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An Analysis of the Impact of Science, Technology, Engineering, Arts, and Mathematics (STEAM) Approach on the Learning Outcomes of Islamic Education among High School Students

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Abstract: An Analysis of the Impact of Science, Technology, Engineering, Arts, and Mathematics (STEAM) Approach on the Learning Outcomes of Islamic Education among High School Students

Objective: This study aims to analyze the impact of using the Science, Technology, Engineering, Arts, and Mathematics (STEAM) approach on the learning outcomes of Islamic education (PAI) students at the Senior High School level. **Methods:** The research design used a survey approach. The sample was taken using a stratified random sampling technique, totaling 300 students. Data collection using questionnaires. Data analysis using analysis of variance (ANOVA). **Results:** The STEAM approach improves students' understanding of Islamic education materials and increases their motivation to learn. **Conclusion:** Applying the STEAM approach in Islamic education can improve learning outcomes and positively impact by creating a more relevant, interesting, and contextualized learning experience. **Contribution:** This research contributes to local governments and schools' formulation of educational policies toward the widespread use of the STEAM approach at the high school level.

Keyword: STEAM Approach; Learning Outcomes; Islamic education; Senior High School

Abstrak: Analisis Dampak Pendekatan Science, Technology, Engineering, Arts, and Mathematics (STEAM) terhadap Hasil Belajar Pendidikan Agama Islam pada Siswa Sekolah Menengah Atas

Tujuan: Penelitian ini bertujuan untuk menganalisis dampak penggunaan pendekatan Science, Technology, Engineering, Arts, and Mathematics (STEAM) terhadap hasil belajar Pendidikan Agama Islam (PAI) siswa di tingkat Sekolah Menengah Atas. **Metode:** Desain penelitian menggunakan pendekatan survei. Sampel diambil menggunakan teknik stratified random sampling, berjumlah 300 siswa. Pengumpulan data menggunakan angket. Analisis data menggunakan analysis of variance (Anova). **Hasil:** Pendekatan STEAM meningkatkan pemahaman siswa tentang materi pendidikan Islam dan meningkatkan motivasi mereka untuk belajar. **Kesimpulan:** Penerapan pendekatan STEAM dalam PAI dapat meningkatkan hasil belajar dan memberikan dampak positif dengan menciptakan pengalaman pembelajaran yang lebih relevan, menarik, dan kontekstual. **Kontribusi:** Penelitian ini berkontribusi sebagai bahan pertimbangan bagi pemerintah daerah dan sekolah dalam merumuskan kebijakan pendidikan terhadap penggunaan pendekatan STEAM secara luas di tingkat SMA.

Kata Kunci: Pendekatan STEAM; Hasil Belajar; Pendidikan Agama Islam; Sekolah Menengah Atas

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A. INTRODUCTION

Islamic education plays an important role in shaping students' character and morals, serving as the foundation of spiritual values that equip them to face the challenges of the modern world (Kurniati & El-Yunusi, 2023). However, in the digital era, marked by rapid technological advancement, conventional methods of teaching Islamic education are often seen as less responsive to the needs of a generation with unlimited access to information and exposure to modern knowledge (Pai, 2024). This situation challenges Islamic education to remain relevant in both content and teaching methods in order to keep pace with evolving ways of thinking and the increasingly dynamic cognitive demands of students (Slavich & Zimbardo, 2012).

The teaching of Islamic education faces several challenges that significantly impact student learning outcomes. A primary issue is the limited competence of educators and the use of ineffective instructional methods. Many educators still lack the necessary skills to manage learning effectively, and the techniques employed are often monotonous and lack diversity (Sivarajah et al., 2019). Traditional methods that emphasize rote memorization over deep understanding continue to dominate, resulting in a failure to foster students' critical thinking skills and active engagement in the learning process (Amaly et al., 2023). Moreover, the learning environment and the media utilized are frequently inadequate. The limited use of interactive and varied learning media hampers students' ability to grasp the material in a contextualized manner and diminishes their interest in studying Islam. This misalignment further deteriorates learning outcomes, as students become less motivated to engage with essential religious values (Omar, 2022).

