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Developing Philosophy of Science Teaching Materials Based on OBE Principles to Support Higher-Order Thinking Skills through Islam–Science Integration

Amrullah, Muhammad Idris, Dete Konggoro, Erik Wiranata, Miryana Hastuti
Institut Agama Islam Negeri Curup, Indonesia

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Corresponding Author:
Amrullah, Institut Agama Islam Negeri Curup, Indonesia
amrullah@iaincurup.ac.id

ABSTRACT

The dichotomy between religious and scientific knowledge, along with the limited availability of outcome-oriented instructional resources, constrains the development of higher-order thinking skills (HOTS) among postgraduate students in Philosophy of Science. A need analysis showed that 84.40% of lecturers and 91.33% of students rated the existing materials as inappropriate. This study aimed to develop and evaluate Outcome-Based Education (OBE)-based instructional materials integrating Islamic and scientific perspectives to enhance students' HOTS. OBE aligns learning outcomes, activities, and assessment, while ontological, epistemological, and axiological reflection frames the Islam–science integration to develop HOTS. Using a Research and Development approach, the study employed the ADDIE model. Experts validated the materials for content, presentation, graphics, and language, while 17 postgraduate students in the Master's Program in Islamic Religious Education at IAIN Curup assessed their practicality and effectiveness using a one-group pretest–posttest design without a control group. The overall validity score was 88.76% of the ideal score (criterion: 80%); 61.85% of students rated the materials feasible and 38.15% highly feasible. HOTS scores increased from 67 on the pretest to 89 on the posttest, with an N-gain of 0.58, indicating a moderate gain; given the small sample and no comparison group, this suggests preliminary improvement only. Unlike earlier studies that examined OBE in Islamic education and HOTS separately, this study combines them into one measurable framework.

INTRODUCTION

In recent decades, the integration of Islam and science has emerged as a prominent global discourse in education, particularly within Islamic higher education institutions. Distinctive integration models have been developed by numerous Islamic educational institutions to harmonize the Qur'anic worldview with science and technology curricula. These initiatives are intended not only to enrich Islamic scholarship but also to reconstruct and reinterpret scientific paradigms to ensure their alignment with Islamic teachings (Mohammed et al., 2021). Within the Indonesian context, Islamic State Higher Education Institutions (PTKIN) have adopted diverse integration paradigms, including the *Wahdat al-ʿUlūm* model and the theo-anthropo-ecocentric approach, as strategic efforts to contextualize Islamic law while simultaneously integrating Islamic sciences

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with contemporary academic disciplines. For instance, the Unity of Sciences *(Waḥdat al-ʿUlūm*) paradigm at UIN Walisongo Semarang seeks the humanization of Islamic sciences and the spiritualization of modern sciences (Wijaya et al., 2021), whereas UIN North Sumatra applies the *Wahdatul ʿulum* concept in curriculum and learning-plan design, and UIN Syekh Ali Hasan Ahmad Addary Padangsidimpuan adopts a theo-anthropo-ecocentric paradigm (Halimah et al., 2023). Given that such paradigms are ultimately operationalized in the classroom through curricula and lesson plans, designing instructional materials that translate Islam–science integration into explicit learning outcomes and higher-order thinking skills (HOTS) becomes the primary focus of this study, which is framed within Outcome-Based Education (OBE).

The advancement of these integrative paradigms has been further strengthened by the expanding utilization of digital resources, including digital encyclopedias and technology-enhanced learning media, which have significantly improved the accessibility, attractiveness, and dissemination of integrated Islam–science knowledge to broader audiences, including non-Muslim communities (Amrullah et al., 2025). From a theological perspective, the Islam–science integration approach is grounded in the epistemological conviction that all knowledge ultimately originates from God and that scholarly inquiry constitutes an integral part of worship (Muslim et al., 2024). These developments matter for the present study because digital and technology-enhanced resources shape how integrated content is packaged and delivered as instructional materials. Concurrently, the conviction that knowledge originates from God provides the value orientation that the materials developed in this study translate into learning activities and assessment.

Several previous studies have reported that integrating Islamic values with scientific concepts through digital technologies and mobile learning platforms is associated with improved academic achievement, as well as with affective outcomes such as gratitude, ethical character, and the internalization of Islamic values among Muslim learners (Ardi et al., 2024; Fahyuni et al., 2020). These affective outcomes are not directly related to the HOTS focus of the present study, which more concentrates on the cognitive dimension of higher-order thinking; the cited evidence is therefore treated as contextual background rather than as direct support for HOTS development. Nevertheless, despite these encouraging outcomes, the implementation of Islam–science integration constantly encounters substantial structural, epistemological, and institutional challenges. Consequently, reforms in academic culture, reinforcement of intellectual authority, and sustained efforts to transcend the long-standing dichotomy between religious and secular sciences remain essential (Daulay et al., 2025; Toisuta et al., 2024).

