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Enhancing Scientific Literacy Skills: Development of Physics Teaching Materials based on Islamic Values

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ABSTRACT

This research aims to develop valid physics teaching materials based on Islamic values, assess their practicality, and analyze their effectiveness in improving scientific literacy skills. This research was conducted at MAN 2 Bulukumba with 27 eleventh-grade class A students and 9 physics teachers as practitioners. This research employed the 4D development model: define, design, develop, and disseminate. The materials' validity was evaluated using Aiken's V, focusing on content, presentation, language, and graphics, and were deemed valid and suitable for use. Practitioners rated the materials as very practical across all assessed aspects. Effectiveness was analyzed through pre- and post-implementation tests of students' scientific literacy, yielding an N-gain of 67% (effective criteria). The study concludes that physics teaching materials based on Islamic values are valid, practical, and effective in enhancing students' scientific literacy. Integrating Islamic values into physics learning strengthens students' understanding of scientific concepts while fostering a holistic perspective that connects science with spiritual and moral dimensions. This integration also increases students' motivation by demonstrating the relevance of physics to their religious teachings, making science learning more engaging. Furthermore, it facilitates contextual teaching of physics concepts, particularly in environments rich in Islamic values.

INTRODUCTION

Science education, especially physics, plays an important role in shaping students' critical and analytical thinking skills and providing a deep understanding of natural phenomena. On the other hand, in the context of education in Indonesia, the majority of students come from an environment that is thick with religious values, especially Islam. However, education that only focuses on cognitive aspects without integrating moral and spiritual values can result in students being unable to relate science to their beliefs (Elfidayati & Azhari, 2022; Syahid, 2024). Therefore, integrating science education and Islamic values is crucial for holistic learning (Nuriyati & Chanifudin, 2020; Sukiyat, 2020).

Observations at MAN 2 Bulukumba showed that the integration of Islamic values in physics teaching has not been fully implemented, as the teaching focuses more on general physics concepts without linking them to Islamic values. As an Islamic education center, the school should develop a learning approach that integrates Islamic teachings with strong academic foundations so that students not only master scientific knowledge but also have good character and

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environmental awareness (Kusjuriansah & Yulianto, 2019).

Developing physics teaching materials based on Islamic values addresses the need for a more contextual and meaningful learning approach. By integrating physics concepts with Islamic teachings, such as the order of nature and human responsibility towards the environment, students gain a deeper understanding of science while fostering their religious character (Khoiri et al., 2017; Subagiya et al., 2024). This approach links physics lessons to Qur'anic verses and Islamic values, highlighting how science can strengthen faith and serve as a means to draw closer to Allah SWT (Budimah et al., 2014; Malichatin & Noor, 2021; Ya'sub, 2021). Such integration enriches students' scientific knowledge and enhances their moral and spiritual awareness, creating a holistic learning experience. Additionally, including Islamic values in teaching materials allows educators to present physics concepts in a context that resonates with students' cultural and religious backgrounds, making the learning process more relevant and impactful (Sari et al., 2024).

Physics teaching materials based on Islamic values emphasize the integration of scientific and religious perspectives in understanding natural phenomena. This approach aligns with the Islamic worldview, which views nature as a manifestation of God's greatness, as expressed in the Qur'an. By embedding Islamic values in physics content, educators can foster students' understanding of scientific concepts and their spiritual and moral development (Ihwani et al., 2023; Susilowati, 2017; Warsah, 2021). This approach enriches students' scientific literacy and instills a sense of responsibility toward nature and humanity as stewards of God's creation (Fajrin & Muqowim, 2020). By embedding these values into physics learning, students gain a deeper understanding of scientific concepts while fostering moral and spiritual growth, making the learning process more meaningful and relevant (Husna et al., 2020; Rosita & Abzar, 2024). Furthermore, developing scientific literacy is crucial in this integration, as it enables students to critically understand, evaluate, and apply scientific knowledge in various contexts, including solving real-world problems and addressing complex issues. Scientific literacy involves mastering fundamental principles, such as those in physics while enhancing the ability to interpret and communicate scientific information effectively (Azmarita et al., 2019; Santhalia & Yuliati, 2021; Siswanto et al., 2023).