Integrating the STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach is a potential solution (Fauzi & Fajrin, 2022). STEAM is an interdisciplinary approach combining five disciplines to create more contextual learning and focuses on developing 21st-century skills such as critical thinking, creativity, communication, and collaboration (Wilson et al., 2021). Implementing STEAM in Islamic education learning can bring innovation to how students perceive and understand Islamic values not merely as a set of rules or dogmas but as principles that can be integrated with real-world problem-solving, including complex global challenges.

The STEAM approach in Islamic education can bridge the gap between religious knowledge and modern science (Adiyono et al., 2024). For example, the concept of tauhid (the oneness of Allah Swt., can be integrated into scientific learning to demonstrate the universe's orderliness as a sign of Allah's greatness (Al Faruqi, 2021). Technology learning can be connected to Islamic ethics regarding the responsible use of technology (Kumar et al., 2022). Art in STEAM can be combined with the expression of Islamic values through calligraphy or visual designs that reflect the moral messages of the Qur'an (Hillenbrand, 2022). Thus, this integration enriches the learning content and expands students' exploration of the relationship between religion and modern knowledge.

From a pedagogical perspective, STEAM can transform Islamic education teaching dynamics from passive lecture-based approaches to more active and collaborative ones (Fisher, 2021). Students are encouraged to participate in problem-based learning projects that allow them to apply Islamic values in real-life contexts (Kholidah, 2022). For instance, students could be tasked with designing eco-friendly technology projects to implement Islamic teachings on environmental conservation (Albar et al., 2024). Activities like these enhance students' emotional and intellectual engagement while deepening their understanding of the essence of Islamic teachings (Huda et al., 2017).

Moreover, integrating STEAM into Islamic education can address the challenge of maintaining Islamic education, which is relevant in students' eyes in the digital era. Technology can make learning more interactive through Qur'an-based educational apps or digital simu-

lations that teach Islamic moral concepts. This can also help shape students' character, enabling them to understand Islamic teachings cognitively and apply them practically in an increasingly interconnected global world. However, implementing STEAM in Islamic education learning requires significant effort. Islamic education teachers must have adequate skills and knowledge about STEAM and the ability to integrate various disciplines into the curriculum. Continuous training and policy support from schools and the government are essential to ensure this integration is effective and has a significant impact.

Research on the STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach in education has developed rapidly, particularly in science and technology subjects. This approach is known to enhance students' critical thinking, creativity, and problem-solving skills (Khan et al., 2023; Mubarok et al., 2024; Robikho et al., 2024; Khoirunnisa & Isdaryanti, 2024; Khotimah et al., 2024; Muntamah et al., 2024; Tajqiyah et al., 2024; Fauzi & Fajrin, 2022; Pramudyani & Indratno, 2022; Rahman et al., 2023; Sanusi et al., 2022). The STEAM approach is generally applied in mathematics and science, while its implementation in Islamic education remains limited. Previous studies have explored technology integration in religious education. Still, they have not specifically examined how STEAM can be applied to improve learning outcomes in Islamic education at the high school (SMA) level.

The gap analysis reveals that most STEAM-related research primarily focuses on improving conceptual understanding in science and technology, while its application to value-based religious education remains largely underexplored. Furthermore, few studies have examined how the STEAM approach can assist students in grasping concepts in Islamic education in a more applied, innovative, and problem-solving-oriented manner. There is still a notable gap in understanding how this method can enhance students' cognitive, affective, and psychomotor learning outcomes within Islamic education contexts.

This study introduces a new perspective by investigating how integrating STEAM into Islamic education can enrich teaching methods, deepen student understanding, and make religious education more contextual and relevant to contemporary developments. This approach not only facilitates the theoretical transmission of religious knowledge but also connects it with technological innovation, artistic creativity, and real-world problem-solving. Moreover, this study contributes to the development of more interdisciplinary learning strategies for teaching Islamic values through project-based activities, experimental learning, and creative arts integration. Consequently, this research broadens the theoretical framework of Islamic education and proposes an innovative instructional model aimed at enhancing the quality of religious education at the high school level.

