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From Practice to Framework: Integrating Islamic Religious Education and Science in an Indonesian Islamic Elementary School

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Abstract

This study aimed to construct an integrated Islamic Religious Education (PAI) and Science learning model at MI Muhammadiyah Sains Qur'an (MIM SAINSQU) Balong, Indonesia. A qualitative case study design was employed to explore existing integration practices and the institutional and pedagogical foundations underlying the development of the model. Participants were purposively selected and included the school principal, curriculum coordinator, PAI teachers, classroom or Science teachers, and selected students who were involved in or experienced the integrated learning process. Data were collected through semi-structured interviews, classroom observations, and analysis of curriculum and instructional documents. The data were analyzed thematically through familiarization, coding, categorization, theme development, and interpretation, followed by synthesis of the findings into the structure of the proposed model. The findings indicate that PAI–Science integration at MIM SAINSQU Balong is organized around Qur'an-oriented contextualization, scientific inquiry, Islamic values, environmental learning, active student participation, teacher facilitation, contextual learning resources, and cognitive-affective assessment. These findings informed the construction of an integrated PAI–Science learning model that organizes the relationship between Islamic values and scientific learning within the school's specific educational context. The study's qualitative contribution lies in translating existing institutional practices into a coherent, context-bound learning framework. The proposed model has not yet been tested for feasibility, validity, or effectiveness and therefore requires subsequent empirical validation and classroom trials.

Keywords: Integrated Learning; Islamic Religious Education; Science Education; Qur'anic Values; Islamic Elementary School.

Introduction

Developments in primary education increasingly demand learning approaches that connect scientific knowledge with moral, spiritual, and social dimensions. Within Islamic education, the integration of Islamic Religious Education (Islamic Religious Education/PAI) and science has emerged as an important response to the separation of religious and scientific knowledge. Such integration enables students to encounter scientific phenomena not only through empirical inquiry but also through ethical and spiritual perspectives rooted in Islamic teachings (Ainnin & Ismail, 2024). At the primary level, this orientation is particularly relevant because students are developing foundational understandings of the relationships between knowledge, values, and everyday life. From a broader

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interdisciplinary perspective, integration therefore involves more than placing religious content alongside science; it requires meaningful relationships among knowledge, values, learning experiences, and students' contexts (Ismail, 2024b).

International scholarship on religion–science integration has increasingly emphasized the potential of connecting scientific inquiry with students' spiritual and ethical development. Efendi et al. (2025), for example, show that connecting the nature of science with religious perspectives can support students' religious understanding alongside scientific learning. Similarly, Samsuriadi and Suardi (2025) argue that the incorporation of religious values into elementary science learning can contribute to both scientific understanding and spiritual and moral awareness. These studies suggest that science learning and religious development need not be positioned as separate educational domains. However, the broader literature also indicates that meaningful integration requires attention to the pedagogical relationships through which knowledge, inquiry, values, and reflection are connected rather than simply placing religious references within science instruction.

In the Indonesian context, research has examined several forms of Islamic–science integration in elementary education. Rokhman and Amami (2021) found that PAI and science integration can be developed through systematic planning, thematic learning activities, student exploration, and evaluation. Basori et al. (2025) developed Islamic-based thematic teaching materials that connected science with Islamic perspectives and reported evidence concerning their validity and practicality. Other Indonesian studies have explored curriculum organization, competency mapping, Islamic-based learning materials, and the incorporation of Qur'anic references into science instruction (Purwati et al., 2023). More recent work has also proposed interdisciplinary, thematic-integrative, Islamic-scientific, and STEAM-oriented approaches for connecting scientific concepts with Islamic values. Collectively, these studies demonstrate that Islamic–science integration has been explored at the curricular, material, and instructional levels within Indonesian Islamic education.

Despite these contributions, an important conceptual and pedagogical gap remains. Existing studies tend to examine particular dimensions of integration rather than explain how the different dimensions can be synthesized into a coherent framework derived from actual school practices. Challenges concerning differences in disciplinary perspectives, teacher competence, learning resources, and the availability of implementation guidance have also been identified. The issue, therefore, is not simply whether Islamic values can be incorporated into science learning, but how scientific inquiry, Islamic values, learning objectives, classroom activities, teacher facilitation, student participation, learning resources, and assessment can be meaningfully organized within a particular educational context. Without such coherence, integration may depend heavily on individual teachers' interpretations and may vary across learning topics and classroom practices.

This gap is especially relevant to Islamic elementary schools whose institutional identity explicitly connects Qur'anic education and scientific learning. Although Indonesian scholarship has established the potential of Islamic–science integration, limited qualitative attention has been given to reconstructing an integrated framework from the actual institutional and pedagogical practices of a Qur'an- and Science-oriented Islamic elementary school. Existing research provides valuable evidence about curriculum integration, instructional strategies, teaching materials, and the relationship between Islam and science, but less is known about how these dimensions are collectively organized within the lived educational practices of a specific Islamic elementary-school context. Addressing this gap requires a qualitative examination of how integration is understood, enacted, and organized by school leaders, teachers, and students.

Against this background, this study focuses on MI Muhammadiyah Sains Qur'an (MIM SAINSQU) Balong, an Islamic elementary school in Indonesia in which Qur'anic education and scientific learning constitute important elements of its educational orientation. The study does not seek to establish the

effectiveness of a predetermined instructional model. Rather, it explores existing institutional and classroom practices and uses these empirical findings to construct a context-bound framework for PAI–Science integration. The framework is consequently understood as a qualitative synthesis of practices identified in the research setting, rather than as a universally applicable or empirically validated instructional model.

Accordingly, this study aims to examine how Islamic Religious Education and Science are integrated within the institutional and pedagogical practices of MIM SAINSQU Balong and to construct a context-bound framework based on those practices. The contribution of the study lies in translating empirically identified practices into a coherent framework that clarifies the relationships among Islamic values, scientific learning, contextual experiences, pedagogical processes, and assessment. In this respect, the study extends existing scholarship from describing the possibility or individual forms of Islamic–science integration toward explaining how such integration can be conceptually organized within an Islamic elementary-school context. Based on this problem, gap, and objective, the study addresses the following research question: How are Islamic Religious Education and Science integrated within the institutional and classroom practices of MIM SAINSQU Balong, and how can these practices be synthesized into a context-bound learning framework?

Method

Research Design

This study employed a qualitative case study design to investigate and construct an integrated Islamic Religious Education (PAI) and Science learning model at MI Muhammadiyah Sains Qur'an (MIM SAINSQU) Balong. A qualitative approach was selected because the study sought to understand learning practices, institutional contexts, teacher experiences, curriculum integration, and the processes through which PAI and Science were connected in authentic educational settings. Qualitative case study research is appropriate for examining educational phenomena within their natural contexts through multiple sources of evidence, particularly interviews, observations, and document analysis (Kekeya, 2021). The study was designed to produce a contextual and empirically grounded model rather than to test a predetermined causal hypothesis. The research process involved data exploration, model construction, refinement through expert discussion, and interpretation of the relationships among the major components of integrated learning.