However, as seen from various national and international education surveys, science literacy in Indonesia is relatively low. Based on some research, students currently have low scientific literacy skills on average due to the lack of teaching materials used as learning resources (Andaresta et al., 2023; Hartono et al., 2023; Naresti & Suratmi, 2024; Suroso et al., 2021). Students' scientific literacy in Indonesia remains relatively low, largely due to learning approaches that are not contextual and do not involve spiritual or locally relevant values (Yusmar & Fadilah, 2023). One of the contributing factors is the learning approach, which tends to be technical and less contextual, with values that are close to students' lives (Pratiwi et al., 2019). Meanwhile, scientific literacy skills are among the skills students must have in the 21st century and the Industrial Revolution 4.0.

By linking physics learning with Islamic values, students are encouraged to see science as a tool for addressing societal challenges while maintaining ethical and moral considerations. This integrated approach strengthens students' scientific capabilities and instills a sense of responsibility as stewards of the environment and humanity, aligning with Islamic teachings. Therefore, developing teaching materials that connect science with religious values is essential to effectively improve students' scientific literacy through

a more contextual approach that aligns with their everyday lives. The integration of Islamic values in education has been widely explored in various disciplines, such as biology (Aulia et al., 2023; Farisi & Abdurrosyid, 2024; Ramadayanti et al., 2022); mathematics (Suhandri & Syahwela, 2024; Syibli et al., 2021), and science subjects (Pratiwi et al., 2019) Moreover, the integration of Islamic values in physics education also exists. Some studies have attempted to connect physics concepts with Islamic teachings to create more contextual and meaningful learning. For example, research by Budimah et al. (2014) linked physics concepts with Quranic verses, while Sukiyat (2020) emphasized the importance of holistic learning based on Islamic values. Development of I-SETS (Islamic, Science, Environment, Technology, Society) based teaching materials to improve students' critical thinking skills (Wahyuni et al., 2024). However, these studies remain limited, particularly in the systematic and explicit development of physics teaching materials that integrate Islamic values to improve students' scientific literacy.

Developing physics teaching materials based on Islamic values remains relevant and necessary. This research not only enriches students' understanding of physics from intellectual and spiritual perspectives but also offers a more contextual learning experience tailored to the needs of students in predominantly Islamic societies. This can be a strategic step to address the gaps in previous studies and expand scientific literacy that integrates moral and spiritual growth among students. Therefore, the study aims to create valid, practical, and effective physics teaching materials based on Islamic values, strengthening students' understanding of physics concepts while fostering a comprehensive perspective on the relationship between science and religion.

METHODS

This research is a type of Research and Development (R&D) research using the 4D development model. This research design uses a 4D model of four development stages: define, design, development, and disseminate (Sugiono, 2012).