B. METHOD

This study adopts a quantitative approach using a survey method to collect data. The population consists of all high school students in Depok City during the 2023–2024 academic year who participated in Islamic education classes, estimated to number around 20,000 students based on the latest educational data. To obtain a representative sample, the study employs stratified random sampling, ensuring variation within the population by dividing students into strata based on school and grade level, followed by random selection from each stratum. The final sample size is set at 400 students, deemed sufficient to yield valid and reliable results.

The research instruments include questionnaires, learning tests, and classroom observations. The questionnaire gathers students' perceptions of STEAM-based learning and its impact on their understanding of Islamic values. The learning tests measure students' knowledge of Islamic education material following the implementation of the STEAM approach, while classroom observations are used to assess student engagement during the learning process. Research procedures involve designing and validating instruments, distributing questionnnaires, administering learning tests, and conducting classroom observations.

The collected data are processed and analyzed using statistical techniques such as linear regression to examine the contribution of STEAM to learning outcomes, and Analysis of Variance (ANOVA) to compare learning outcomes between students who receive Islamic education instruction with and without the STEAM approach. This methodology aims to provide a comprehensive understanding of the effectiveness of integrating STEAM into Islamic education in the digital era.

C. RESULTS AND DISCUSSION

Result

The research results indicate a significant difference in students' average learning outcomes before and after implementing the STEAM approach in Islamic education (PAI). Before applying STEAM, the average learning outcome score was 72.3, with a standard deviation 8.5. After the implementation of STEAM, the average score increased significantly to 81.7, with a standard deviation of 7.2. This change signifies a substantial improvement in students' understanding of PAI material after applying the STEAM approach.

Table 1. Comparison of Students' Learning Outcomes before and After the Implementation of the STEAM Approach in Islamic Education

Learning Outcome	Mean Score	Standard Deviation (SD)
Before STEAM	72.3	8.5
After STEAM	81.7	7.2

In addition to improving learning outcomes, students' motivation to learn significantly increased. The motivation scores measured using a questionnaire revealed an average motivation score of 65.4 before the application of STEAM, which rose to 78.1 after the STEAM implementation. This indicates that the STEAM approach enhances students' learning outcomes and effectively boosts their learning motivation. This increase demonstrates that the STEAM approach, integrating science, technology, engineering, arts, and mathematics, can significantly impact students' understanding of the material and their motivation in PAI learning.

Table 2. Comparison of Students' Motivation Scores before and After the Implementation of the STEAM Approach in Islamic Education

Measurement Time	Average Motivation Score
Before STEAM Implementation	65.4
After STEAM Implementation	78.1

The findings of this study provide strong support for the initial hypothesis that implementing the STEAM approach in Islamic education can enhance student learning outcomes and motivation. The increase in the average learning outcome score from 72.3 to 81.7 following the application of STEAM indicates that this approach effectively improves students' understanding of Islamic education material. This improvement can be attributed to the interdisciplinary nature of STEAM, which integrates components of science, technology, engineering, arts, and mathematics, creating a more holistic and contextualized learning experience. By connecting Islamic education concepts to real-world applications, students can grasp theoretical content and recognize its relevance in contemporary contexts.

Additionally, the rise in motivation scores from an average of 65.4 to 78.1 reinforces these results. Increased motivation suggests that STEAM positively influences cognitive development and students' affective domains. Higher motivation levels are closely linked to greater engagement and a stronger desire to learn key indicators of an effective teaching method. By making learning more relevant, interactive, and engaging, the STEAM approach addresses the boredom and passivity often associated with traditional instructional methods.

Table 3. Summary of Learning Outcomes and Motivation Scores Before and After STEAM Implementation in Islamic Education

Measurement Time	Average Learning Outcome Score	Average Motivation Score
Before STEAM Implementation	72.3 ± 8.5	65.4
After STEAM Implementation	81.7 ± 7.2	78.1

These findings align with previous studies demonstrating the benefits of the STEAM approach in various learning contexts. Research by Mubarok et al. (2024) shows that STEAM can improve conceptual understanding in physics education, while Khoirunnisa & Isdaryanti (2024) confirmed the effectiveness of STEAM in enhancing students' critical thinking skills in science subjects. These results affirm the strength of the STEAM approach in improving understanding and motivation across different subjects.

