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STEAM AND ISLAMIC EDUCATION INTEGRATION IN MADRASAH: CULTIVATING MUSLIM SCIENTISTS FROM EARLY EDUCATION

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Abstrak

Penelitian ini bertujuan untuk mengkaji integrasi pendidikan STEAM (Sains, Teknologi, Rekayasa, Seni, dan Matematika) dengan nilai-nilai Islam di MI Al-Khoiriyah sebagai upaya menumbuhkan literasi sains pada siswa Muslim tingkat dasar. Pendekatan yang digunakan adalah studi kasus kualitatif dengan teknik pengumpulan data melalui observasi kelas, wawancara mendalam dengan guru, serta analisis dokumen pembelajaran. Hasil penelitian menunjukkan bahwa strategi pembelajaran berbasis proyek yang dilandasi oleh ajaran Islam mampu meningkatkan keterlibatan aktif siswa, memperkuat pemahaman terhadap konsep-konsep sains, serta mendorong pengembangan keterampilan berpikir kritis dan kolaboratif. Integrasi nilai-nilai keislaman dalam proses pembelajaran menjadikan sains tidak hanya sebagai pengetahuan, tetapi juga sebagai sarana penguatan iman dan karakter. Kendati demikian, tantangan utama yang dihadapi adalah belum tersusunnya kurikulum integratif yang sistematis dan terbatasnya kapasitas guru dalam menerapkan pendekatan lintas disiplin ini. Oleh karena itu, penelitian ini merekomendasikan adanya dukungan kelembagaan yang kuat, program pelatihan berkelanjutan bagi guru, serta penyusunan kurikulum nasional yang secara formal menggabungkan pendekatan STEAM dengan pendidikan Islam. Model ini dinilai potensial dalam membentuk generasi ilmuwan Muslim yang unggul secara intelektual dan spiritual sejak jenjang pendidikan dasar.

***Kata kunci**: Integrasi STEAM, Pendidikan Dasar, Pendidikan Islam.*

Abstract

This article aims to examine the integration of STEAM education (Science, Technology, Engineering, Arts, and Mathematics) with Islamic values at MI Al-Khoiriyah as an effort to foster scientific literacy among Muslim elementary students. A qualitative case study approach was employed, with data collected through classroom observations, in-depth interviews with teachers, and analysis of instructional documents. The findings reveal that project-based learning grounded in Islamic principles effectively enhances student engagement, strengthens understanding of scientific concepts, and promotes the development of critical and collaborative thinking skills. Integrating Islamic values into the learning process enables students to perceive science not merely as knowledge, but also as a means of strengthening faith and character. However, major challenges include the absence of a systematic, integrative curriculum and the limited capacity of teachers to implement interdisciplinary approaches. Therefore, this study recommends strong institutional support, continuous professional development programs for teachers, and developing a national curriculum that formally integrates STEAM with Islamic education. This integrative model is considered a strategic approach to shaping a generation of Muslim

scientists who are intellectually competent and spiritually grounded from an early stage of education.

Keywords: Islamic Education, Primary Education, STEAM Integration.

INTRODUCTION

Education is a fundamental element in shaping students' character Aslam et al., (2022); Vazquez-Marin et al., (2023) and intellectual capacity (Smith, 2024); (Tripon et al., 2023). A common phenomenon observed in society is that low-quality education leads to a lack of critical thinking and (Batlolona & Diantoro, (2023) among the younger generation, two essential skills are needed to face the challenges of the 21st century. In Indonesia, education serves a dual function: as a means of knowledge transfer and as a tool for moral development Rehren & Sauer, (2024) based on Islamic values. However, the integration between general education and Islamic values still faces various structural and cultural barriers, resulting in the suboptimal role of Islamic education in producing competent and ethical individuals (Tolchah, 2019). This condition creates an urgent need to formulate an educational model that addresses global challenges without neglecting the roots of spiritual values.