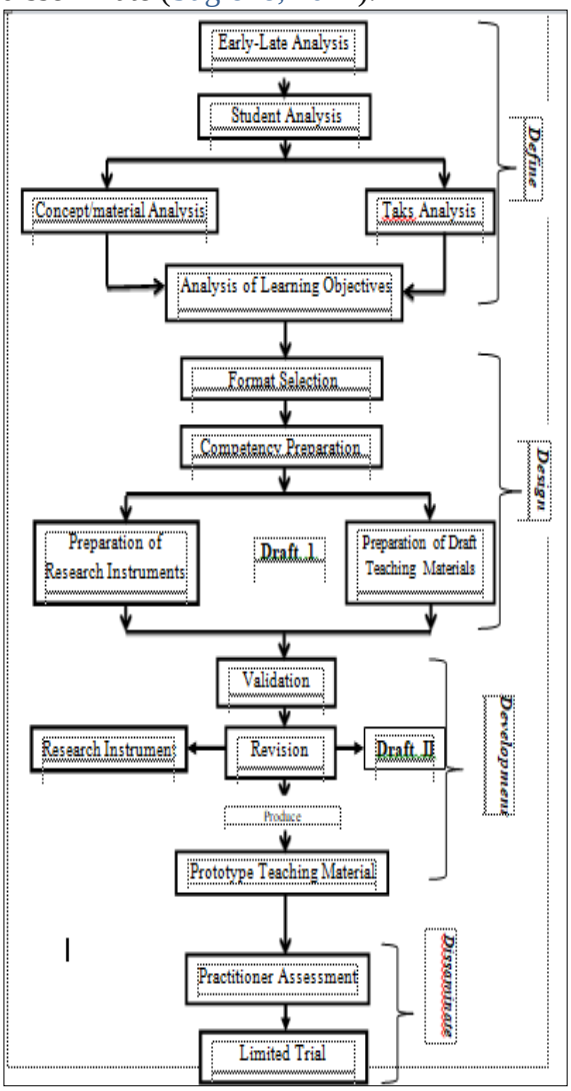

Figure 1. Implementation Procedures for the Development and Trial of Physics Teaching Materials Based on Islamic Values

The research procedure begins at the Define stage, which aims to determine the product to be developed and its specifications. At this stage, learning requirements are identified, including learning objectives and the limitations of the learning process. This stage covers initial analysis, student analysis, task analysis,

material analysis, and the formulation of learning objectives.

The next step is the design stage after the issues are identified in the definition stage. This stage aims to design appropriate and effective teaching materials for learning. The teaching materials include various sections, such as the cover, foreword, table of contents, introduction, instructions for use, concept map, basic competencies, competency achievement indicators, learning objectives, material descriptions, integration with Islamic values, sample questions, practice questions, assessments, glossary, and bibliography. The Design stage involves format selection, competency development, research instrument development, and the preparation of teaching materials.

Next, in the development stage, the designed teaching materials and research instruments are validated to produce products in the form of physics teaching materials based on Islamic values and research instruments (practitioner assessment questionnaires and student scientific literacy skills tests). Validation of teaching materials and research instruments is carried out at this stage. The dissemination stage involves distributing physics teaching materials based on Islamic values to students and physics teachers at high schools in Bulukumba Regency. This distribution is done on a limited basis as part of a pilot test.

The research trial subjects involved 27 students from class XI.A at MAN 2 Bulukumba, 9 physics teachers from MAN 2 Bulukumba, and several other schools in Bulukumba Regency. The trial used a One-Group Pretest-Posttest Design, an experimental design involving one group of participants without a control group for comparison, to evaluate changes before and after treatment (Ahmad et al., 2020). The test design used can be seen in Figure 2.

O1	x	**O2**

Figure 2. Trial Design

Information
O1 : Initial Test of Science Literacy Skills
X : Application of materials teach physics based on Islamic values
O2 : Final Test of Science Literacy skills

The instruments used in the research were validation sheets, teacher or practitioner response sheets, and science literacy skills test sheets (Handayani & Istiyono, 2018). According to Azwar (Zahro et al., 2023), the analysis used by three experts to determine the level of relevance is Aiken's V. The Aiken's V formula is one way to determine content validity using the following equation.

$$v = \frac{\sum s}{n(C-1)} \quad (1)$$

Information:
V: Rater (validator) agreement index regarding item validation
s: The score assigned by each rater (validator) is reduced by the lowest score used (s = r-Io), with r the score of the rater's chosen category and Io the lowest score.
n: Number of raters (validators)
c: The highest validity assessment number

Aiken test requirements, after calculations are carried out if V ≥ 0.4, then the expert agreement index is said to be valid.

Practical response data analysis using the following equation.

$$PRS = \frac{\sum A}{\sum B} x100\% \quad (2)$$

Information:
PRS: Percentage of the number of practitioners who responded to the categories stated in the instrument.
∑A: Total score obtained for each category stated in the questionnaire
∑B: Maximum score from each category that responded to the questionnaire.