In the context of Islamic education, the application of STEAM offers an innovative solution to bridge the gap between spiritual values and modern technological demands (Shatunova et al., 2019). By integrating STEAM elements into Islamic education learning, teachers can make the teaching material more relevant to current challenges and realities faced by students (Domenici, 2022). This integration allows students to connect Islamic principles with current technology and innovations, making them more understandable and acceptable (Adi, 2020). Furthermore, this approach helps students develop skills needed in the digital era, such as critical thinking, creativity, and problem-solving, which are essential components of holistic and relevant education.

Overall, the results of this study indicate that integrating the STEAM approach into Islamic education education at the high school level improves student learning outcomes and motivation. This underscores the importance of adopting an interdisciplinary approach in religious education to address the challenges of the digital age and prepare students with the skills and knowledge necessary for future success.

Discussion

The STEAM approach, which integrates disciplines such as science, technology, engineering, arts, and mathematics, creates a more holistic and contextualized learning experience. This integration helps students understand Islamic education theories and relate them to real-world applications. For instance, applying Islamic education concepts within scientific or technological contexts can demonstrate the relevance of religious teachings in the modern world. By combining theoretical knowledge with practical applications, STEAM fosters a more engaging and meaningful learning environment, thereby reducing the monotony often associated with purely theoretical instruction.

The improvement in learning outcomes and motivation can largely be attributed to the interdisciplinary nature of STEAM. By bridging the gap between abstract spiritual principles in Islamic education and their practical real-world applications, STEAM enables students to explore ethical questions surrounding technological advancements, thus connecting Islamic values with contemporary challenges (Shatunova et al., 2019).

The rise in student motivation is closely tied to increased engagement during learning activities. Higher levels of motivation encourage students to participate more actively, ask critical questions, and engage in class discussions-all key indicators of an effective teaching method. By addressing common challenges in traditional learning, such as boredom and passivity, the STEAM approach significantly enhances the overall learning experience. Moreover, previous research by Mubarok et al. (2024) and Khoirunnisa & Isdaryanti (2024) supports the positive impact of STEAM in fostering critical thinking and conceptual understanding across various disciplines, further reinforcing the findings of this study. Domenici (2022) also high-

lights the relevance of STEAM in modern education, noting its role in connecting traditional knowledge with essential 21st-century skills such as creativity and problem-solving.

Applying STEAM in Islamic education enhances not only cognitive outcomes but also affective aspects by increasing students' motivation and engagement. By contextualizing Islamic principles through interdisciplinary learning, educators offer students a holistic educational experience that is both spiritually enriching and practically applicable (Riaz et al., 2023). This approach aligns with the needs of the digital era, equipping students with critical skills to navigate contemporary challenges while remaining rooted in Islamic values.

The implementation of STEAM in Islamic education offers an innovative solution to bridge the gap between spiritual values and the demands of modern technology (Shatunova et al., 2019). By incorporating STEAM elements into Islamic education, teachers can make learning more relevant to the current realities faced by students (Domenici, 2022). This integration not only helps students connect Islamic principles with technological and scientific innovations but also fosters skills crucial for the digital age, such as critical thinking, creativity, and problem-solving (Adi, 2020).

The findings of this study confirm the initial hypothesis that the STEAM approach significantly improves learning outcomes and student motivation in Islamic education. By creating a more interactive and engaging learning environment, STEAM enables students to apply Islamic concepts to real-life situations, making education more meaningful and impactful. Future research could expand on these findings by exploring the broader application of STEAM in different religious and cultural educational contexts to further validate its effectiveness.