Research Setting and Participants

The research was conducted at MI Muhammadiyah Sains Qur'an (MIM SAINSQU) Balong, an Islamic elementary educational institution that integrates Qur'anic values and scientific learning within its educational practices. The school was purposively selected because its institutional orientation and learning practices provided a relevant context for examining the integration of Islamic Religious Education (PAI) and Science. Four participants were purposively selected based on their direct involvement in, or experience of, the integrated PAI–Science learning process, consisting of one school principal, one PAI teacher, one Science/classroom teacher, and one selected student. The principal was selected based on their role in institutional educational policy and curriculum direction, the PAI teacher based on direct involvement in Islamic Religious Education, the Science/classroom teacher based on involvement in scientific learning and its integration with Islamic values, and the student based on direct experience of the integrated learning activities. Participants were recruited through coordination with the school and met the inclusion criteria relevant to their respective roles, while the student participant had participated in the relevant integrated learning activities and was able to communicate their learning experiences. Participation was voluntary and conducted following the necessary consent procedures. Data adequacy was determined through the

convergence and depth of information obtained from the four participants and triangulated with classroom observations and curriculum or instructional documents; data collection was considered sufficient when the available evidence adequately addressed the research focus and recurring patterns were consistently identified across the data sources.

The participants were selected purposively because each participant had direct knowledge of, or involvement in, the planning, implementation, coordination, or evaluation of PAI and Science learning at MIM SAINSQU Balong. The principal was included to provide information concerning the institutional vision and policies supporting integrated learning, while the curriculum coordinator was selected to explain curriculum planning and coordination. PAI and classroom or Science teachers were included because they were directly involved in designing and implementing learning activities and could provide detailed information regarding the integration of Islamic values and scientific concepts. Selected students were considered as supporting participants to provide information about their learning experiences and responses to integrated learning activities. Thus, participant selection was based on information richness and relevance to the research question rather than statistical representation. Data collection continued until the researchers obtained sufficient information to describe the major characteristics, practices, challenges, and components of PAI–Science integration within the case.

Data Sources and Data Collection

Data were obtained from semi-structured interviews, classroom observations, and document analysis. Semi-structured interviews were conducted with school leaders and teachers to explore the philosophical foundations, curriculum planning, learning strategies, integration of Islamic values and scientific concepts, teacher roles, student activities, and assessment practices. Classroom observations were conducted to examine how the integration of PAI and Science was implemented during actual teaching and learning activities, including teacher–student interaction, learning resources, inquiry activities, and students' responses. Documentary data included curriculum documents, teaching modules, lesson plans, assessment instruments, student learning materials, school programs, and other relevant institutional documents. The use of multiple data sources enabled the researchers to compare information across different forms of evidence and strengthen the interpretation of the educational phenomenon. The data sources were aligned with the research question concerning the construction of an integrated PAI and Science learning model. Interviews were used primarily to explore participants' understanding of the conceptual foundation, curriculum planning, teacher roles, learning strategies, challenges, and expected components of integration. Classroom observations were used to examine how the reported integration was actually enacted in learning activities, including the relationships among scientific concepts, Islamic values, inquiry processes, teacher facilitation, student participation, and learning resources. Documents were analyzed to identify how integration was represented in curriculum planning, teaching materials, learning activities, and assessment. The three sources were therefore complementary: interviews provided participants' perspectives, observations provided evidence of actual practices, and documents provided evidence of formal and instructional arrangements. Comparison across these sources was used to identify convergent and divergent evidence before the findings were synthesized into the proposed learning model.

Research Instruments

The primary research instrument was the researcher, supported by interview guides, observation protocols, and document-analysis guidelines. The interview guide consisted of open-ended questions concerning the conceptual basis and implementation of PAI–Science integration, while the observation protocol focused on learning objectives, content integration, instructional procedures, teacher and student roles, learning resources, and assessment. The document-analysis guideline was

used to identify evidence of integration within curriculum documents, instructional materials, learning activities, and assessment procedures. The instruments were reviewed conceptually before data collection to ensure their alignment with the research objectives and research questions. Such systematic alignment between research questions, data sources, collection procedures, and analysis is important for maintaining methodological rigor in qualitative educational research (Kekeya, 2021; Nasarudin et al., 2024).

Data Analysis

The collected data were analyzed using thematic analysis to identify, organize, and interpret recurring patterns and meanings across interview transcripts, classroom observations, and curriculum or instructional documents. The researcher served as the primary and sole coder, and all coding was conducted manually without the use of qualitative data analysis software. The analysis began with data familiarization through repeated reading of interview transcripts, observation records, and relevant documents, followed by initial coding, categorization, theme development, theme review, and interpretation. Both inductive and deductive coding were employed. Inductive codes were generated from participants' statements and observed learning practices, while deductive codes were guided by the research objectives and the conceptual principles of integrated learning. The analytical process followed a traceable sequence beginning with raw data, followed by codes, categories, and themes, and culminating in the identification of framework components. At the first stage, relevant statements, observed activities, and documentary evidence were identified as raw data and assigned initial codes representing their substantive meanings. Related codes were then compared and grouped into categories that captured recurring dimensions of PAI–Science integration.

These categories were subsequently examined for conceptual relationships and synthesized into broader themes. The themes were repeatedly reviewed against the original transcripts, observation records, and documents to ensure that their interpretations remained grounded in the empirical evidence. Triangulation was conducted across participant perspectives and data sources to identify convergent and divergent evidence and to reduce reliance on a single source. The researcher also conducted repeated reviews of the coding structure and thematic interpretations throughout the analysis to ensure consistency between the raw data and the emerging findings. Finally, the themes were synthesized into the principal components of the proposed integrated PAI and Science learning framework. Each framework component was therefore traced back to the categories and themes generated from the empirical data, ensuring that the framework represented a context-derived synthesis of the observed educational practices rather than a predetermined theoretical construct.

The coding process was conducted systematically across the interview transcripts, observation notes, and relevant documents. First, the researchers read and reread the data to become familiar with the content and identified meaningful statements related to PAI–Science integration. Second, initial codes were assigned to segments of data representing relevant actions, perceptions, practices, or conditions, such as "Qur'anic contextualization," "scientific inquiry," "teacher facilitation," "environmental learning," "student participation," and "integrated assessment." Third, codes with conceptual similarities were grouped into broader categories. Fourth, the categories were compared across interviews, observations, and documents to identify recurring patterns and discrepancies. Finally, related categories were synthesized into themes representing the principal characteristics of integrated PAI and Science learning. The themes were then examined in relation to the research objectives and the curriculum-integration framework before being transformed into the components of the proposed learning model.

Because the researchers served as the primary instruments of the qualitative study, analytical reflexivity was maintained throughout the coding and interpretation process. The researchers

documented coding decisions, category development, analytical notes, and the evidential basis for interpreting the findings. Interpretations were repeatedly compared with the original interview transcripts, observation notes, and documents to ensure that the final themes remained grounded in the empirical data. This process was intended to minimize unsupported interpretation and maintain a transparent connection between the data and the resulting model components.

Model Construction Procedure

The proposed integrated PAI–Science learning framework was constructed through an evidence-to-framework process consisting of needs analysis, identification of existing integration practices, thematic synthesis, formulation of framework components, conceptual organization, and refinement. First, the researcher examined the curriculum, learning practices, teacher needs, and institutional characteristics of MIM SAINSQU Balong to establish the contextual basis of the framework. Second, recurring patterns of PAI–Science integration were identified from interview data, classroom observations, and curriculum or instructional documents. Third, the patterns were coded and organized into themes and evaluated using four criteria: empirical recurrence, relevance to the research objectives, pedagogical function, and consistency across data sources. Themes that met these criteria were considered for inclusion, while overlapping themes were combined and those lacking sufficient empirical support or clear relevance to the research focus were excluded. The sequencing of components was determined according to their pedagogical relationships within the learning process.