Within the philosophy of science, overcoming the dichotomy of scientific knowledge and transcending disciplinary boundaries has been regarded as a fundamental prerequisite for developing comprehensive understanding and addressing increasingly complex problems (Hannon et al., 2018). Recognition of the importance of interdisciplinary and transdisciplinary approaches has been more pronounced, as scientific advancement increasingly relies on continuous and critical philosophical reflection (Sokolova, 2023). From an epistemological standpoint, scientific progress is conceived as a historical and dynamic process that rejects claims of static and absolute truth while emphasizing the continual evolution of scientific knowledge through dialogue, critical inquiry, and interdisciplinary integration (Fam et al., 2018). Accordingly, the philosophy of science promotes interdisciplinary collaboration as an essential means of addressing complex issues that cannot be adequately resolved within the boundaries of a single discipline (Wannenmacher, 2019). Such approach is increasingly relevant for responding to real-world challenges, including environmental and social issues, that

extend beyond the explanatory capacity of isolated disciplinary frameworks (Frodeman 2008). Therefore, interdisciplinary knowledge integration is expected not only to advance the theoretical development of the philosophy of science but also to generate practical contributions by fostering innovative solutions to the multifaceted challenges confronting contemporary society (Horlick-Jones & Sime, 2004; Shanableh et al., 2022).

One of the most tangible educational implications of this interdisciplinary perspective can be observed in the development of instructional materials (Lee, 2021). Well-designed instructional materials play a strategic role in enhancing learning by deepening students' conceptual understanding, increasing learning motivation, and promoting independent learning through contextualized, diverse, and learner-oriented content (Decuypere et al., 2021). Furthermore, high-quality instructional materials facilitate the effective integration of educational technologies, improve teachers' instructional efficiency, and contribute substantially to the overall quality of the teaching and learning process (Marin et al., 2021). Beyond supporting the achievement of intended learning outcomes, such materials cultivate learners' critical, adaptive, and responsive thinking in coping with the rapidly changing demands of contemporary society (Kassam et al., 2012). Within the context of the Philosophy of Science course, instructional materials represent an essential medium for fostering students' higher-order thinking skills because the learning content is designed not merely to be understood but also to be analyzed, critically evaluated, and deeply reflected to develop conceptual, argumentative, and problem-solving competencies for addressing complex scientific issues.

Although the discourse and practice of Islam–science integration have expanded considerably through the reinforcement of integrative paradigms in Islamic State Higher Education Institutions (PTKIN) and the growing use of digital resources that have been reported to improve both learning outcomes and character development, studies that critically situate this integration within the framework of interdisciplinary philosophy of science remain relatively limited (Van Lambalgen & Van Der Tuin, 2024). Existing research has predominantly emphasized pedagogical implementation and instructional practices (Eden, 2010), whereas the epistemological foundations, the historical dynamics of scientific knowledge, and systematic efforts to transcend the religion–science dichotomy have not yet been comprehensively examined (Ijatuyi et al., 2025). In the face of persistent structural, epistemological, and institutional challenges, the integration of Islam and science requires more rigorous philosophical reflection and interdisciplinary engagement to ensure that it extends beyond normative or symbolic formulations.

Accordingly, scholarly investigations that examine Islam–science integration from the perspective of interdisciplinary philosophy of science have been increasingly significant, not only for strengthening its theoretical and epistemological foundations but also for advancing a more adaptive, dialogical, and relevant scientific framework capable of addressing the complex challenges of contemporary society.

A number of previous relevant studies to the present research have generated important findings that enrich the discourse on contemporary Islamic education. Research examining the implementation of Outcome-Based Education (OBE) within the Islamic Religious Education (IRE) curriculum has demonstrated that an OBE-oriented curriculum emphasizes the achievement of Specific Learning Outcomes through instructional strategies centered on case-based learning and project-based learning. An evaluation of its implementation using the Provus Discrepancy Evaluation Model revealed several discrepancies between curriculum planning standards and their implementation in educational practice. These outcomes highlight the necessity of designing IRE curricula that are contextual, adaptive, and responsive to the demands of twenty-first-century

education. Concurrently, it is essential to enhance teachers' proficiency through ongoing training in outcomes-based pedagogical methods and syllabus redesign to meet shifting professional standards (Ellson et al., 2023).

Corresponding to these findings, research investigating the development of Higher-Order Thinking Skills (HOTS) through the integration of Islamic education and science has demonstrated that combining scientific perspectives with Islamic values facilitates comprehensive understanding while promoting advanced cognitive abilities, including analysis, evaluation, and design. This integration has been systematically implemented through curriculum development, syllabus design, interdisciplinary team teaching, collaborative assignments, and joint scientific writing. The integrative approach has not only expanded students' learning experiences but also strengthened their conceptual comprehension of the compatibility between scientific knowledge and religious values within the framework of Islamic education (Saparudin & Hidayati, 2023).

Notwithstanding the expanding scholarship concerning the application of Outcome-Based Education in IRE curricula, as well as the enhancement of Higher-Order Thinking Skills through the integration of Islamic education and science, the strands of this research have largely evolved independently. To date, comprehensive studies that have integrated the OBE approach with HOTS development based on Islam–science integration into a single, systematic, and measurable instructional framework remain scarce. This study therefore seeks to address this research gap by developing and evaluating an instructional material model that systematically integrates Outcome-Based Education, Higher-Order Thinking Skills, and Islam–science values to meet the evolving demands of Islamic education in the twenty-first century.

The present study is necessary because the development of instructional materials for the Philosophy of Science course has not yet optimally integrated the Outcome-Based Education (OBE) approach with the enhancement of Higher-Order Thinking Skills (HOTS) and the integration of Islamic and scientific values within a framework of measurable learning outcomes. The absence of systematically designed and contextually relevant instructional materials may hinder students' readiness to meet both the academic demands of higher education and the professional challenges of the twenty-first century. Consequently, there is a pressing need to develop innovative instructional materials that are adaptive, integrative, and explicitly oriented toward learning outcomes.