This study presents the integration of the STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach into Islamic education as a novel contribution to educational practice. The research demonstrates significant improvements in both learning outcomes and student motivation through the fusion of traditional religious instruction with modern interdisciplinary methods. This approach prepares students with essential 21st-century skills while grounding them in Islamic values. Its novelty lies in addressing the gap between religious education and the demands of the digital age, showing how STEAM can make Islamic education more relevant, engaging, and applicable to real-world contexts (Khoirunnisa & Isdaryanti, 2024; Shatunova et al., 2019). Incorporating STEAM into religious education can thus better equip students for future challenges while fostering both their academic and spiritual development.

D. RESEARCH IMPLICATIONS AND CONTRIBUTIONS

1. Research Implications

This study has significant implications for the field of education, particularly in enhancing the quality of Islamic education at the senior high school level. The findings demonstrate that incorporating the STEAM approach integrating science, technology, engineering, arts, and mathematics into Islamic education can significantly improve students' comprehension of the material. Through this interdisciplinary method, students can better perceive the relevance of religious teachings within the context of the modern world, leading to greater engagement in the learning process. Additionally, the notable increase in student motivation indicates that this approach positively influences cognitive development and affective aspects, such as students' interest and enthusiasm for learning. Consequently, implementing the STEAM approach presents a promising alternative to conventional teaching methods, which often struggle to maintain students' engagement and relevance in today's educational environment.

2. Research Contribution

This study makes several key contributions. First, from a theoretical standpoint, it expands the existing knowledge on integrating STEAM disciplines within religious education, particularly in Islamic education. Second, it provides empirical evidence demonstrating the

positive effects of the STEAM approach on students' learning outcomes and motivation, offering valuable insights for educators in designing more effective teaching strategies. Third, the research highlights the significance of an interdisciplinary approach to religious education that blends religious teachings with scientific concepts. The findings can serve as a foundation for developing modern, relevant religious education curricula in schools and offer policymakers new perspectives for adopting more innovative and comprehensive teaching methods.

E. RECOMMENDATIONS FOR FUTURE RESEARCH DIRECTIONS

Future studies are anticipated to make broader and more in-depth contributions to advancing the STEAM approach in Islamic Education, both theoretically and practically. They should explore the impact of digital tools or applications in facilitating STEAM-based learning in Islamic Education and investigate how local educational policies support the integration of STEAM in religious education.

F. CONCLUSION

This study shows that incorporating the STEAM (Science, Technology, Engineering, Arts, Mathematics) approach into Islamic education significantly improves students' learning outcomes and motivation. Before the implementation of STEAM, the average learning score was 72.3, with a standard deviation of 8.5. After applying the STEAM method, the average score rose to 81.7, with a standard deviation of 7.2, reflecting a notable enhancement in students' comprehension of Islamic education content. In addition, student motivation increased considerably as the motivation score improved from 65.4 to 78.1. This highlights that the STEAM approach positively influences cognitive and affective aspects, boosting engagement and enthusiasm for learning.

Integrating STEAM elements in Islamic education provides an innovative solution to reconcile spiritual values with modern technological demands. This approach offers a more comprehensive and contextually relevant learning experience, enabling students to connect Islamic principles with real-world applications. By blending disciplines such as science, technology, engineering, arts, and mathematics, students gain a deeper understanding of Islamic education material and develop vital skills, including critical thinking, creativity, and problem-solving, essential for thriving today.

The findings highlight the effectiveness of the STEAM approach in enhancing learning outcomes and motivation at the high school level. It underscores the importance of an interdisciplinary approach to religious education that addresses the challenges of the digital age while equipping students with the knowledge and skills necessary for future success. To build on these findings, future research could examine the long-term effects of STEAM on student performance and explore its applicability across various educational levels and cultural contexts. Additionally, research into the role of teacher training in implementing STEAM could offer valuable insights into the method's effectiveness in diverse educational environments.

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AUTHOR CONTRIBUTIONS STATEMENT

All authors discussed the results and contributed to the final manuscript. NA: Conceptualization, Research framework & Writing - Original Draft. FM: Writing - Review & Editing.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no significant competing financial, professional or personal interests that might have influenced the performance or presentation of the work described in this manuscript.

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