One location that represents these challenges is the Madrasah Ibtidaiyah in suburban urban areas, where there is a disparity in access to educational resources, particularly in technology and modern pedagogical approaches. In the research location, the teaching system is still oriented toward conventional and segmented learning between general Marangio & Cooper, (2022) and religious subjects (Paiva et al., 2022). This lack of integration causes students to struggle in understanding the relationship between scientific concepts and religious values (Guilfoyle et al., 2023), leading to a low interest in exploring both areas (Billingsley & Nassaji, 2021). The situation is exacerbated by teachers' limited ability to implement interdisciplinary and contextual learning methods.

Several previous studies have discussed the relevance of integrating science with Islamic values. The integrative learning approaches based on the Qur'an enhanced students' conceptual understanding (Saputra et al., 2024). Similarly, implementing the STEAM model in madrasahs could foster students' creativity (Sánchez & Cortés, 2015). The importance of teacher training in executing an integrative curriculum (Septianingsih et al., 2024), project-based learning within an Islamic context encouraged student engagement (Fakhrurrazi et al., 2023). These studies emphasise integrating values and science, though they differ in context (Madrasah versus Public Schools) and approach (theoretical versus classroom practice).

This study differs by emphasising genuine collaboration between general subject teachers and religious teachers within an integrative learning ecosystem at the Madrasah Ibtidaiyah level. This study offers novelty by developing a STEAM-based integrative model that is thematically linked with Islamic values and

collaboratively implemented by both general and religious teachers within a unified learning ecosystem. Furthermore, this study focuses on the madrasah ibtidaiyah level as a foundational stage for character formation and cognitive skills development. By combining project-based learning and Islamic values within the curriculum, students are expected to internalise scientific concepts (Harrison et al., 2020) more meaningfully and holistically. These findings are expected to advance progressive, contextual, and relevant Islamic education significantly. This article aims to examine the integration of STEAM education with Islamic values at MI Al-Khoiriyah as an effort to foster scientific literacy among Muslim elementary students

METHODS

This study employs a qualitative descriptive approach using the case study method, aiming to gain an in-depth understanding of the integration process of the STEAM approach with Islamic values in learning at a Madrasah Ibtidaiyah (Islamic elementary school). This approach was chosen because it allows the researcher to explore educational phenomena holistically, considering the social, cultural, and spiritual contexts that influence learning practices within the madrasah environment. The case study aims to reveal the dynamics, strategies, challenges, and opportunities that arise in developing and implementing the STEAM-Islamic integrative learning model.

This study was conducted over four months, from February to May 2025, at MI Al-Khoiriyah in Banyuasin, South Sumatra. The school was purposively selected for its implementation of a learning approach that integrates STEAM education with Islamic values at the elementary level. The informants comprised 12 individuals: one principal, three fourth-grade teachers, six fourth-grade students, and two parents. Informants were selected purposively to understand the integration of STEAM and Islamic education practices in the madrasah.

The research subjects consisted of the principal, general subject teachers (science and mathematics), Islamic education teachers, and fourth and fifth-grade students at a selected Madrasah Ibtidaiyah that has implemented an integrative learning approach. The subjects were selected through purposive sampling, based on criteria such as the school's initiative to develop curriculum integration and experience in implementing project-based learning. The object of the study is the integrative learning model applied in the madrasah, particularly in connecting science and technology concepts with Islamic values.

Data collection techniques were carried out through three main methods: (1) in-depth interviews with the principal and teachers to obtain information about the planning and implementation of learning; (2) participant observation of classroom activities that integrate STEAM components and Islamic values; and (3) document analysis, including syllabi, lesson plans, project worksheets, and student work as

physical evidence of the model's implementation. The interviews were conducted semi-structuredly to allow broader exploration in accordance with field dynamics.

The collected data were analysed using thematic analysis, identifying, grouping, and interpreting key themes from interviews, observations, and documentation. The analysis steps included data transcription, coding, categorisation, and drawing conclusions based on emerging patterns. This technique enabled the researcher to uncover the integrative learning practice's contextual meaning and evaluate its effectiveness and challenges in the madrasah ibtidaiyah context.