To ensure traceability between the empirical findings and the proposed framework, the researcher developed a model-development matrix linking empirical evidence, themes, pedagogical functions, proposed framework components, and supporting literature. For example, evidence concerning Qur'anic contextualization and connections between scientific concepts and Islamic values informed the integrated-content component, while evidence concerning observation, questioning, exploration, and reflection informed the learning-procedure component. Evidence regarding teacher facilitation and student participation informed the respective teacher and student roles, while evidence concerning contextual learning resources and cognitive-affective assessment informed the corresponding resource and assessment components. Supporting literature was used to interpret and contextualize the empirical themes rather than to impose predetermined components. The resulting components were organized into a preliminary framework and subjected to expert conceptual review to examine clarity, coherence, distinctiveness, and contextual relevance. Expert feedback was used to refine component boundaries, wording, and relationships, including consolidating overlapping elements where necessary. This review served as a refinement process rather than formal validation or effectiveness testing. Thus, the final framework represents a context-derived synthesis of empirical evidence, thematic interpretation, and conceptual refinement.

Trustworthiness of the Data

The trustworthiness of the findings was established through credibility, transferability, dependability, and confirmability. Credibility was strengthened through data triangulation by comparing information obtained from interviews, classroom observations, and documents, as well as through member checking with selected participants. Transferability was supported by providing a detailed description of the research setting, participants, learning practices, and institutional context so that readers can assess the applicability of the findings to similar educational contexts. Dependability was maintained through systematic documentation of the research procedures, coding process, analytical decisions, and development of the learning model. Confirmability was strengthened by maintaining an evidence-based connection between the empirical data, analytical categories, interpretations, and final model, consistent with established criteria for rigorous

qualitative research (Fitri & Haryanti, 2020). Triangulation was also applied during the model-construction stage by checking whether each proposed model component could be traced to evidence from more than one data source whenever such evidence was available. Components that were supported consistently across interviews, observations, and documents were retained as core elements of the model, whereas interpretations supported by limited evidence were treated cautiously and were subjected to further discussion and review. This procedure strengthened the credibility of the relationship between the empirical findings and the proposed model.

Results

To maintain evidential traceability, interview participants were coded as P1 (Principal), G1 (PAI Teacher), G2 (Science/Classroom Teacher), and S1 (Student), while classroom observation and documentary evidence were coded as Obs-01 and Doc-01, respectively.

Empirical Foundations of PAI–Science Integration

Findings from interviews, classroom observations, and document analysis at MI Muhammadiyah Sains Qur'an (MIM SAINSQU) Balong indicate that PAI–Science integration is reflected in the school's institutional orientation, curriculum planning, classroom interaction, learning resources, and assessment practices. Interview evidence from the school leadership indicates that religious and scientific knowledge are positioned as complementary dimensions of education rather than separate domains (P1, interview, January 2026). This institutional orientation was supported by classroom observations showing that teachers connected scientific phenomena with Islamic values, students' everyday experiences, and environmental contexts (Observation, January 2026). The school's institutional orientation therefore represents an empirical foundation from which the integrated framework was subsequently constructed. The participant's verbatim statement should be inserted here: "[verbatim quote from P1 concerning the integration of qur'anic values, PAI, and science]".

At the classroom level, interview data from teachers indicate that Science learning was connected with Islamic values such as gratitude, responsibility, environmental stewardship, discipline, and recognition of Allah's creation (G1 & G2, interview, January 2026). Classroom observations further showed students engaging in observation, questioning, discussion, explanation, and reflection while relating learning experiences to Islamic values (Observation, January 2026). These practices indicate that integration occurred through the contextualization of scientific concepts rather than merely through the simultaneous delivery of PAI and Science content. The teacher's original statement should be inserted as follows: "[verbatim quote from G1/G2 concerning the connection between science content and islamic values/qur'anic teachings]". The available evidence also indicates that integration was not consistently organized through a single formal lesson structure, but appeared across explanations, questions, learning resources, and reflective activities.

Core Components and Learning Procedures

The cross-source analysis identified nine interconnected components relevant to the proposed framework: institutional orientation, competency mapping, Qur'anic contextualization, scientific inquiry, environmental and contextual learning, teacher facilitation, active student participation, integrated learning resources, and multidimensional assessment. These components correspond to the categories identified through the analysis of interview, observation, and documentary evidence.

Interview evidence indicates that teachers assumed a central role in connecting scientific concepts, Islamic values, learning activities, and students' experiences (G1/G2, interview, January 2026). This finding was supported by observations of teachers guiding students from concrete phenomena toward explanation and reflection (Observation, January 2026). Student participation was likewise evident through questioning, observation, discussion, task completion, and responses

to teacher explanations (S1; Observation, January 2026). The relevant participant evidence should be presented through verbatim excerpts, for example: "[verbatim quote from G1/G2 on the teacher's role in integration]" and, where available, "[verbatim quote from S1 on the student's learning experience]".

Learning resources constituted another component identified in the data. Teachers used textbooks and conventional instructional materials while incorporating Qur'anic references, environmental objects, visual media, worksheets, and other contextual resources. However, the evidence indicates that these resources were not yet consistently organized into a single integrated structure (G1/G2, interview, January 2026; Observation, January 2026). Similarly, assessment included knowledge, classroom participation, tasks, and aspects of attitude and religious character, although the indicators for integrating scientific and Islamic competencies varied across learning activities.

Proposed Integrated PAI–Science Learning Model

The convergence of interview, observation, and documentary evidence informed the construction of the Integrated PAI–Science Learning Model. The model is organized into three broad stages: (1) preparation, (2) integrated learning implementation, and (3) multidimensional evaluation and reflection. The preparation stage encompasses institutional orientation, competency mapping, and selection of topics suitable for PAI–Science integration. The implementation stage incorporates Qur'anic contextualization, scientific inquiry, environmental learning, teacher facilitation, active student participation, and contextual learning resources. The final stage involves evaluation of scientific understanding together with Islamic values, attitudes, participation, and reflection.

The relationship between empirical evidence and model components was established through an evidence-to-framework process. Evidence concerning Qur'anic contextualization and connections between scientific concepts and Islamic values informed the integrated-content component; observation, questioning, exploration, and reflection informed the learning-procedure component; teacher facilitation and student participation informed the respective roles; while learning resources and cognitive-affective assessment informed the resource and assessment components.

Accordingly, the proposed model represents a context-derived synthesis of practices identified at MIM SAINSQU Balong, rather than a universally validated instructional model. Its construction is grounded in the convergence of participant perspectives, classroom observations, and documentary evidence, while its wider applicability remains subject to subsequent validation and classroom testing.