The novelty of this study lies in the systematic development of Outcome-Based Education-based instructional materials for the Philosophy of Science course that comprehensively integrate Islamic values, scientific knowledge, and the enhancement of Higher-Order Thinking Skills within a unified framework of measurable learning outcomes. Unlike previous studies, which have generally examined these dimensions independently, the proposed approach offers a contextualized instructional design that simultaneously aligns learning outcomes, interdisciplinary knowledge integration, and higher-order cognitive development. As such, the proposed model extends beyond the fragmented perspectives of earlier research by providing a more holistic instructional framework that responds to the evolving demands of twenty-first-century Islamic higher education.

Based on these considerations, this study aims to develop and evaluate Outcome-Based Education-based instructional materials that integrate Islamic and scientific perspectives to enhance the Higher-Order Thinking Skills (HOTS) of postgraduate students enrolled in the Philosophy of Science course at IAIN Curup.

The conceptual framework of this study is grounded in the alignment of learning outcomes, instructional activities, and assessment, which constitutes a central principle

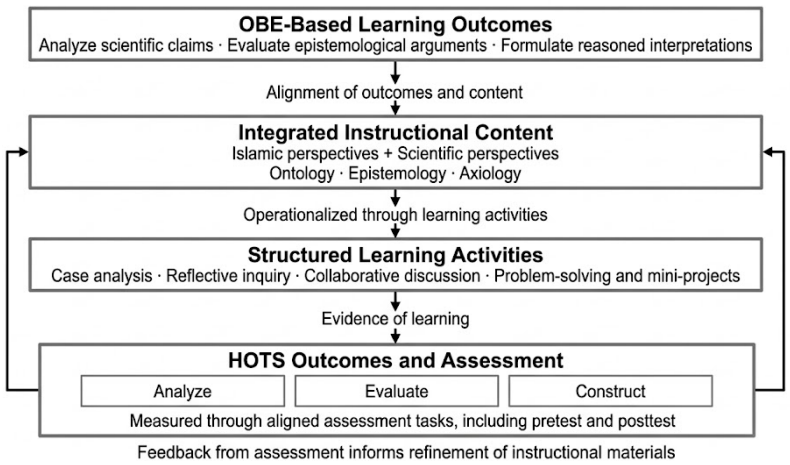
of Outcome-Based Education (OBE). In OBE, instructional materials should be designed backward from the student competencies that are expected to demonstrate rather than organized solely around the coverage of subject matter (Spady, 1994). In the Philosophy of Science course, this principle requires learning outcomes that extend beyond the recall of philosophical concepts to include the ability to analyze scientific claims, evaluate the epistemological foundations of knowledge, and formulate reasoned arguments concerning the relationship between Islamic perspectives and scientific inquiry. Accordingly, the instructional materials developed in this study interpret the intended learning outcomes into structured learning activities and corresponding assessment tasks.

The integration of Islamic and scientific perspectives provides the epistemological orientation of the instructional content. Rather than presenting religious and scientific knowledge as separate bodies of information, the materials encourage students to examine their assumptions, sources of justification, methods of inquiry, and ethical implications through philosophical reflection. The dimensions of ontology, epistemology, and axiology provide an organizing structure for this examination. These dimensions are operationalized through case analysis, reflective inquiry, collaborative discussion, and problem-solving activities, consistent with the instructional design described in this study. Such activities enable students to relate philosophical concepts to contemporary scientific and educational issues while critically considering the contributions and limitations of different perspectives.

The development of higher-order thinking skills (HOTS) constitutes the intended cognitive outcome of this instructional framework. Specifically, students are expected to demonstrate analytical skills by identifying assumptions and examining relationships between Islamic and scientific perspectives; evaluative skills by assessing arguments, evidence, and the epistemological justification of claims; and creative or constructive thinking by formulating coherent arguments, proposing solutions, or developing reasoned interpretations of contemporary issues. These indicators guide the selection of learning activities and the design of assessment tasks. The resulting alignment among OBE-based learning outcomes, Islam–science integration, learning activities, and HOTS assessment provides the conceptual basis for developing and evaluating the instructional materials in this study.

Figure 1

Operational Conceptual Framework for OBE-Based Teaching Materials Integrating Islamic and Scientific Perspectives in Philosophy of Science



METHOD

This study adopted a Research and Development (R&D) approach to develop instructional materials for the Philosophy of Science course based on Outcome-Based Education (OBE) and the integration of Islam and science with the aim of enhancing the Higher-Order Thinking Skills (HOTS) of postgraduate students at IAIN Curup. The instructional materials were developed using the ADDIE model, which comprises five sequential phases: Analysis, Design, Development, Implementation, and Evaluation. Owing to its systematic, adaptive, and learner-centered characteristics, the ADDIE framework was employed to facilitate the development of instructional products grounded in users' needs and continuous evaluation (Molenda, 2003). Furthermore, its iterative design enables formative revisions throughout the development process, thereby ensuring that the resulting instructional materials achieve acceptable levels of validity, practicality, and effectiveness.

The study was conducted in the Graduate Program of the State Islamic Institute (IAIN) Curup, specifically in the Philosophy of Science course offered by the Master's Program in Islamic Religious Education (PAI). This setting was intentionally selected because of the growing need to strengthen learning through the integration of Islamic and scientific knowledge. A preliminary need analysis revealed that the existing instructional materials remained predominantly theoretical and had not adequately incorporated the principles of Outcome-Based Education, the Islam–science integration perspective, or the systematic development of students' Higher-Order Thinking Skills. These findings highlighted the relevance of the research context and underscored the necessity of developing instructional materials that are more reflective, critical, and integrative.