To ensure data validity, the researcher used triangulation of sources and techniques by comparing data from various informants (teachers, principal, students) and methods (interviews, observations, documentation). Additionally, member checking was conducted, where respondents confirmed interim findings to ensure the accuracy and credibility of the data. An audit trail further reinforced validity, which involved systematically documenting the entire data collection and analysis process to ensure traceability and rigour throughout the research.

The selection of a case study in this research is based on a contextual approach that emphasises the importance of an in-depth understanding of phenomena within their natural settings. A case study is considered appropriate for exploring the integration of STEAM education and Islamic values at MI Al-Khoiriyah, as it allows the researcher to holistically grasp the relationships between individuals, school culture, and learning practices. This approach aligns with social constructivism, which views meaning as being formed through social interaction. The unique characteristics of MI Al-Khoiriyah make it a relevant case that can enrich Islamic education theory at the elementary level.

RESULTS AND DISCUSSIONS

The research findings indicate that the Madrasah Ibtidaiyah (Islamic Elementary School) selected for the study has made various efforts to integrate the STEAM approach with Islamic values in its teaching practices. Based on observations in grades IV and V, it was found that teachers have begun to link scientific concepts with Islamic values within thematic learning activities. For example, in the ecosystem lesson, the teacher connected the importance of maintaining environmental balance with a verse from the Qur'an, Surah Al-A'raf, verse 56. Students were then assigned an "Eco-Friendly Beautiful Garden" mini project based on Islamic principles, as shown in Figure 1.

Figure 1. Implementation of STEM Project-Based Learning

Based on the documentation results, it can be seen that the STEM learning implemented by the students of Madrasah Ibtidaiyah Al-Khoiriyah is grounded in a Project-Based Learning (PjBL) approach. In science, students observed various materials such as wood, cardboard, and pipes to understand their properties and uses. In contrast, in the technology aspect, they utilised simple tools such as scissors, glue, and rulers in the design process. Furthermore, the engineering aspect was realised through collaboration in building construction models by applying principles of design and structure. In contrast, the mathematics aspect was applied through measurement, shape calculation, and symmetry to ensure the project produced was stable and balanced.

This STEM practice has been integrated with Islamic Religious Education through several value dimensions. The values of togetherness and cooperation are linked to the principle of mutual assistance in goodness (QS. Al-Maidah: 2). The values of accuracy and responsibility are in line with the Prophet Muhammad's SAW hadith on the importance of working with *itqan* (excellence). Order and balance reflect the perfection of Allah's creation (QS. Al-Mulk: 3–4). At the same time, the use of knowledge and technology for the benefit of society is viewed through the lens of *fiqh* and *muamalah*. Thus, STEM learning practice not only develops skills in science, technology, engineering, and mathematics but also instills Islamic values in the domains of ethics (*akhlaq*), faith (*tauhid*), and social interaction (*muamalah*) (Asyafah, 2019; Septianingsih et al., 2024).

Interviews with one of the teachers at MI Al-Khoiriyah revealed that:

> "Project-based learning is relatively easier to implement in science and mathematics themes. Teachers noted that these subjects' exploratory and observation-based nature aligns well with the STEAM approach, especially when connected to real-life contexts enriched with Islamic values. For example, in a lesson on the water cycle, students were tasked with creating a simple model and encouraged to reflect on Quranic verses related to rain and

God's power in regulating the universe. This added meaningfulness to the learning activities by linking scientific knowledge with spirituality."

Integrating the STEAM approach with Islamic Religious Education at MI Al Khoiriyah is an innovative effort to bring students more meaningful learning. Through this integration, teachers teach 21st-century cognitive aspects and skills and instil Islamic spiritual values and morals relevant to daily life. The results of field observations show that these integration efforts have been carried out in various forms, although there is no standard curriculum model. The following findings illustrate how STEAM and Islamic Religious Education integration is implemented at MI Al Khoiriyah based on student responses, the principal's statements, and learning documentation.