Table 1. Practicality Category Criteria

Mark (%)	Criteria
76 ≤ x ≤ 100	Very Practical
51 ≤ x ≤ 75	Practical
26 ≤ x ≤ 50	Less practical
0< x ≤ 25	Not Practical

Source: (Sahida, 2018)

Data Analysis of the Effectiveness of Using Physics Teaching Materials Based on Islamic Values to Improve Science Literacy Skills. The effectiveness of teaching materials based on Islamic values can be seen from the scores of students' scientific literacy skills after being tested. Then, we will use gain score analysis to see how much the increase in scientific literacy skills is. N-gain score is the difference between pretest and posttest. The results will later show whether there is an increase in scientific literacy skills in students. The calculation of the gain score is done with the following equation 3.4:

$$g=\frac{skor\ posttest-skor\ pretest}{skor\ maksimum-skor\ pretest} \quad (3)$$

Information:

g	: N-Gain Score
Posttest score	: Initial test scores
Pretest score	: Final test score
Maximum score	: Maximum score

The n-gain results obtained are then interpreted in Table 2 to determine the category of test improvement that occurred.

Table 2. N-gain Value Criteria

Gain Value	Criteria
0.70< g 100≤	High
0.30 < g 0.70≤	Medium
0.00 < g 0.30≤	Low
g = 0.00	No Change Occurred
-1.00 g < 0.00≤	There is a Decrease

Source: (Salam et al., 2023)

Furthermore, the effectiveness of using teaching materials based on Islamic values is categorized based on the interpretation of the effectiveness of the N-gain score obtained, which is then converted into a percentage (%), as in Table 3.

Table 3. Interpretation of N-gain Score Effectiveness

Intervals (%)	Category
g 55≤	Ineffective
g ≥ 56	Effective

Source: adapted Hake (Halmuniati et al., 2022)

Physics teaching materials based on Islamic values are said to be effective if the N-gain percentage is ≥ 56% or is in the effective category.

RESULTS AND DISCUSSION

This research is a research and development (Research and Development). The development carried out is the development of physics teaching materials based on Islamic values using the 4D development model consisting of 4 main stages: defining, designing, developing, and disseminating. Furthermore, based on the results of research and development by examining the indications of physics teaching materials developed using content validity tests, practitioner assessments, and the effectiveness of using physics teaching materials based on Islamic values, a picture is obtained of the achievement of the criteria for validity, practicality, and effectiveness of using teaching materials based on Islamic values to improve students' scientific literacy skills. The results of this study are explained in the following discussion.

a. Validity of the Content of Physics Teaching Materials Based on Islamic Values

The validity of the content of physics teaching materials based on Islamic values is carried out by presenting experts to assess the physics teaching material products that have been designed. Each expert is asked to assess the product made to determine the advantages and disadvantages of the teaching materials developed. The content validity results obtained from the expert assessment are then analyzed using Aiken's V index analysis by looking at the validated content validity coefficient. Physics teaching materials based on Islamic values

are said to be valid if the content validity coefficient V ≥ 0.4. The results of the validity of each aspect assessed can be seen in Table 4, which states that physics teaching materials based on Islamic values are declared valid.

Table 4. Validation Analysis of the Content of Physics Teaching Materials Based on Islamic Values

Aspect	Total Validity Score	V	Category
Content suitability	10.77	0.67	Valid
Presentation	10.88	0.68	Valid
Language	13.44	0.67	Valid
Graphics	5.33	0.66	valid

Physics teaching materials based on Islamic values that have been developed are assessed by three experts to measure the validity of the content of the teaching materials. There are four aspects assessed by the three experts regarding the physics teaching materials that have been developed. These aspects include the appropriateness of the content, presentation, language, and graphics (Finsi et al., 2021)

Each expert was asked to assess the design of teaching materials based on four aspects to determine the product's strengths and weaknesses before the trial was conducted. From the four analysis results of these aspects, it can be concluded that physics teaching materials based on Islamic values are declared valid and suitable for use at the limited trial stage.