The study participants comprised of two groups: expert validators and end users. The expert panel consisted of academics specializing in the Philosophy of Science, Islamic education, educational technology, and curriculum development, all of whom were responsible for evaluating the validity of the developed instructional materials. The end-user group included postgraduate students enrolled in the Master's Program in Islamic Religious Education (PAI) who were taking the Philosophy of Science course. Their evaluations focused on the practicality, readability, attractiveness, and perceived contribution of the instructional materials to the enhancement of their Higher-Order Thinking Skills (HOTS). A total sampling technique was employed because all students enrolled in the course participated directly in the implementation and evaluation of the developed instructional materials.

The research procedure followed the ADDIE instructional design model, which comprises five sequential phases: Analysis, Design, Development, Implementation, and Evaluation. During the Analysis phase, a comprehensive need assessment was conducted to identify learning requirements, students' characteristics, and instructional gaps through curriculum review, course syllabus (Semester Learning Plan), instructional material analysis, interviews, and questionnaires. The findings confirmed the need for instructional materials that systematically integrate the philosophy of science, Outcome-Based Education (OBE), Islam–science perspectives, and the development of Higher-Order Thinking Skills (HOTS).

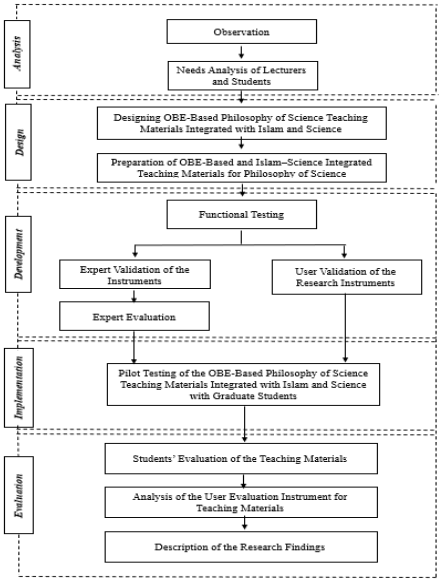
The Design phase focused on developing the instructional blueprint based on OBE principles, including the formulation of learning outcomes, HOTS indicators, content organization, learning activities, and assessment strategies. The instructional content was designed by integrating the philosophical dimensions of ontology, epistemology, and axiology within the Islam–science perspective, while adopting a constructivist learning approach that emphasizes case analysis, reflective inquiry, collaborative discussion, and

problem-solving activities. The developed instructional materials were evaluated by four expert validators specializing in content, instructional presentation, graphic design, and language. Each validator assessed the materials within their respective area of expertise using a five-point Likert scale, and the resulting scores were converted into percentages of the ideal score. The materials were considered feasible when the score reached at least 80% of the ideal score. The implementation involved 17 postgraduate students enrolled in the Master's Program in Islamic Religious Education at IAIN Curup, Indonesia. The participants were involved in evaluating the practicality of the materials and completing the HOTS assessment.

During the Development phase, the instructional materials were produced and subsequently validated by experts in the philosophy of science, Islamic education, and instructional design. The validation process evaluated several dimensions, including content relevance, the integration of Islam and science, alignment with OBE principles, linguistic quality, and graphical design. A five-point Likert scale was employed for the validation, with instructional materials considered feasible when they achieved a minimum score equivalent to 80% of the ideal score.

The Implementation phase involved pilot testing the developed instructional materials in the Philosophy of Science course to examine their practicality and effectiveness. Empirical data were collected through classroom observations and student response questionnaires, whereas improvements in students' Higher-Order Thinking Skills (HOTS) were measured by comparing pretest and posttest performance. Finally, the Evaluation phase consisted of both formative and summative evaluations. Formative evaluation was undertaken throughout each stage of the development process to facilitate continuous refinement of the instructional materials, whereas summative evaluation was conducted following implementation to determine the overall effectiveness of the final product. The improvement in students' Higher-Order Thinking Skills was analyzed using the normalized gain score (N-gain) (Hake 1998), which was interpreted according to three categories: high ($g \geq 0.70$), moderate ($0.30 \leq g < 0.70$), and low ($g < 0.30$).

Figure 2
Research Stages Following the ADDIE Development Model: Data Analysis



The research data were analyzed using a combination of quantitative and qualitative approaches. Quantitative data, including expert validation scores, student response ratings, and Higher-Order Thinking Skills (HOTS) test results, were subjected to descriptive statistical analysis to determine the validity, practicality, and effectiveness of the developed instructional materials. In contrast, qualitative data obtained from interviews, classroom observations, and evaluation notes were analyzed through a systematic process involving data reduction, categorization, interpretation, and conclusion drawing. To enhance the trustworthiness of the findings, methodological triangulation was employed by comparing evidence derived from multiple data sources and collection techniques.

Quantitative data were analyzed descriptively to determine the validity, practicality, and effectiveness of the learning materials. Expert validation scores were summarized based on assessment dimensions, while student response data were used to describe perceptions regarding the materials' practicality. Changes in students' Higher-Order Thinking Skills (HOTS) were examined by comparing the average pretest score of 67 with the average posttest score of 89; the obtained N-gain value of 0.58 falls into the moderate category. The procedures for administering the pretest and posttest—including timing, test format, and the assessment process—require clarification to accurately reflect actual implementation. Qualitative data from interviews, open-ended responses, and evaluation notes underwent reduction, categorization, and interpretation to complement the quantitative findings and serve as a basis for refining the learning materials. Given the limited sample size and the absence of a reported comparison group, these findings are interpreted as evidence of improvement within the specific research context rather than as definitive proof of causal effectiveness.

