Implementation of STEAM in Pesantren Curriculum: An Experimental Study Based on Local Wisdom

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ABSTRACT

This study aims to examine the implementation of STEAM (Science, Technology, Engineering, Arts, and Mathematics) approaches based on local wisdom in pesantren curriculum, as well as its impact on students' learning outcomes, interest, and participation. Utilizing a quasi-experimental design with pretest-posttest control group, the study involved two groups of pesantren students: one receiving STEAM-based learning integrated with pesantren local values, and the other using conventional methods. Data were collected through critical thinking tests, learning interest questionnaires, and observation sheets. The results indicate that students in the STEAM group achieved significantly better learning outcomes, showed higher interest, and were more actively involved in classroom activities compared to the control group. The integration of local wisdom—such as cooperation, responsibility, and environmental awareness—played a crucial role in contextualizing abstract scientific concepts into meaningful and applicable learning. This study contributes to the development of a culturally grounded educational model in Islamic boarding schools that harmonizes religious values with 21st-century skills.

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1. INTRODUCTION

Education is the main pillar in forming a strong generation that is able to face global challenges **(Fahdini, Furnamasari, & Dewi, 2021).** In the era of the Industrial Revolution 4.0, which is marked by the rapid development of digital technology and automation, the world of education is required to be more adaptive and innovative in preparing students to have 21st century skills such as critical thinking, collaboration, creativity, and digital literacy **(Susanto, 2024).** One approach that has received attention in responding to this challenge is the STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach (Aguilera &

Ortiz-Revilla, 2021). This approach emphasizes integrated and contextual cross-disciplinary learning, providing space for students to develop their academic potential as well as their socio-cultural character through project-based activities and problem solving **(Marín-Marín, Moreno-Guerrero, Dúo-Terrón, & López-Belmonte, 2021).**

Meanwhile, Islamic boarding schools as the oldest Islamic educational institutions in Indonesia have a major contribution in shaping the character and spirituality of the nation's generation. The existence of Islamic boarding schools not only produces graduates who understand religion, but also have noble values such as sincerity, independence, simplicity, and love for the environment. These values are referred to as the local wisdom of Islamic boarding schools, and are very important social capital in forming a religious and civilized generation. However, along with the development of the era and the needs of the modern work world, Islamic boarding schools face major challenges in integrating their religious curriculum with a contemporary educational approach based on science and technology **(Mejias et al., 2021).**

Problems arise when most Islamic boarding schools still adopt a traditional curriculum and have not been systematically integrated with the STEAM approach. This causes students to lack interdisciplinary, applicable, and relevant learning experiences with real problems in society. In addition, there is a gap between the potential local values of Islamic boarding schools and modern learning methods based on projects and innovation. In fact, local values such as mutual cooperation, concern for the environment, and social responsibility are very much in line with the spirit of STEAM which prioritizes active involvement, creativity, and contextual solutions. Another obstacle is also found in the lack of teacher training in understanding and applying local-based STEAM methods in daily learning **(Conradty & Bogner, 2020).**

As a solution to this problem, it is necessary to carry out a curriculum innovation in Islamic boarding schools that integrates the STEAM approach with local wisdom. In this way, science and technology learning is no longer seen as something foreign or contrary to the values of the Islamic boarding school, but rather as a means to strengthen the spirituality and empowerment of students. STEAM-based learning models that are designed by considering the local context and culture of Islamic boarding schools will be more easily accepted and internalized by students. Learning like this can be realized through exploration activities, collaborative projects, or problem solving that originates from the environment around the Islamic boarding school, such as simple technology-

based waste management, development of digital preaching media, or design of environmentally friendly agricultural systems.

Several previous studies have shown the effectiveness of the STEAM approach in improving students' critical thinking skills and creativity. Wahyuningsih **(Wahyuningsih et al., 2020)** explains that the STEAM approach allows for the harmonious integration of science and art to form holistic individuals. In Indonesia, research by Nuragnia et al. **(Nuragnia, Nadiroh, & Usman, 2021)** proves that STEAM learning at the elementary school level is able to encourage active participation and innovation in students. However, research examining the implementation of STEAM in Islamic boarding schools is still very limited, especially those developed based on local values typical of Islamic boarding schools. In fact, the local context is very important in determining the success of a learning approach, especially in an Islamic boarding school environment that has a unique culture and its own education system.