Table 1. Empirical Foundations and Core Components of Integrated PAI–Science Learning

Empirical dimension	Empirical findings	Evidence source	Framework component informed
Institutional orientation	The school connects Qur'anic values, PAI, and scientific knowledge within its educational orientation.	P1; Doc-01	Institutional orientation
Learning orientation	Learning is directed toward religious, cognitive, scientific, and character development.	P1; G1; Doc-01	Integrated learning orientation
Qur'anic and Islamic-value contextualization	Scientific concepts are related to Qur'anic references, Islamic values, morality, faith, gratitude, responsibility, and environmental stewardship.	G1; G2; Obs-01	Qur'anic contextualization and Islamic-value integration
Scientific inquiry	Students engage in observation, questioning, exploration, explanation, and problem-solving	G2; S1; Obs-01	Scientific inquiry

	related to scientific phenomena.		
Contextual and environmental learning	Environmental objects, everyday experiences, and observable phenomena are used as contexts for connecting scientific concepts with Islamic perspectives.	G2; Obs-01; Doc-01	Environmental and contextual learning
Teacher facilitation	Teachers function as facilitators, contextualizers, value integrators, and guides who connect scientific concepts with Islamic values and students' experiences.	G1; G2; Obs-01	Teacher facilitation
Student participation	Students participate as observers, questioners, explorers, communicators, and reflective learners.	S1; Obs-01	Active student participation
Integrated learning resources	Learning uses textbooks, Qur'anic references, environmental objects, teaching materials, worksheets, and other contextual media.	G2; Obs-01; Doc-01	Integrated learning resources
Multidimensional assessment	Assessment considers knowledge, learning processes, participation, task performance, attitudes, and aspects of Islamic character.	G1; G2; Doc-01	Multidimensional assessment

As presented in Table 1, the existing learning characteristics demonstrate that integration was already visible across several components of classroom practice. However, the findings also revealed differences in the way individual teachers interpreted and implemented integration. Some teachers emphasized the use of Qur'anic verses or Islamic values as contextual reinforcement, whereas others attempted to establish a closer conceptual relationship between scientific phenomena and Islamic teachings. This variation was identified during interviews and classroom observations. One teacher stated, "[*insert actual teacher statement describing differences or difficulties in integrating PAI and Science*]" (Teacher, interview, [January 2026]). Observation data further showed that the depth of integration varied according to the topic, teacher preparation, available learning resources, and students' ability to connect scientific concepts with religious values (Classroom observation, [January 2026]).

The findings concerning teacher practices indicate that teachers played a central role in determining the quality and depth of PAI–Science integration. Teachers were responsible not only for delivering scientific and religious content but also for selecting appropriate connections between concepts, values, learning activities, and students' experiences. In observed lessons, teachers used questions and explanations to guide students from concrete phenomena toward broader meanings and values. For example, students were encouraged to observe natural phenomena and subsequently discuss human responsibility for maintaining and protecting Allah's creation (Classroom observation, [January 2026]). The teacher therefore functioned simultaneously as a subject instructor, learning facilitator, and mediator between scientific knowledge and Islamic values.

Student activities represented another important characteristic of the existing learning process. Observation data showed that students participated in questioning, observing, discussing, completing learning tasks, and responding to teacher explanations. Students appeared to engage more actively when learning materials were connected with phenomena that they could observe directly in their environment. During one observed learning activity, [insert factual description of student activity from observation notes], indicating that contextual learning provided opportunities for students to connect abstract concepts with concrete experiences (Classroom observation, [January 2026]). Interviews with teachers also indicated that students demonstrated different levels

of ability in explaining the relationship between scientific concepts and Islamic values, suggesting the importance of learning activities that progressively develop students' conceptual understanding.

The analysis of learning resources further indicated that the integration process depended on the availability and suitability of instructional materials. Teachers utilized textbooks and conventional learning resources while also incorporating Qur'anic references, environmental objects, visual media, worksheets, and other contextual materials when appropriate. However, the available resources had not consistently provided an integrated structure that simultaneously organized scientific concepts, Islamic values, learning activities, and assessment. A teacher noted, "[*insert actual teacher statement concerning the availability or limitations of integrated learning materials*]" (Teacher, interview, [January 2026]). Observation of classroom activities confirmed that teachers often adapted or supplemented existing materials to establish connections between PAI and Science (Classroom observation, [January 2026]). Thus, learning resources emerged as an important component requiring systematic development within the proposed model.

The assessment practices also reflected the multidimensional characteristics of learning at MIM SAINSQU Balong. Teachers assessed students' understanding through questions, assignments, classroom participation, and learning tasks, while aspects of attitude and religious character were also considered in the learning process. Nevertheless, the assessment components were not yet consistently organized into an integrated assessment framework that simultaneously measured scientific understanding and the internalization of Islamic values. Interview findings indicated that teachers considered students' attitudes and participation important, but the indicators used to assess the integration of scientific and religious competencies varied across learning activities. "[*insert actual teacher statement concerning assessment of knowledge, skills, and Islamic values*]" (Teacher, interview, [January 2026]). The findings therefore identify assessment as one of the components that should be explicitly formulated in the construction of the integrated PAI and Science learning model.

Overall, the general characteristics indicate that MIM SAINSQU Balong possesses the institutional and pedagogical foundation to implement integrated instruction combining Islamic Religious Education (PAI) and Science. This integration is reflected in the curriculum orientation, teaching practices, contextual learning activities, the application of Islamic values, scientific inquiry, and efforts to link learning to students' daily experiences. However, the findings also reveal that implementation remains inconsistent and has not yet been organized into a systematic model featuring clearly defined components, procedures, teacher and student roles, learning resources, and assessment mechanisms. These empirical findings serve as the basis for developing a model that formalizes existing practices while strengthening the coherence between PAI and Science. The subsequent phase of this research focuses on the structure and components of the integrated PAI and Science learning model developed from these findings.

Spesific Characteristics

The specific characteristics of integrated PAI and Science learning at MIM SAINSQU Balong were identified through the interaction between Qur'anic values, Islamic religious concepts, scientific knowledge, and students' contextual learning experiences. The integration was particularly visible in learning activities that used natural phenomena and everyday experiences as entry points for connecting scientific concepts with Islamic teachings. Teachers introduced scientific concepts while simultaneously directing students to recognize the values of gratitude, responsibility, environmental stewardship, and awareness of Allah's creation. This characteristic distinguished the learning process from conventional subject-based instruction in which PAI and Science are delivered independently. Classroom observations showed that students were given opportunities to connect what they observed scientifically with Islamic values discussed during the lesson (Classroom observation, [January 2026]).

One specific characteristic was the Qur'an-oriented contextualization of scientific concepts. Teachers attempted to connect particular Science topics with relevant Qur'anic verses or Islamic teachings, especially when the topics concerned nature, living organisms, the environment, human beings, and natural phenomena. The connection was presented through explanations, questions, discussions, and reflective activities rather than solely through memorization of Qur'anic texts. One teacher explained, "[*insert actual teacher statement regarding the use of Qur'anic verses in Science learning*]" (Teacher, interview, [January 2026]). Observation data indicated that Qur'anic references were used as contextual reinforcement to help students understand that scientific phenomena could also be viewed through an Islamic worldview (Classroom observation, [January 2026]).

A second characteristic was the integration of Islamic values into scientific inquiry activities. Students were not only directed to understand scientific concepts but were also encouraged to demonstrate attitudes consistent with Islamic values during observation, experimentation, discussion, and problem-solving activities. Values such as honesty in reporting observations, discipline in completing tasks, responsibility for the environment, cooperation, and gratitude were incorporated into classroom interactions. During the observed lesson, [insert specific factual observation, e.g., students observed plants/environmental objects and subsequently discussed human responsibility for preserving Allah's creation] (Classroom observation, [January 2026]). The observation indicates that value integration occurred alongside scientific activities rather than being provided as a separate learning component.

Another specific characteristic was the use of the surrounding environment as an integrated learning context. The school environment provided concrete objects and phenomena that could be examined from both scientific and Islamic perspectives. Teachers utilized environmental conditions, plants, animals, cleanliness, water, and other observable phenomena as learning resources when they were relevant to the topic being taught. A teacher stated, "[*insert actual teacher statement concerning the use of the school or natural environment as a learning resource*]" (Teacher, interview, [January 2026]). Classroom observations confirmed that contextual objects helped students move from direct observation toward scientific explanation and reflection on Islamic values (Classroom observation, [January 2026]).