The success of the study was determined based on three principal indicators: validity, practicality, and effectiveness. The instructional materials were considered valid when they achieved a minimum score of 80% of the ideal score according to expert evaluations. In reporting the results, the mean percentage score of each aspect and of the overall validation was compared with this 80% threshold; all aspects exceeded it and are labelled “Highly Feasible” in Table 1. Practicality was established through positive responses from both lecturers and students, indicating that the instructional materials were easy to use, contextually relevant, and supportive of the teaching and learning process. Meanwhile, effectiveness was assessed by measuring the improvement in students' Higher-Order Thinking Skills (HOTS) following the implementation of the instructional materials developed on the basis of Outcome-Based Education (OBE) and the integration of Islam and science.

All stages of the research were conducted in accordance with established principles of academic research ethics. Participation by lecturers and students was entirely voluntary and was secured through informed consent. Furthermore, the confidentiality of all collected data was strictly maintained, and the information was used exclusively for scholarly purposes and the improvement of educational quality. By adopting an ADDIE-based Research and Development (R&D) approach, this study is expected to produce Philosophy of Science instructional materials that are not only academically valid but also capable of supporting integrative learning practices that strengthen students' Higher-Order Thinking Skills within the context of twenty-first-century Islamic higher education.

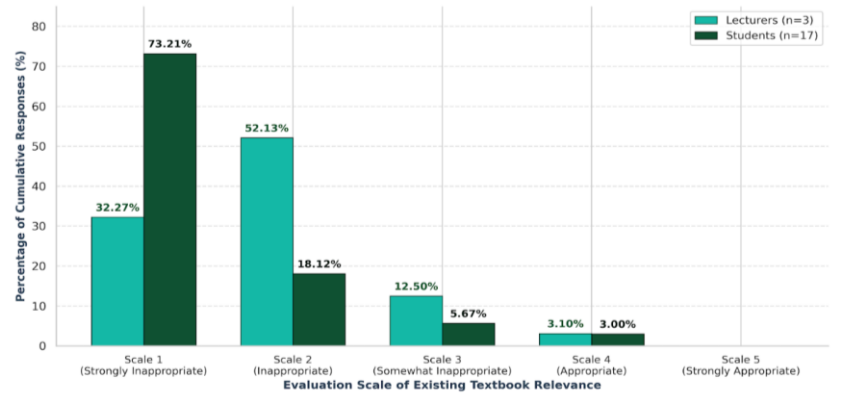
RESULT AND DISCUSSION

Needs Analysis of Lecturers and Students

The need analysis revealed that the Philosophy of Science instructional materials used prior to this study had not adequately addressed the learning requirements of postgraduate education. Questionnaire data collected from the three course lecturers indicated that 32.27% of the responses classified the existing instructional materials as "highly inappropriate," 52.13% as "inappropriate," 12.50% as "less appropriate," and only 3.10% as "appropriate." None of the respondents rated the materials as "highly appropriate." Collectively, these findings demonstrate that 84.40% of the lecturers considered the existing instructional materials to be insufficiently aligned with the instructional demands of postgraduate learning, particularly those requiring advanced philosophical analysis.

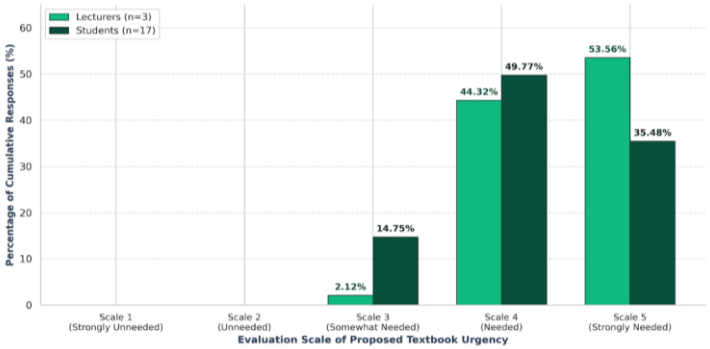
A comparable pattern emerged from the questionnaire administered to 17 postgraduate students. The findings showed that 73.21% of the students perceived the existing instructional materials as "highly inappropriate," 18.12% as "inappropriate," 5.67% as "less appropriate," and only 3.00% regarded them as "appropriate." These results indicate that the previously adopted instructional materials lacked contextual relevance and were not sufficiently designed to foster students' analytical thinking skills effectively.

Figure 3
Lecturers' and Students' Perceptions of the Teaching Materials Currently in Use



Conversely, the need assessment for the development of Outcome-Based Education (OBE)-based Philosophy of Science instructional materials integrated with Islam and science demonstrated an exceptionally high level of demand among both lecturers and students. Among the lecturer respondents, 53.56% indicated that such instructional materials were "highly needed," 44.32% rated them as "needed," and only 2.12% considered them "less needed." These responses yielded an overall demand level of 97.88%, reflecting a very high level of need. Similarly, the student responses revealed substantial support for the proposed instructional materials, with 35.48% categorizing them as "highly needed," 49.77% as "needed," and 14.75% as "less needed." Notably, none of the respondents indicated that the materials were "not needed." The overall level of student demand reached 83.25%, which falls within the high category.

Figure 4
Results of the Lecturer and Student Needs Assessment for the OBE-Based Philosophy of Science Teaching Material Integrated with Islamic and Scientific Perspectives.