Table 5. Results of Teaching Materials Development

1. Cover of Teaching Materials

2. Concept Maps

3. Contents

4. Bibliography

Table 5 shows the results of the development of physics teaching materials based on Islamic values. The results of this analysis are in line with research development of physics teaching materials based on integrated Islamic science on the material of Newton's laws I, II, III for Madrasah Aliyah (Doctoral dissertation, IAIN Palangka Raya), and further research conducted by (Husna et al., 2020). Development of physics modules based on integrating Islam science on straight-motion material to improve student learning outcomes.

b. Practitioner Assessment of Physics Teaching Materials Based on Islamic Values

Practitioner assessment sheet for physics teaching materials based on Islamic values declared valid by experts. Furthermore, at the dissemination stage, the practitioner assessment sheet for teaching materials is given to practitioners to assess the implementation and usefulness of the teaching materials developed. Practitioners in this study were physics teachers at the senior high school level in Bulukumba Regency. The results of the practitioner assessment analysis are presented in Table 6.

Table 6. Practitioner Assessment Results of Physics Teaching Materials Based on Islamic Values

Aspect	Percentage (%)	Category
Content suitability	81.30	Very Practical
Presentation	76.39	Very Practical
Language	80.19	Very Practical
Graphics	76.85	Very Practical
Average	78.86	Very Practical

Then, the results of this assessment are supported by direct responses from practitioners when assessing the developed teaching materials. Practitioners provide a lot of input to improve the quality of the developed teaching materials. Practitioners assess that aspects of Islamic values in the material must be supplemented with topics that are easy to find in the student's environment. Another statement item that received a response was the illustration of the material. According to practitioners, visualization of the material needs to be added so that students can better understand the concept.

The results of the practitioner assessment analysis concluded that practitioners, on average, gave very practical assessments of the aspects of content feasibility, presentation, language, and graphics. The physics teaching materials based on developed Islamic values were declared practical. This aligns with research conducted by (Astiti, 2019) entitled Development of contextual-based high school physics teaching materials on temperature and heat material. The results of small-scale tests obtained related to the practicality of Physics teaching materials are classified as excellent.

c. Effectiveness of Using Physics Teaching Materials Based on Islamic Values to Improve Science Literacy Skills

Physics teaching materials based on Islamic values are implemented in class XI. A MAN 2 Bulukumba. Physics teaching materials based on Islamic values that have been developed are then tested for effectiveness on sound wave and light wave materials. Physics teaching materials based on Islamic values will be applied to students in the implementation of trials at each learning activity meeting.

Physics learning is effective and related to the learning resources used in the learning process (Anggraini, 2019). Physics teaching materials based on Islamic values were developed using language that is easy for students to understand. Physics teaching materials based on Islamic values were tested on 27 students. The effectiveness of

using physics materials based on Islamic values can be seen in the achievement of the results of increasing scientific literacy skills tests using scientific literacy indicators, namely explaining scientific phenomena based on the application of physics concepts, interest in science issues, and interpreting data and evidence scientifically. The improvement of students' scientific literacy skills can be seen from the students' pretest and posttest results. The students' pretest scores were obtained from tests carried out before the trial of using physics teaching materials based on Islamic values.

Table 7. Results of Statistical Analysis of Science Literacy Skills

Parameter	Students' Science Literacy Skills	
	Pretest	***Posttest***
Number of Subjects	27	27
Maximum Ideal Score	40	40
Minimum Ideal Score	0	0
Maximum Empirical Score	28	38
Minimum Empirical Score	8	17
Standard Deviation	4.76	4.73
Average Score	18.15	30.11

Table 7 shows an increase in students' scientific literacy skills as seen from the average score obtained by students in the pretest of 18.15, while the average score obtained by students in the posttest was 30.11. Furthermore, to determine the effectiveness of physics teaching materials based on Islamic values, the increase in scientific literacy skills was analyzed using the N-gain Score equation. The results of the N-gain analysis are shown in Table 8.