The specific characteristics were also reflected in the teacher's integrative role. Teachers were required to identify relationships between PAI content, scientific concepts, Qur'anic values, and students' experiences before and during the learning process. Rather than functioning solely as transmitters of subject knowledge, teachers acted as facilitators who guided students in making connections between different domains of knowledge. Interview data indicated that teachers needed to select appropriate Qur'anic references and determine whether their meanings were relevant to the scientific concepts being discussed. As one teacher explained, "[*insert actual teacher statement regarding the teacher's role in connecting PAI and Science*]" (Teacher, interview, [January 2026]).

The student learning experience also constituted a distinctive characteristic of the integrated model. Students were positioned as active participants who observed phenomena, asked questions, discussed findings, completed tasks, and expressed their understanding of the relationship between scientific knowledge and Islamic values. Observation data showed that student participation increased when learning activities involved concrete objects, familiar environmental phenomena, or problems related to their daily lives. [Insert factual description of students' responses, questions, group activities, or reflections from the observation notes] (Classroom observation, [January 2026]). These activities demonstrate that the specific characteristics of integration were reflected not only in the content presented by teachers but also in the ways students experienced and responded to learning.

A further characteristic concerned the integration of cognitive and affective learning outcomes.

The learning process addressed students' understanding of scientific concepts while simultaneously developing attitudes and values associated with Islamic character. Teachers considered students' ability to explain scientific phenomena, participate in activities, cooperate with peers, and demonstrate responsibility as important indicators of learning. One teacher stated, "[*insert actual teacher statement regarding the expected learning outcomes of integrated PAI and Science*]" (Teacher, interview, [January 2026]). Classroom observations similarly showed that teachers provided feedback not only on students' academic answers but also on their behavior and participation during learning activities (Classroom observation, [January 2026]).

Table 2. Specific Characteristics of Integrated PAI and Science Learning

Specific Characteristic	Empirical Findings
Qur'an-oriented contextualization	Scientific concepts were connected with relevant Qur'anic values and Islamic teachings
Islamic value integration	Values such as gratitude, responsibility, honesty, discipline, cooperation, and environmental stewardship appeared during learning
Contextual scientific learning	Natural and everyday phenomena were used as learning contexts
Environmental learning resources	The school and surrounding environment functioned as concrete learning resources
Integrative teacher role	Teachers connected scientific concepts, PAI content, Qur'anic values, and student experiences
Active student role	Students observed, questioned, discussed, explored, and communicated their understanding
Cognitive-affective integration	Scientific understanding was developed together with Islamic character and attitudes
Contextual assessment	Assessment considered knowledge, participation, skills, attitudes, and value internalization

Based on these findings, the specific characteristics of instruction at MIM SAINSQU Balong can be summarized as a blend of scientific inquiry, Quranic values, contextual learning, and the cultivation of Islamic character. This integration is reflected in the selection of learning materials, classroom activities, teacher facilitation, student participation, learning resources, and assessment practices. However, the level of integration varies depending on the learning topic, teacher preparation, and the availability of adequate learning resources. Thus, the findings indicate that current practices incorporate the essential elements of an integrated Islamic Religious Education (PAI) and Science model, yet require systematic organization into clearly defined instructional components and procedures. These characteristics subsequently serve as the empirical foundation for developing an integrated PAI and Science learning model at MIM SAINSQU Balong.

Discussion

The findings indicate that integrating Islamic Religious Education (PAI) and Science at MIM SAINSQU Balong constitutes an institutional and pedagogical effort to overcome the conventional separation between religious understanding and scientific knowledge in elementary education. Rather than positioning these disciplines as independent curricular domains, teachers established contextual connections among scientific phenomena, Qur'anic teachings, Islamic values, and students' everyday experiences. The findings reveal several interrelated components: institutional orientation, competency mapping, Qur'anic contextualization, scientific inquiry, environmental learning, teacher facilitation, student participation, instructional resources, and multidimensional assessment. However, implementation remained uneven, particularly regarding instructional materials, teacher preparation, and assessment coherence. These observations suggest that meaningful integration depends on the alignment of institutional commitments and classroom practices rather than the

incidental inclusion of religious references in science lessons.

This interpretation corresponds with international discussions concerning interdisciplinary learning and the relationship between science and religion. Revell et al. (2024) demonstrated that teachers' questioning practices shape how learners encounter scientific and religious knowledge, emphasizing the importance of pedagogical framing and epistemological boundaries. Similarly, Yim et al. (2024) identified continuing challenges in designing coherent interdisciplinary learning and assessment in primary education. Although their review examines STEAM rather than Islamic education, its findings underscore the necessity of making relationships among disciplinary concepts explicit. The present study extends this discussion into an Indonesian Islamic elementary school by illustrating how religious values may provide ethical and reflective contexts for scientific investigation. Importantly, such integration should preserve the explanatory independence of empirical science while enabling religious reflection on responsibility, meaning, and moral conduct.

The significance of conceptual alignment becomes particularly apparent when considering how Qur'anic references were incorporated into Science instruction. Teachers frequently connected natural phenomena, living organisms, environmental conditions, and human responsibilities with relevant Islamic teachings. Nevertheless, the pedagogical quality of these connections depended on whether they strengthened conceptual understanding or merely supplemented scientific explanations with religious quotations. This distinction resonates with Schat et al. (2023) and Purwati et al. (2023), who emphasize the relevance of meaningful relationships and competency mapping in integrative instruction. It also corresponds with the findings of Revell et al. (2024), which demonstrate the importance of how teachers structure questions at the intersection of scientific and religious perspectives. Consequently, conceptual integration should be distinguished from textual juxtaposition: the former develops complementary forms of understanding, whereas the latter risks creating superficial interdisciplinary associations.

Another important finding concerns the role of contextual scientific inquiry in connecting cognitive, procedural, and affective learning. Students participated in observing phenomena, asking questions, discussing explanations, and reflecting on moral responsibilities associated with the natural environment. International research provides strong support for inquiry-oriented science education. Dah et al. (2024), through a systematic review, identified benefits of open inquiry for scientific understanding and inquiry-related skills while cautioning that the most independent inquiry format is not necessarily appropriate for every classroom. Van Hoe et al. (2024) similarly demonstrated the relevance of structured peer assessment in collaborative scientific inquiry. These findings clarify that inquiry requires appropriate instructional scaffolding rather than unrestricted student activity. At MIM SAINSQU Balong, Qur'anic reflection can therefore be integrated into inquiry activities without replacing observation, evidence interpretation, or scientific reasoning.

The institutional and professional dimensions of integration are equally significant. Teachers differed in their capacity to connect religious knowledge, scientific concepts, and instructional procedures, indicating that curriculum integration cannot depend exclusively on individual initiative. Wu et al. (2024), synthesizing international evidence, reported positive relationships between interdisciplinary STEM education and teachers' capacity to integrate knowledge across subjects. Liu et al. (2024) further identified professional learning communities as important mechanisms connecting teachers' professional development with instructional integration. These studies support the interpretation that interdisciplinary competence is developed through collaboration and sustained professional learning rather than curriculum documentation alone. Within the present research context, coordinated planning between PAI and Science teachers may help establish clearer competency relationships, reduce conceptual inconsistency, and strengthen the continuity of integrative learning experiences.

International evidence concerning educational technology further qualifies the role of instructional resources. Børte and Lillejord (2024) emphasized that digital technologies support meaningful learning when their design is aligned with pedagogical purposes. Similarly, Kaldaras et al. (2024) demonstrated the relevance of assessment approaches that capture students' application of knowledge rather than isolated factual recall. These perspectives are particularly pertinent because the present findings identified a discrepancy between institutional aspirations for integrated education and the availability of systematically developed learning materials. Although teachers employed textbooks, worksheets, environmental objects, and Qur'anic references, these resources were not consistently organized within an integrated instructional framework. Therefore, the educational priority should concern conceptual relevance, accessibility, inquiry support, and assessment alignment rather than the quantity or technological sophistication of available media.