Overall, both groups of respondents expressed a strong consensus regarding the necessity of developing new instructional materials that extend beyond the presentation of philosophical concepts from a purely theoretical perspective. Instead, the proposed materials systematically incorporate scientific and technological perspectives while reinforcing Islamic values as the ethical foundation of scientific inquiry and learning.

Expert Validation of the Instructional Materials

Following the completion of the design and development phases, the prototype of the instructional materials was subjected to expert validation by a panel of four specialists: (1) a content expert, (2) a presentation expert, (3) a graphic design expert, and (4) a language expert. The validation process assessed multiple dimensions, including content relevance, the organization and systematic presentation of the materials, conceptual accuracy, the integration of Islamic and scientific perspectives, and linguistic clarity. The expert evaluation demonstrated that the developed instructional materials achieved a very high level of feasibility across all assessed dimensions. The mean scores obtained for each validation aspect are presented in Table 1.

Table 1
Summary of the Validation Results for the OBE-Based Philosophy of Science Teaching Material Integrated with Islamic and Scientific Perspectives

No.	Assessment Aspect	Mean Score	Category
1	Content/Material Feasibility	90.20	Highly Feasible
2	Presentation Feasibility	87.10	Highly Feasible
3	Graphical Design Feasibility	88.30	Highly Feasible
4	Language Feasibility	88.24	Highly Feasible
Overall Mean		88.76	Highly Feasible

Source: Expert validation data (processed by the authors, 2026).

The expert validation results indicated that the developed instructional materials satisfied the established standards of academic feasibility across the dimensions of content quality, instructional organization, learning design, and language use. Although several recommendations were provided by the expert reviewers, these were limited to minor revisions, primarily involving editorial refinements and the inclusion of more contextually relevant illustrations to strengthen students' conceptual understanding. No major revisions were recommended by any of the validators, indicating that the

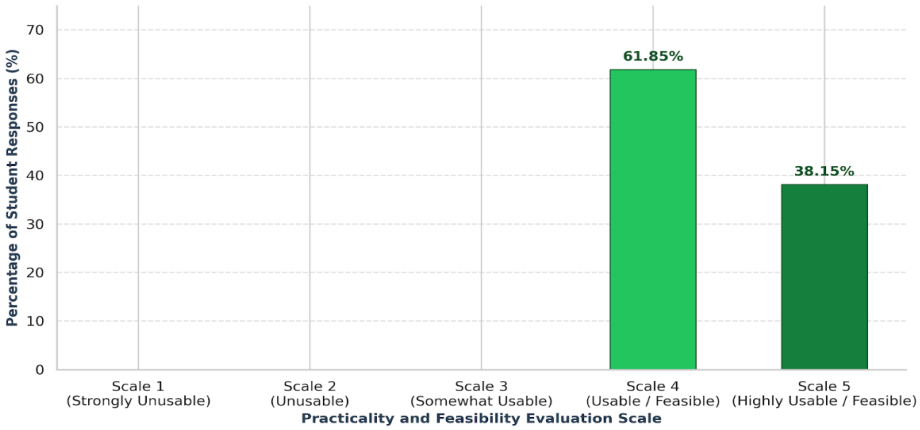
instructional materials met the required quality standards and were therefore deemed suitable for progression to the implementation phase.

Results of the Practicality and User Feasibility Evaluation

During the implementation phase, the developed instructional materials were pilot-tested with 17 postgraduate students enrolled in the Philosophy of Science course. The findings from the user response questionnaire demonstrated a highly positive evaluation of the instructional materials. Specifically, 61.85% of the students rated the materials as "feasible," while the remaining 38.15% assessed them as "highly feasible." Consequently, 100% of the participating students considered the instructional materials to be either feasible or highly feasible for use in the teaching and learning process, indicating an excellent level of user acceptance and practicality.

Figure 5

Feasibility of the OBE-Based Philosophy of Science Teaching Material Integrated with Islamic and Scientific Perspectives for Enhancing Students' HOTS



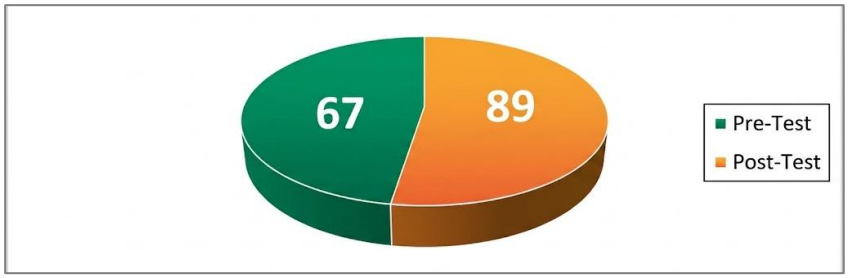
Qualitative feedback obtained from the students further confirmed three major strengths of the developed instructional materials. First, the materials effectively synchronized Islamic values with contemporary scientific discourse. Second, they promoted critical discussion through reflective learning activities. Third, they provided structured mini-project guidelines that contextualized philosophical concepts within the domains of modern technology and education. These findings were corroborated by the course lecturer, who reported that the instructional materials enhanced the organization and coherence of the teaching process by providing a more structured and systematic instructional framework. Collectively, these indicators demonstrate that the developed instructional materials achieved a high level of practicality from the perspectives of both students and instructors.

