materials. However, this study is unique in its use of QR Code as a medium for linking access to content, providing greater flexibility in mobile learning-based education. Therefore, this study expands previous findings by showing that QR Code can be an effective technological alternative to support digital learning across educational levels [59].

Overall, when compared to previous studies, the findings of this study reinforce the consistency of results that QR Code-based electronic teaching modules are feasible, engaging, and positively impact both the learning process and outcomes. The main contribution of this study lies in its application within the context of Islamic Religious Education (PAI), which has been relatively underexplored in the development of QR Code-based digital learning materials. Therefore, this study not only supports previous findings but also expands empirical evidence that QR Code-based digital teaching materials are relevant and applicable for Islamic Religious Education (PAI) learning at the junior high school level.

CONCLUSION

This study focuses on the development of a QR Code-based electronic teaching module for Islamic Religious Education (PAI) aimed at improving the learning outcomes of grade VII students at SMP Negeri 16 Bandar Lampung. In line with the importance of utilizing digital learning tools within the context of the Merdeka Curriculum, this research addresses the challenges of traditional Islamic education by integrating multimedia elements and interactivity through the use of QR Codes. The QR Code in the e-module connects students to additional digital content such as videos, interactive exercises, and enrichment readings, facilitating a more engaging and flexible learning experience. This study uses a Research and Development

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The results from the development phase show very high feasibility, with expert validation scores of 97% for content, 95% for language, and 74% for media design, all categorized as highly feasible for educational use. Additionally, the implementation phase showed positive student engagement, with a significant improvement in learning outcomes, as evidenced by an N-Gain score of 0.69 and Paired Samples T-Test results showing significant improvement ($p < 0.001$). This study contributes to the development of digital learning tools by highlighting the potential of QR Code-based modules to support independent learning and enhance understanding of Islamic teachings. The study also emphasizes the importance of context-appropriate design in the integration of digital tools in Islamic education.

LIMITATIONS

This study has several limitations, including the fact that it was only conducted at SMP Negeri 16 Bandar Lampung, so the findings may not be fully generalizable to other schools with different student characteristics. Additionally, although the QR Code-based teaching module has been validated by experts, its implementation in a broader context still requires further evaluation. The measurement of learning outcomes, which was only based on a post-test, may not encompass all the cognitive, affective, and psychomotor dimensions expected in Islamic Religious Education. Finally, while QR Code technology provides easy access, limitations in devices and internet access at some schools may affect the effectiveness of the module's use.

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AUTHOR CONTRIBUTION

NR conceptualized the study, designed the research framework, coordinated the overall research process, and prepared the initial draft of the manuscript. AL contributed to data collection, instrument development, and assisted in data analysis. NQ supported the literature review, data organization, and manuscript drafting. DA assisted with field data collection, documentation, and the preparation of supporting research materials. AT provided academic supervision, methodological guidance, and critical review of the manuscript, as well as contributed to refining the theoretical framework and revising the final version of the manuscript. All authors have reviewed and approved the final version of the manuscript.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DECLARATION OF USE OF AI IN SCIENTIFIC WRITING

In the preparation of this article, we declare that artificial intelligence (AI) was utilized to assist in several stages of the writing process, including language enhancement, formatting, and improving the clarity of scientific ideas. However, all concepts, methodologies, and analyses presented in this article are entirely the work of the authors. AI was used solely as a supportive tool to facilitate the writing process and enhance the readability of the text, and no AI-generated content has been directly included in the research findings or conclusions. The authors guarantee that the use of AI did not affect the integrity of the research outcomes or the writing process, and all sources have been properly cited.

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