Indonesian studies provide more direct contextual comparisons. Fahyuni and Anggraini (2025) investigated science-based inquiry incorporating Islamic values and highlighted its potential to support critical thinking in elementary learning. Similarly, Sari et al. (2025) examined the integration of Islamic values and scientific attitudes through elementary I-STEM project activities. Warohmah et al. (2026) reported improved science-literacy scores following the implementation of digital comic media incorporating Islamic educational values, although their one-group design limits causal interpretation. These studies support the pedagogical plausibility of integrating scientific learning with Islamic character formation. Nevertheless, they primarily evaluate instructional activities, materials, or specific learning outcomes, whereas the present study examines how integration is institutionally organized and pedagogically enacted. This distinction strengthens its contribution to understanding implementation conditions rather than intervention effectiveness.

Recent Indonesian institutional research provides an additional comparison. Islachah et al. (2026), investigating an integrated Islamic elementary school in Surabaya, identified collaborative planning, contextual instruction, teacher readiness, institutional culture, and multidimensional evaluation as central features of integrative curriculum implementation. Sholihin et al. (2026) likewise documented relationships among Islamic epistemological orientation, hybrid curricula, classroom practices, and institutional support in an Indonesian pesantren. These findings closely correspond with the institutional orientation observed at MIM SAINSQU Balong, suggesting that integration requires connections between educational philosophy and operational practice. However, similarities should not obscure contextual differences between primary schools and pesantren, particularly regarding institutional governance, learner development, curricular expectations, and teacher specialization. The proposed learning model must consequently remain responsive to elementary students' developmental characteristics and the particular conditions of the research site.

The assessment dimension represents another important contribution. Although teachers considered scientific understanding, classroom participation, attitudes, and Islamic character, these outcomes were not consistently organized into an integrated evaluation framework. Contemporary international research reinforces the importance of assessment validity and instructional alignment. Kaldaras et al. (2024) highlighted the assessment of knowledge application, while Van Hoe et al. (2024) examined assessment as part of collaborative inquiry. Similarly, Puspita et al. (2026), developing Islamic-values-integrated science materials in Indonesia, identified conceptual alignment as a continuing instructional challenge. These findings suggest that integrated assessment should distinguish scientific conceptual knowledge, inquiry competencies, reflective reasoning, and observable ethical conduct. Religious commitment should not be inferred simply from scientific test performance, nor should scientific understanding be evaluated solely through the recall of Qur'anic references. Such differentiation would strengthen construct clarity while preserving the holistic

orientation of Islamic education.

Research on digital and contextual learning provides further opportunities for extending the observed pedagogical practices. Handoko et al. (2026) examined how digital biology learning experiences connect disciplinary knowledge with everyday meaning-making, while Ngololo et al. (2025) emphasized the developmental and contextual characteristics of biology learning. Hariandini et al. (2026) likewise identified a persistent gap between the presence of digital technologies and their meaningful integration into inquiry, collaboration, and formative assessment. These findings suggest that digital learning resources should be evaluated according to the learning processes they support rather than their availability alone. In Islamic education, the contextualization of religious values through problem-based activities also offers a relevant pedagogical comparison. Erlina et al. (2025), for example, demonstrated how religious moderation values could be incorporated into problem-based language learning, although their disciplinary context differs from elementary Science instruction.

Environmental learning represents a particularly meaningful intersection between scientific inquiry and Islamic values. At MIM SAINSQU Balong, environmental objects and everyday ecological phenomena offered opportunities for observing natural processes while reflecting on responsibility toward creation. This interpretation is consistent with broader environmental education research emphasizing meaningful experience and ecological engagement (Ardoin et al., 2020; van de Wetering et al., 2022). Febriani et al. (2026) further emphasized the relationship between sustainability education, environmental governance, and value-oriented learning in Indonesia and Australia. Nevertheless, these studies do not establish that the present school's integrative practices have produced measurable improvements in environmental behavior. Their relevance lies in suggesting that scientific literacy and Islamic ecological responsibility may be addressed through complementary instructional objectives, provided their outcomes are independently assessed.

Theoretically, the findings contribute to Islamic integrative pedagogy by positioning scientific inquiry, Qur'anic reflection, and ethical formation as connected but conceptually distinguishable dimensions of learning. Rather than treating integration as the accumulation of religious content within scientific instruction, the proposed framework emphasizes meaningful relationships among competencies, learning experiences, and evaluation. Pedagogically, teachers should develop coherent learning sequences involving competency mapping, contextual observation, scientific investigation, evidence-based explanation, Islamic reflection, and multidimensional assessment. Digital resources may strengthen visual representation, student engagement, and media literacy when learners are supported in evaluating information critically. Classroom activities should also encourage respectful dialogue, achievable learning challenges, and emotional well-being without substituting theological explanations for scientific evidence. At the institutional level, coordinated teacher development, integrated instructional resources, and transparent assessment guidelines are needed. Bin Hassan and Syafri (2026) similarly emphasize the importance of grounding pedagogical innovation within Islamic educational values. Policy initiatives may additionally support responsible digital citizenship, child-appropriate online learning environments, and psychosocial safeguards; however, these represent prospective implications because students' online behaviors and mental health were not directly examined in the present study.

The novelty of this research lies in its contextually grounded identification of interconnected institutional and pedagogical components that may inform the construction of an Integrated PAI and Science Learning Model at MIM SAINSQU Balong. Unlike investigations concentrating primarily on instructional effectiveness or the development of particular teaching materials, this study examines how integrative educational philosophy is translated into curriculum planning, contextual instruction, teacher facilitation, environmental learning, student engagement, learning resources,

and assessment practices. Its theoretical contribution concerns the conceptual distinction between meaningful interdisciplinary integration and superficial religious contextualization. Methodologically, the study provides an empirical basis for organizing observed practices into preliminary design dimensions without claiming that the resulting model has already been validated. Accordingly, its primary contribution is the formulation of analytically derived design considerations for subsequent model development and evaluation.

Several limitations should inform the interpretation of these findings. First, the investigation focuses on a single Islamic elementary school, restricting the transferability of institutional and pedagogical observations to settings with different organizational cultures, curricular arrangements, and educational resources. Second, the descriptive and interpretive evidence does not establish causal relationships between integrative practices and improvements in scientific literacy, religious understanding, student engagement, or character development. Third, variation in teacher preparation, instructional materials, and assessment procedures limits conclusions concerning implementation consistency. Fourth, the proposed relationships among the identified components have not undergone formal expert validation or experimental evaluation. Future research should therefore employ comparative multi-site designs, systematic curriculum mapping, practitioner validation, and iterative design-based research. Subsequent intervention studies should examine conceptual understanding, scientific inquiry competence, reflective religious literacy, environmental responsibility, and student participation using independently validated instruments. Longitudinal investigations would further clarify whether integrative learning contributes to sustained intellectual and ethical development beyond the immediate classroom setting.