Results of the Instructional Materials Effectiveness Evaluation

The effectiveness of the developed instructional materials was evaluated by comparing students' Higher-Order Thinking Skills (HOTS) before and after their implementation. Students achieved a mean pretest score of 67, which increased to a mean posttest score of 89 following the use of the instructional materials. To determine the magnitude of learning improvement, the normalized gain (N-gain) was calculated using the formula proposed by (Hake, 1998). The analysis yielded an N-gain value of 0.58, indicating a moderate level of improvement in students' Higher-Order Thinking Skills.

A visual representation of the improvement in students' analytical thinking performance is presented in Figure 5.

Figure 6
Improvement in Students' Higher-Order Thinking Skills (HOTS)



Mean N-gain score = 0.58 (moderate category)
Source: Results of the teaching material effectiveness evaluation (processed by the authors, 2025)

These findings indicate that the implementation of the Outcome-Based Education (OBE)-based Philosophy of Science instructional materials integrated with Islam and science substantially enhanced students' Higher-Order Thinking Skills (HOTS). The improvement was reflected in their increased ability to comprehend fundamental concepts in the philosophy of science, critically examine the relationship between Islamic values and scientific knowledge, and construct coherent, evidence-based arguments during classroom discussions.

Overall, the developed instructional materials successfully fulfilled the three principal quality indicators established in this study—validity, practicality, and effectiveness. The expert validation confirmed that the materials met rigorous academic standards, the implementation results demonstrated a high level of practicality from both student and instructor perspectives, and the effectiveness evaluation verified their capacity to improve students' Higher-Order Thinking Skills. These findings suggest that the instructional materials constitute a feasible, practical, and effective learning resource for supporting Philosophy of Science instruction in postgraduate Islamic higher education.

The development of Outcome-Based Education (OBE)-based Philosophy of Science instructional materials integrated with Islam and science was motivated by the urgent need to transform the cognitive orientation of postgraduate students. Empirical evidence revealed that 84.40% of lecturers and 91.33% of students considered the existing instructional materials to be no longer relevant, as they primarily emphasized the memorization of historical perspectives and were insufficient in fostering Higher-Order Thinking Skills (HOTS). Conversely, both groups expressed a strong demand for the reconstruction of instructional materials, with 97.88% of lecturers and 83.25% of students supporting the development of learning resources that integrate science, technology, and the prophetic values of Islam as the ethical foundation of scientific inquiry. From a theoretical perspective, instructional materials should be systematically designed based on learners' characteristics while fulfilling the principles of validity and practicality to establish an effective learning environment. The need for instructional reconstruction is consistent with previous studies conducted by Gusti Ayu Dewi et al. (2025); Miratul and Sisca Nurul (2025); Ramadhani (2026) which argue that postgraduate instructional materials entail substantially greater conceptual complexity than those developed for lower educational levels and therefore require an epistemological integration of revelation and reason to prevent scientific disorientation.

The development process was subsequently followed by expert validation involving four specialists in content, instructional presentation, graphic design, and language. The evaluation demonstrated that the developed instructional materials achieved the

qualification of "Highly Feasible", with an overall mean score of 88.76. Among the assessed dimensions, content feasibility obtained the highest score (90.20), whereas instructional presentation received the lowest (87.10). This variation reflects the inherent challenge of aligning the structured nature of the OBE curriculum—which follows a design-down approach emphasizing measurable learning performance—with the dynamic characteristics of Islam–science integration, which require greater opportunities for theological and philosophical exploration. Nevertheless, the absence of any recommendation for major revision indicates that the instructional materials were sufficiently robust for implementation. These findings are consistent with those of Gusti Ayu Dewi et al. (2025) who reported the effectiveness of the Content Validity Ratio (CVR > 0) in validating OBE-based instructional materials, while also reinforcing the conclusions of Miratul and Sisca Nurul (2025) who demonstrated that rigorous expert validation ensures the academic quality of instructional materials grounded in Islamic values devoid of compromising their epistemological, ontological, and axiological foundations.

The practicality findings suggest that the instructional materials were positively received because they connected abstract concepts in the Philosophy of Science with structured and contextualized learning experiences. The reflective activities encouraged students to examine assumptions and reconsider the relationship between philosophical concepts, scientific developments, and Islamic perspectives, while the mini-project guidelines provided a more concrete pathway for applying these ideas to educational and technological issues. These features may have helped students engage with complex concepts more actively rather than relying primarily on lecturer explanations. From an Outcome-Based Education (OBE) perspective, the alignment between learning outcomes, learning activities, and expected student performance also made the learning process more structured and purposeful. This interpretation is consistent with the emphasis on outcome-oriented curriculum design discussed by Spady (1994) and with previous findings cited in this study concerning active learning and student engagement (Jayarekha and Jayarekha and Dakshayini (2014). Nevertheless, the 100% positive evaluation should be interpreted specifically as evidence of perceived practicality among the 17 participating students, since all rated the materials as either feasible (61.85%) or highly feasible (38.15%); it does not, by itself, establish their effectiveness across other student populations.

The increase in the mean HOTS score from 67 on the pretest to 89 on the posttest, with an N-gain of 0.58, indicates a moderate improvement following the implementation of the instructional materials. This improvement may be understood in relation to the interaction of three instructional features. First, the OBE framework provides alignment between intended learning outcomes, learning activities, and assessment, thereby directing students toward the cognitive performances expected from the course rather than knowledge recall alone. Second, the reflective tasks and mini-projects create opportunities for students to analyze philosophical problems, consider alternative explanations, and formulate reasoned responses to contemporary issues in education and science. Third, the integration of Islamic and scientific perspectives presents students with an epistemological task: examining how knowledge derived from revelation and empirical inquiry can be discussed in relation to one another without reducing either perspective to a simplistic comparison. Collectively, these features may provide meaningful opportunities to practice higher-order thinking. This interpretation corresponds with the studies cited in this research: Ramadhani (2026) on HOTS-oriented instructional materials, Irvani et al. (2024) and Mohanta and das Mandal (2019) on OBE

and self-directed learning, and Fajar et al. (2025) on active learning and problem-solving. The present findings extend this discussion by illustrating how outcome alignment, reflective learning, mini-projects, and Islam–science integration can be combined within Philosophy of Science instruction at the postgraduate level.