Table 1. Integration of STEAM and Islamic Education in MI Al Khoiriyah

Aspect	Field Findings	Data Source	Additional Notes
Student Responses	Students showed greater enthusiasm when hands-on learning was connected to religious values they understood.	Classroom observation, student interview	One student stated they felt more 'connected' when learning science through stories of prophets and Islamic teachings.
Principal's Statement	There is no standardised curriculum or systematic model for STEAM-Islamic integration. Teachers develop their lessons independently using personal experience or online sources.	Interview with the school principal	Model development is still heavily reliant on individual teacher initiative and self-sourced materials.
Learning Documentation	Lesson plans and student project sheets showed integrative efforts, such as linking physical motion concepts with faith in Allah as the Creator of natural laws.	Documentation review (lesson plans, project sheets)	Integration of Islamic values is often symbolic and lacks in-depth analysis from an Islamic scientific perspective.

From the students' perspective, the observation results show they are more enthusiastic when practical learning is connected to religious values they understand. One student mentioned feeling more "engaged" when learning science linked to the stories of the Prophets and Islamic teachings. On the other hand, interviews with the head of the madrasah confirmed that there is no established model or standardised curriculum regarding the integration of Islamic STEAM. So far, teachers have taken initiative, often relying solely on personal experience or independent internet searches.

However, teachers also highlighted several challenges that hinder the optimal implementation of this integrated approach (Desfita et al., 2024). One of the main issues is the limited availability of teaching materials that explicitly combine Islamic values with STEAM topics. Most textbooks and available references still separate scientific content from religious teachings, requiring teachers to develop relevant instructional materials independently. Additionally, time constraints in designing lesson plans tailored to this approach pose another difficulty. Teachers need extra time to plan meaningful activities, select appropriate verses or hadiths, and balance cognitive and affective learning objectives.

Despite these challenges, teachers expressed strong enthusiasm for this method. They observed a notable increase in student participation during the learning process. Students were more actively engaged in asking questions, discussing, and showing a high interest in the subject, especially when recognising the connection between scientific concepts and Islamic teachings. This was considered one of the major successes of the STEAM-Islamic education integration strategy, as it enhanced students' academic skills and nurtured their spiritual awareness from an early age. Teachers hoped this approach would continue to be developed through professional training, providing integrative modules and policy support from school administrators and government bodies.

The obtained documentation, such as teaching modules and student project sheets, shows integrative efforts, although they are not yet systematic. For example, some worksheets link the concept of motion with faith in Allah as the Creator of the laws of nature. However, the integration of Islamic values tends to be symbolic and has not yet delved into an in-depth analysis of scientific concepts from an Islamic perspective (Kasim & and Yusoff, 2024). These facts indicate a significant potential for integrating STEAM and Islamic values, although its implementation still faces various structural and methodological challenges. Integrative education at the primary level remains partial and highly dependent on the teachers' individual capacity, highlighting the need for systematic curriculum planning.

This condition presents a compelling research opportunity due to its significant potential for educational transformation by integrating STEAM with Islamic values. This integration is believed to cultivate academically and spiritually excellent students and equip them to meet the era's demands for innovative and morally upright individuals. Such an approach aligns with the spirit of Islamic education, which emphasises the balance between reason and faith. Therefore, the research site provides an appropriate setting for developing and testing an applicable and sustainable value-science integrated learning model.

Several previous studies have discussed the relevance of integrating science with Islamic values. For example, integrative learning approaches based on the Qur'an enhanced students' conceptual understanding (Saputra et al., 2024). Similarly, implementing the STEAM model in madrasahs could foster students'

creativity. The importance of teacher training in executing an integrative curriculum (Septianingsih et al., 2024), project-based learning within an Islamic context, encouraged student engagement (Fakhrurrazi et al., 2023). These studies emphasise integrating values and science, though they differ in context (madrasah vs. public schools) and approach (theoretical vs. classroom practice). From a pedagogical approach, project-based learning linked to moral values can significantly enhance students' motivation and engagement. (Batubara et al., 2023). This supports field findings that students are more enthusiastic when the learning approach is contextual and spiritually meaningful.