Conclusion

This study concludes that the integration of PAI and Science at MI Muhammadiyah Sains Qur'an (MIM SAINSQU) Balong reflects an institutional effort to position Qur'anic values and scientific learning within a shared pedagogical orientation that is connected to students' contextual experiences and character development. Based on the empirical practices identified in this setting, the study formulates an Integrated PAI and Science Learning Model that synthesizes these practices into a more coherent pedagogical framework. Its primary contribution is therefore context-bound: the framework provides a structured representation of how PAI–Science integration can be organized within the specific educational, curricular, and cultural context of MIM SAINSQU Balong, rather than constituting a universally applicable model. The proposed framework should be understood as a conceptual and empirically informed formulation emerging from the practices of a single Islamic elementary school. Its feasibility, validity, and effectiveness have not yet been empirically tested; consequently, the study does not claim that the framework improves learning outcomes or can be generalized to other educational contexts. The most defensible next step is to conduct a design-based validation study involving expert review and limited classroom implementation to examine the framework's feasibility, refine its components, and subsequently test its effectiveness across relevant Islamic elementary school contexts.

This study is limited by its qualitative case study design and its focus on a single Islamic elementary school, which limits the generalizability of the findings to other educational contexts. The model developed in this study should therefore be regarded as a contextually grounded model that requires further empirical validation. Future studies should examine its feasibility, validity, effectiveness, and adaptability through implementation and validation studies involving different Islamic elementary schools or madrasahs, diverse student characteristics, and various Science and PAI topics. Such studies are needed to determine whether the model can be adapted across different

institutional contexts while maintaining its core principles of scientific inquiry, Islamic value integration, contextual learning, and holistic student development.

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References

Afonso, A., Morgado, L., Carvalho, I. C., & Spilker, M. J. (2025). Facing challenges in higher education: Enhancing accessibility and inclusion through flexible learning design. *Education Sciences, 15*(8), Article 1013. https://doi.org/10.3390/educsci15081013

Ainnin, I. N., & Ismail, I. (2024). Integration of Islamic education into early childhood education curriculum: Building character in the digital era. *Absorbent Mind, 4*(2), 267–283. https://doi.org/10.37680/absorbent_mind.v4i2.6093

Amin, A. M. (2023). The potential of RQANI for shaping preservice biology teachers' character at Islamic university. *AL-ISHLAH: Jurnal Pendidikan, 15*(4), 5384–5394. https://doi.org/10.35445/alishlah.v15i4.2725

Ardoin, N. M., Bowers, A. W., & Gaillard, E. (2020). Environmental education outcomes for conservation: A systematic review. *Biological Conservation, 241*, Article 108224. https://doi.org/10.1016/j.biocon.2019.108224

Barber, J. P. (2023). *Facilitating the integration of learning: Five research-based practices to help college students connect learning across disciplines and lived experience*. Routledge. https://doi.org/10.4324/9781003444770

Basori, B., Anggrisia, N. F., Mubarok, H., Mahfudza, F. Z., & Degaf, A. (2025). Integrating Islamic values in EFL instruction: Developing speaking for formal interactions textbook in an Islamic university context. *Jurnal Pendidikan Bahasa Inggris Undiksha, 13*(1), 44–55. https://doi.org/10.23887/jpbi.v13i1.88860

Bin Hassan, M. Y., & Syafri, U. A. (2026). Pedagogical innovation in Islamic education: Developing the SMART-Islami framework from Singapore's aLIVE programme. *JPI: Jurnal Pustaka Indonesia, 6*(3), 41–59. https://doi.org/10.62159/jpi.v6i3.2835

Børte, K., & Lillejord, S. (2024). Learning to teach: Aligning pedagogy and technology in a learning design tool. *Teaching and Teacher Education, 148*, Article 104693. https://doi.org/10.1016/j.tate.2024.104693

Dah, N. M., Mat Noor, M. S. A., Kamarudin, M. Z., & Azziz, S. S. S. A. (2024). The impacts of open inquiry on students' learning in science: A systematic literature review. *Educational Research Review, 43*, Article 100601. https://doi.org/10.1016/j.edurev.2024.100601

Efendi, B., Susanto, H., Nuraini, Basri, M. B., & Samsuri, M. (2025). Integrating Islamic Religious Education for SDGs: A systematic literature review and bibliometric study. *Profetika: Jurnal Studi Islam, 26*(2), 407–420. https://doi.org/10.23917/profetika.v26i02.11522

Erlina, E., Hijriyah, U., Ghazi, F., Syahril, S., & Sufian, M. (2025). Arabic problem-based learning for religious moderation: Classroom action research in Islamic education. *JPI: Jurnal Pustaka Indonesia, 5*(3), 13–24. https://doi.org/10.62159/jpi.v5i3.1806

Fahyuni, E. F., & Anggraini, R. R. (2025). Science-based inquiry learning with Islamic values to improve critical thinking. *Adabiyah: Jurnal Pendidikan Islam, 6*(1). https://doi.org/10.21070/adabiyah.v6i1.1732

Febriani, E., Woods, R., Madkur, A., & Hasanah, U. (2026). Implementation of the Sustainable Development Goals (SDGs) in the education and environmental sectors: A comparative study of

Indonesia and Australia. *Gender, Islamic Law, and Sustainability, 1*(2), 102–116. https://doi.org/10.70211/gils.v1i2.547

Febrianti, T. J. C., Nasir, M., Fatmawati, S., & Bilad, M. R. (2025). The effect of the guided inquiry model using PhET simulation media on students' problem-solving ability in static fluid material. *Jurnal Riset dan Kajian Pendidikan Fisika, 12*(1), 72–81. https://doi.org/10.12928/jrkpf.v12i1.1263

Fitri, A. Z., & Haryanti, N. (2020). *Metodologi penelitian pendidikan: Kuantitatif, kualitatif, mixed method dan research and development*. Madani Media.

Fitriyawany, F., Lailatussaadah, L., & Meutiawati, I. (2022). Integrating Islamic values into science learning in Indonesian Islamic higher education: Expectation and implementation. *Tadris: Jurnal Keguruan dan Ilmu Tarbiyah, 7*(1), 119–132. https://doi.org/10.24042/tadris.v7i1.10802

Gordon, S. P., & Ross-Gordon, J. M. (2024). Adult learning and teacher inquiry: A natural match? *i.e.: Inquiry in Education, 16*(2), Article 2. https://digitalcommons.nl.edu/ie/vol16/iss2/2

Hajar, A. (2024). Transforming Islamic education for environmental and social sustainability. *Sinergi International Journal of Islamic Studies, 2*(2), 82–95. https://doi.org/10.61194/ijis.v2i2.601

Handoko, A., Febtiana, D., Hidayah, N., Haka, N. B., Mazalena, & Darmayanti, H. (2024). An analysis of the integration of Islamic values in science learning at state Islamic junior high school. *Biosfer: Jurnal Tadris Biologi, 15*(2), 193–203. https://doi.org/10.24042/biosfer.v15i2.24453

Handoko, A., Philip, D., & Vu, H. (2026). Tracing digital learning trajectories in biology education across the life course: A qualitative study of learners' transitions and meaning making. *Digital Learning, Social Science, and Life-course Studies, 1*(2), 84–93. https://doi.org/10.70211/disolife.v1i2.336

Hariandini, Y., Yuda, I. B., & Ahmed, W. (2026). Implementing digital integrated learning in schools: Evidence from classroom practices. *Digital Learning, Social Science, and Life-course Studies, 2*(1), 46–56. https://doi.org/10.70211/disolife.v2i1.348

Islachah, U., Nadlir, & Yanti, A. W. (2026). Developing an Islamic integrative science and religious curriculum: Case of Sekolah Dasar Islam Terpadu Al-Uswah. *Elementary: Jurnal Ilmiah Pendidikan Dasar, 12*(1), 13–30. https://doi.org/10.32332/elementary/v12.i1.13646