The moderate N-gain also indicates that improvement was meaningful but not complete. Integrating Islamic perspectives with empirical scientific reasoning involves more than understanding individual concepts; it requires students to compare different forms of justification, evaluate arguments, and develop coherent positions on complex philosophical issues. Such intellectual work may require sustained practice beyond a single implementation period. However, the present study did not directly measure which specific instructional component contributed most to the observed improvement, nor did it include a comparison group to isolate the effect of the developed materials from other possible influences. Therefore, the increase in HOTS scores should be interpreted as an improvement observed after implementation, rather than conclusive evidence that the instructional materials alone caused the change. Future studies could examine students' project outputs and reasoning processes in greater depth and compare the materials with alternative instructional approaches to clarify how each design feature contributes to HOTS development.

Limitations of the Study

Although this study makes a meaningful contribution to the development of Outcome-Based Education (OBE)-based Islam–science integrated instructional materials, several limitations should be acknowledged. First, the field implementation was conducted on a limited scale, involving only 17 postgraduate students from a single higher education institution. Consequently, the generalizability of the findings to broader and more diverse educational contexts remains limited and warrants further empirical verification. Second, the N-gain score of 0.58, categorized as moderate, suggests that students continued to encounter metacognitive challenges in synthesizing knowledge derived from Islamic revelation with empirical scientific evidence. However, these cognitive processes were not examined in depth through post-intervention qualitative analyses. Furthermore, while this study primarily emphasized the development of instructional content and the establishment of its substantive validity, it did not investigate students' long-term knowledge retention or evaluate the sustained impact of the proposed mini-projects on students' scholarly outputs, such as academic publications. These limitations provide valuable directions for future research, particularly by expanding field implementation across multiple universities and adopting mixed-methods approaches to obtain a more comprehensive understanding of students' cognitive adaptation throughout the process of integrating Islamic and scientific knowledge.

CONCLUSION

This study developed Outcome-Based Education (OBE)-based instructional materials for Philosophy of Science that integrate Islamic and scientific perspectives for postgraduate students. The materials received a mean expert validation score of 88.76, indicating a high level of feasibility. The practicality evaluation also showed that all participating students (100%) rated the materials as either feasible or highly feasible. Regarding HOTS, the mean score increased from 67 on the pretest to 89 on the posttest, with an N-gain of 0.58, which falls within the moderate category. These findings provide preliminary evidence of the potential effectiveness of the developed materials in supporting students' higher-order thinking within the context of Philosophy of Science

learning. The integration of OBE principles, reflective activities, and contextualized mini-projects offers a structured approach to connecting Islamic perspectives with scientific discourse and engaging students in the analysis of philosophical and contemporary issues. However, given the limited number of participants, the implementation at a single institution, the absence of a comparison group, and the lack of long-term evaluation and in-depth analysis of students' cognitive processes, the findings should be interpreted with caution. Further research involving larger and more diverse samples, comparative designs, and longitudinal and qualitative investigations is necessary to examine the sustainability of learning gains and to better understand how these instructional features support HOTS development. Thus, the developed materials represent a promising instructional resource for postgraduate Islamic higher education, although their effectiveness and broader applicability require further empirical investigation.

DECLARATION OF AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During manuscript preparation, the author used ChatGPT to assist with translation and Grammarly to refine the language. All outputs from these tools were critically reviewed to ensure semantic accuracy, terminological consistency, and appropriateness for the academic context. The author takes full responsibility for the accuracy, originality, and scholarly integrity of the published manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Author 1: Responsible for the conceptualization of the study, methodology development, data collection and analysis, and preparation of the original draft.
Author 2: Contributed to the development of the theoretical framework, data analysis, and interpretation of the research findings.
Author 3: Contributed to research supervision, validation of the findings, and refinement of the manuscript's scholarly content.
Author 4: Contributed to the critical review and editing of the manuscript to improve its clarity, coherence, and academic quality.
Author 5: Contributed to the review and editing of the manuscript, including language refinement and suggestions for improving the overall presentation of the article.

AUTHOR BIOGRAPHY

Author 1: The author is an academic in Islamic Education at Institut Agama Islam Negeri (IAIN) Curup, Indonesia. Their research interests include the Philosophy of Islamic Education, Philosophy of Science, instructional material development, and educational evaluation.

Author 2: The author is an academic at Institut Agama Islam Negeri (IAIN) Curup, Indonesia. Their research focuses on Islamic education curriculum and instructional material development.
Author 3: The author is a researcher and academic at Institut Agama Islam Negeri (IAIN) Curup, Indonesia. Their research interests include Islamic broadcasting and Islamic preaching (da'wah).
Author 4: The author is a postgraduate student in the Islamic Religious Education Study Program at Institut Agama Islam Negeri (IAIN) Curup, Indonesia.
Author 5: The author is a postgraduate student in the Islamic Religious Education Study Program at Institut Agama Islam Negeri (IAIN) Curup, Indonesia

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