Integrating science and Islam requires teachers to possess interdisciplinary competence and institutional support, such as training and teaching materials (Astuti et al., 2024). The fact that teachers at the Madrasah Ibtidaiyah in the research location took the initiative to integrate Islamic values reflects teacher agency, but also indicates a lack of systemic structural support. Integrating religious values into STEAM learning can encourage students to understand science from a *tauhid* (monotheistic) perspective, provided that the integration is carried out in a deep and non-symbolic manner. This finding is highly relevant to the observation results, which show that integration in Madrasah Ibtidaiyah is still limited to textual associations and has not yet reached the conceptual and analytical level.

A comparison between field findings and previous studies reveals that the novelty of this research lies in the presentation of in-depth empirical data at the Madrasah Ibtidaiyah level, as well as an authentic portrayal of the challenges and informal strategies involved in Islamic STEAM integration without a standardised curriculum. This study also emphasises that to establish Madrasahs as centres of integrative education, there is a need for a structured curriculum framework, comprehensive teacher training, and the provision of relevant and contextual learning resources (Alkhabra et al., 2023).

STEAM Integration in Islamic Education

STEAM integration in Islamic education has significantly enhanced MI Al-Khoiriyah students' interest and understanding of science. Integrating STEAM education into Islamic education through a constructivist lens emphasises the importance of interdisciplinary learning and cultural relevance. This approach aligns with KH's ideas. Sahal Mahfudz, who advocated for integrative Islamic education that is open to socio-cultural contexts and innovative practices (Irham, 2022). Several elementary schools indicate that the implementation of the STEAM approach, combined with Islamic values, can increase student engagement in learning (Bertrand & Namukasa, 2023), (Jamali et al., 2023). Most students reported that they became more interested in science lessons after participating in a STEAM program integrated with Islamic teachings, such as the concept of *tawhid*, which teaches that everything in the universe is a creation of Allah.

Furthermore, evaluation results show that students involved in this program were able to develop critical and creative thinking skills. In a group project involving the creation of simple tools to utilise renewable energy, students not only learned about science but also understood the importance of environmental stewardship as part of their responsibility as Muslims (Marín et al., 2021). Thus, the integration of STEAM in Islamic education not only enhances academic knowledge but also shapes students' character in accordance with Islamic values (Green & Lee, 2020).

Student and teacher responses to teaching methods integrating STEAM with Islamic education are generally positive. Teachers feel that the STEAM approach provides space for students to explore and innovate, an essential aspect of 21st-century education. This aligns with the view that education should prepare students to face global challenges in creative and critical ways (Lewis & Lingard, 2023).

On the other hand, students also experience the positive impact of this method. Many students felt more confident presenting their ideas in front of the class. For instance, in an art project that combined painting techniques with Islamic themes, students felt proud to express their understanding of religion through artistic creations (Dalimunthe et al., 2024). This indicates that STEAM integration focuses on academic achievement and supports students' social and emotional development.

Developing a STEAM-Based Curriculum Integrated with Islamic Values

Developing a STEAM-based curriculum that integrates Islamic values is crucial in nurturing Muslim scientists from an early age. This curriculum must be carefully designed to encompass aspects of science and technology while remaining grounded in Islamic principles (Hashim, 2020). A curriculum that emphasises such integration can enhance students' understanding of scientific concepts while simultaneously strengthening their faith and fostering greater tolerance toward differences in worship practices (Amar et al., 2025).

MI Al-Khoiriyah teachers can explain the water cycle by highlighting the greatness of Allah's creation. This makes the lesson more engaging and gives students a deeper spiritual context. In several schools, STEAM-based projects involving scientific experiments connected to Islamic teachings have successfully improved students' awareness of the importance of environmental preservation (Eissa & Khalid, 2019). Thus, developing an appropriate curriculum is key to shaping a generation of Muslim scientists with integrity.