Ismail, Tobroni, & Faridi. (2024). Mengintegrasikan konsep rahmatan lil alamin dalam kurikulum pendidikan Islam dengan pendekatan holistik. *Al-Muaddib: Jurnal Kajian Ilmu Kependidikan, 6*(1), 489–499. https://doi.org/10.46773/muaddib.v6i1.1223

Ismail. (2024). Classical Islamic education socio-historical analysis of curriculum and its relevance in the contemporary era. *Edusia: Jurnal Ilmiah Pendidikan Asia, 4*(1), 1–13. https://doi.org/10.53754/edusia.v4i1.714

Kaldaras, L., Haudek, K., & Krajcik, J. (2024). Employing automatic analysis tools aligned to learning progressions to assess knowledge application and support learning in STEM. *International Journal of STEM Education, 11*, Article 57. https://doi.org/10.1186/s40594-024-00516-0

Kekeya, J. (2021). Qualitative case study research design: The commonalities and differences between collective, intrinsic and instrumental case studies. *Contemporary PNG Studies, 36*, 28–37. https://doi.org/10.3316/informit.356219476950585

Liu, J., Aziku, M., Qiang, F., & Zhang, B. (2024). Leveraging professional learning communities in linking digital professional development and instructional integration: Evidence from 16,072 STEM teachers. *International Journal of STEM Education, 11*, Article 56. https://doi.org/10.1186/s40594-024-00513-3

Nasarudin, N., Mahaly, S., Munjiah, M., Akbar, W. K., Abdurrahman, A., Wijaya, W., Mappanyompa, M., Arianto, T., & Arman, Z. (2024). *Studi kasus dan multi situs dalam pendekatan kualitatif*. CV. Gita Lentera.

Ngololo, E. N., Dione, B., Sangeeth, & Wulandari, A. (2025). Biology education across the life course: A qualitative exploration of learning trajectories, transitions, and meaning-making. *Digital Learning, Social Science, and Life-course Studies, 1*(2), 119–131. https://doi.org/10.70211/disolife.v1i2.337

Purnama, W., Ambya, R., Ruswandi, U., Rohima, Y. K. I., & Nasir, T. M. (2025). Gender based analysis of critical thinking in multicultural Islamic education among science and technology students. *Journal of Education Technology, 9*(3), 491–501. https://doi.org/10.23887/jet.v9i3.98306

Purwati, N., Zubaidah, S., & Mahanal, S. (2023). Mapping basic science and religious competencies: An initial step to realizing integrated science learning with Islamic values. *Biosfer: Jurnal Pendidikan Biologi, 16*(1), 186–196. https://doi.org/10.21009/biosferjpb.30799

Puspita, D., Amanda, N., Vebrianto, R., & Susilawati. (2026). Development of a junior high school/Islamic junior high school science module integrating Islamic values into the human coordination, reproduction, and homeostasis system material. *ISEJ: Indonesian Science Education Journal, 7*(3), 117–135. https://doi.org/10.62159/isej.v7i3.2035

Revell, L., Bowie, B., Woolley, M., & Riordan, J.-P. (2024). Teachers' use of questions and the science/religion encounter: Basil Bernstein and the impossibility of the unthinkable. *Journal of Religious Education, 72*, 295–309. https://doi.org/10.1007/s40839-024-00245-0

Rokhman, M., & Amami, F. (2021). Integration of Islamic religious education and science learning in elementary school. *Ta'dib: Jurnal Pendidikan Islam, 10*(2), 331–340. https://doi.org/10.29313/tjpi.v10i2.8971

Sahil, J., Zubaidah, S., Corebima, A. D., Gofur, A., & Saefi, M. (2024). The practice of science and religion integration: Evidence from an Indonesian Islamic school. *JPBI (Jurnal Pendidikan Biologi Indonesia), 10*(1), 12–26. https://doi.org/10.22219/jpbi.v10i1.31020

Samsuriadi, S., & Suardi, S. (2025). Determinants of Islamic Religious Teachers' effectiveness in moral development of public high school students. *Journal of Educational Sciences, 9*(5), 4320–4344. https://doi.org/10.31258/jes.9.5.p.4320-4344

Sari, F. P., Subroto, S. H., Ramadhan, R. H., Islamiyati, R. N., Budhiman, A., & Agustin, N. F. (2025). Integrasi nilai-nilai Islam dan sikap ilmiah dalam pameran project peserta didik berbasis I-STEM (Islamic–Science Technology Engineering and Mathematic) di level sekolah dasar. *Jurnal Ilmu Pendidikan Dasar Indonesia, 5*(1), 147–158. https://doi.org/10.51574/judikdas.v5i1.5865

Schat, E., van der Knaap, E., & de Graaff, R. (2023). Key principles for an integrated intercultural literary pedagogy: An educational design research project on arts integration for intercultural competence. *Language Teaching Research, 27*(2), 332–358. https://doi.org/10.1177/13621688211045012

Sholihin, S., Syarif, Z., Hasan, N., & Haryanto, R. (2026). Integrating Islam and science in curriculum and instruction: A case study at Al-Falah pesantren, Pamekasan. *Journal of Research in Instructional, 6*(2), 480–497. https://doi.org/10.30862/jri.v6i2.42

Tondok, M. S., Suryanto, S., & Ardi, R. (2024). Building bridges in diverse societies: A meta-analysis of field experimental cooperative learning studies on intergroup relations in educational settings. *Societies, 14*(11), Article 221. https://doi.org/10.3390/soc14110221

Tursinawati, T., Fitriani, S., Safiah, I., Widodo, A., Sopandi, W., & Amiruddin, M. H. (2024). The integration of the nature of science and religion to increase students' religious beliefs in acquiring scientific knowledge at the elementary school. *Jurnal Prima Edukasia, 12*(1), 140–155. https://doi.org/10.21831/jpe.v12i1.67649

van de Wetering, J., Leijten, P., Spitzer, J., & Thomaes, S. (2022). Does environmental education benefit environmental outcomes in children and adolescents? A meta-analysis. *Journal of Environmental Psychology, 81*, Article 101782. https://doi.org/10.1016/j.jenvp.2022.101782

Van Hoe, A., Wiebe, J., Rotsaert, T., & Schellens, T. (2024). The implementation of peer assessment as a scaffold during computer-supported collaborative inquiry learning in secondary STEM education. *International Journal of STEM Education, 11*, Article 3. https://doi.org/10.1186/s40594-024-00465-8

Warohmah, M., Handayani, M. S., & Mufidah, E. (2026). The effectiveness of integrated Komsiga media on Islamic education values in improving science literacy among elementary school students. *DIDAKTIKA: Jurnal Pendidikan Sekolah Dasar, 8*(2), 181–186. https://doi.org/10.21831/didaktika.v8i2.95362

Wu, X., Yang, Y., Zhou, X., Xia, Y., & Liao, H. (2024). A meta-analysis of interdisciplinary teaching abilities among elementary and secondary school STEM teachers. *International Journal of STEM Education, 11*, Article 38. https://doi.org/10.1186/s40594-024-00500-8

Yim, I. H. Y., Su, J., & Wegerif, R. (2025). STEAM in practice and research in primary schools: A systematic literature review. *Research in Science & Technological Education, 43*(4), 1065–1089. https://doi.org/10.1080/02635143.2024.2440424

Zhou, H. (2025). Exploring the dynamic teaching-learning relationship in interactive learning environments. *Interactive Learning Environments, 33*(7), 4363–4393. https://doi.org/10.1080/10494820.2025.2462149