Table 8. N-gain Score Analysis of Improvement in Science Literacy Skills Test

Interval	Category	Freq	(%)
$0.70 \leq g$	High	4	15
$0.30 < g \leq 0.70$	Medium	20	74
$g \leq 0.30$	Low	1	4
$g = 0.00$	No Change Occurred	2	7
Amount		**27**	**100**

Furthermore, the effectiveness of the use of physics teaching materials based on Islamic values is obtained from the calculation of students' scientific literacy skills tests using the N-gain formula. The following are the results of the N-gain Score analysis, which can be seen in Table 9.

Table 9. Percentage of Effectiveness of Physics Teaching Materials Based on Islamic Values

Interval	Category	Number of Students	Percentage (%)
$g \leq 55$	Ineffective	9	33
$g \geq 56$	Effective	18	67
Total		27	100

Figure 3 presents the improvement scores of students' scientific literacy skills tests as a bar chart.

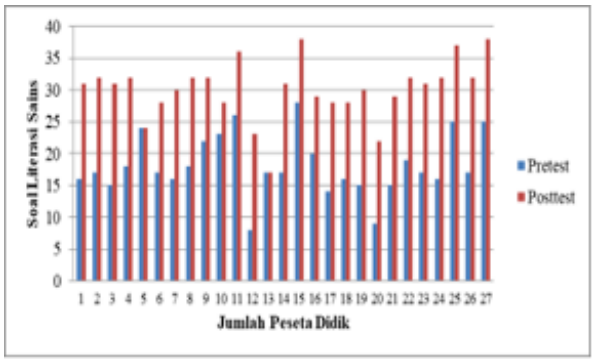

Figure 3. Pretest and Posttest of Students' Science Literacy Skills

The results of the analysis in this study show that the use of physics teaching materials based on Islamic values significantly improves students' scientific literacy skills, especially in the category of students who are active in learning (Halmuniati* et al., 2022). the effectiveness of a teaching material is determined using the N-gain score indicator, where a teaching material is said to be effective if the percentage is ≥ 56%.

Although some students have not achieved optimal results, overall, physics teaching materials based on Islamic values can be said to be effective in improving scientific literacy. The achievement of 67%

of students who reached the effective category is enough to show that an Islamic-based approach can motivate students, especially if they are actively involved in the learning process.

Based on the N-gain score data and the results of its analysis, it can be concluded that using physics teaching materials based on Islamic values effectively improves most students' scientific literacy skills. However, some are still not optimal, which is caused by the lack of active participation in the learning process and factors such as dependence on group friends. This shows that the effectiveness of teaching materials is not only determined by the quality of the material but also by the level of involvement and seriousness of students in learning (Asysyifa et al., 2017).

The statement above is also strengthened by the results of the effectiveness test analysis using the N-gain score test and supported by previous studies. In his research, Oktarisa, 2022) stated that one factor causing high school students not to optimally achieve physics learning outcomes is that the teaching materials are still less interactive. These non-interactive teaching materials are one of the causes of the low scientific literacy skills of high school students. The development of e-magazine teaching materials concludes that they are suitable for use as supporting teaching materials to improve scientific literacy skills.

CONCLUSION

The validation process results demonstrated that the teaching materials meet the criteria for validity, indicating their alignment with educational objectives and relevance to integrating Islamic values into physics education. The implementation in a limited trial with high school students and physics teachers in Bulukumba Regency revealed positive feedback, suggesting the practicality of these materials in fostering deeper understanding and meaningful learning experiences. The findings emphasize the importance of a holistic approach to physics education that builds students' intellectual competence and fosters moral and spiritual growth. By linking scientific concepts with Islamic teachings, these materials provide a contextual and culturally relevant framework for learning.

Future research should focus on broader trials to evaluate the effectiveness of these materials in different educational settings and their impact on long-term scientific literacy improvement. This study contributes to the literature on value-based science education and serves as a model for integrating local religious and cultural contexts into physics teaching.

AUTHOR CONTRIBUTIONS

NN conceptualized the research idea and research methods and analyzed the data. HA and PP guided the writing of the review, editing, supervision, and validation of the instruments used in the research.

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