Challenges and Solutions

The integration of STEAM into Islamic education shows great potential; its implementation has several challenges. One of the main challenges teachers at MI Al-Khoiriyah face is the lack of learning resources regarding teaching materials and facilities. As a school located in a remote area, it does not have adequate access to the tools and technologies needed to implement the STEAM approach.

Another challenge lies in the understanding and acceptance of the STEAM method among some teachers and parents. Some educators may feel uncomfortable with this new approach and prefer traditional teaching methods that they find more manageable (Rosanti et al., 2024). This situation can hinder the learning process and reduce the effectiveness of the programs that have been designed (Körtesi et al., 2022). Therefore, it is important to identify and address these obstacles to implement STEAM integration in Islamic education effectively. Several strategic steps are needed to overcome these challenges. First, the government and educational institutions must provide sufficient resources, including tools and teaching materials that meet the needs of a STEAM-based curriculum. Government aid programs or partnerships with the private sector can help increase access to these resources (Li et al., 2022).

Second, professional development and teacher training must be strengthened. Ongoing training programs can help teachers better understand and master the STEAM method to implement it confidently. In addition, involving parents in the educational process through seminars or workshops can help them understand the benefits of this approach, making them more supportive of the changes occurring in schools (Nipyrakis et al., 2023). With these measures, it is hoped that STEAM integration into Islamic education can be more successfully implemented, producing Muslim scientists who excel academically and in character and integrity.

Research Contributions to the Theory and Practice of STEAM-Islamic Education Integration

The findings of this study make an important contribution to the development of theory regarding the integration of STEAM and Islamic education. The approach implemented by MI Al-Khoiriyah demonstrates that this integration is theoretically feasible and practically applicable in primary education. Theoretically, it supports the idea that science and religion need not be separated but can reinforce each other in shaping students' character and competencies.

Integrating STEAM and Islamic education at MI Al-Khoiriyah also provides evidence that a holistic educational approach can balance the development of students' cognitive, affective, and spiritual dimensions. Practically, the strategies applied by MI Al-Khoiriyah, such as using scientific experiment-based projects linked to Islamic values, integrated thematic learning, and teacher involvement in cross-disciplinary collaboration, have proven effective in cultivating students' interest in science while strengthening their Islamic identity. This approach can be a model for other Madrasahs seeking to adopt STEAM education without compromising their Islamic mission.

On the other hand, challenges remain, such as the limited number of STEAM teachers with a strong understanding of Islamic teachings. This ongoing task must be addressed through targeted teacher training and developing a more systematic,

integrative curriculum. Integrating STEAM with Islamic education is becoming increasingly important in modern education. This integration teaches students about science and technology and the moral and ethical values rooted in Islamic teachings. According to research by UNESCO, education that combines spiritual aspects with scientific knowledge can enhance students' creativity and innovation (Zapp, 2021). For example, in several schools in Indonesia, STEAM programs integrated with Islamic education have improved students' achievements in science and mathematics and their character development (Hamami & Nuryana, 2022).

CONCLUSIONS AND SUGGESTIONS

Integrating the STEAM approach with Islamic values at the Islamic Elementary Education level offers significant theoretical and practical contributions. Theoretically, this approach reinforces the concept of holistic education that combines scientific knowledge with character and spiritual development, which aligns with constructivist theory and integrative pedagogy. Practically, research findings indicate that students engaged in STEAM-Islamic learning demonstrate a better understanding of scientific concepts and exhibit positive attitudes such as responsibility, collaboration, and social awareness.

Therefore, education policymakers and curriculum developers at the primary level should promote the systematic integration of STEAM-Islamic education through adaptive curricula, continuous teacher training, and adequate resource provision, especially in remote areas. This model also holds great potential for national development as an alternative framework for elementary education, and can even be expanded internationally as Indonesia's unique contribution to Islamic teaching. Further research, particularly longitudinal studies and the exploration of technologies such as artificial intelligence, is needed to optimise the development of this approach in shaping intellectually and spiritually strong future generations.

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