This study aims to develop and test the implementation of local wisdom-based STEAM learning in the pesantren curriculum. This study not only aims to measure the effectiveness of the approach on the learning outcomes of students, but also to formulate a contextual, applicable, and transformative learning model. Thus, this study is expected to be able to contribute to the development of a pesantren curriculum that is more adaptive to the development of the times, without abandoning its Islamic identity and local wisdom. This study also has high urgency in order to support the Merdeka Belajar policy and strengthen religious moderation, where students are not only required to be academically intelligent, but also have a strong cultural and religious identity.

This study will use a quasi-experimental method with a pretest-posttest control group design to test the effectiveness of local wisdom-based STEAM learning in Islamic boarding school environments **(Sugiyono, 2016).** The sample will consist of two groups of students, namely the experimental group that follows learning with the STEAM approach and the control group with conventional learning. Data collection instruments include critical thinking tests, learning interest questionnaires, and learning activity observation sheets. Data analysis will be carried out quantitatively using the t-test to determine the significance of the differences between the experimental and control groups.

The uniqueness and novelty of this research lies in its approach that combines STEAM education with local values of Islamic boarding schools in an experimental manner. If so far STEAM has been applied more in public schools or formal madrasas, then this research tries to bring this approach into the Islamic

boarding school ecosystem which is full of spiritual and cultural values. By designing a learning model that is not only based on science, technology, and art, but also rooted in local wisdom, this research offers a new perspective in building a modern, adaptive Islamic education system that remains authentic to its local values. This is the main scientific contribution of this study—an integrative approach that unites modernity and tradition in one meaningful educational framework.

2. METHODS

This study uses a quantitative approach with a quasi-experimental design method, which aims to test the effectiveness of implementing a local wisdom-based STEAM approach in the Islamic boarding school curriculum **(Sugiyono, 2016).** The research design used was a pretest-posttest control group design, in which there were two groups: an experimental group that received STEAM-based learning treatment with the integration of local pesantren values, and a control group that received conventional learning according to the applicable pesantren curriculum. This design was chosen because it allows researchers to compare the impact of the treatment objectively even though it was not carried out completely randomly (randomized controlled trial). The population in this study were junior high school/MTs equivalent students at one of the pesantren in Indonesia that already had a formal curriculum. The sample was taken using a purposive sampling technique, namely selecting classes or groups of students who have homogeneous characteristics in terms of age, educational background, and cognitive level. Each group consists of 25-30 students to maintain statistical validity. The experimental group will follow specially designed STEAM-based learning, where science, technology, engineering, art, and mathematics content is integrated with local values such as mutual cooperation, environmental awareness, independence, and the typical work ethic of the pesantren.

The research instruments include: First, Critical thinking test, to measure the students' ability to analyze, evaluate, and solve problems logically. Second, Learning interest questionnaire, to determine changes in students' attitudes and interests in learning after treatment. Third, Learning activity observation sheet, to evaluate students' involvement during the learning process, especially in the aspects of collaboration, creativity, and utilization of local wisdom. Fourth, Documentation and field notes, used to support qualitative data and interpretation of experimental results. Before treatment, both groups will be given a pretest to determine the initial conditions of critical thinking skills and learning interests. Furthermore, the experimental group will be given treatment

for 4-6 meetings with learning materials designed based on projects (project-based learning) using the STEAM approach and raising local issues or potentials around the Islamic boarding school, such as waste management, water conservation, or utilization of simple technology. After the treatment is complete, a posttest will be given to see changes in learning outcomes.

The pretest and posttest data will be analyzed using a t-test (paired and independent samples t-test) to determine the significance of differences in learning outcomes between before and after treatment and between the experimental group and the control group. In addition, descriptive analysis is used to evaluate the students' responses to STEAM-based learning and the extent to which the integration of local values affects the effectiveness of learning. This study is expected to produce a contextual and applicable STEAM learning model for Islamic boarding schools, as well as become the basis for developing a more integrative Islamic boarding school curriculum between modern science and local Islamic values. Thus, this research method not only tests the effectiveness of an approach, but also contributes to an implementative design for local and global-based Islamic boarding school education innovation in a balanced manner.

3. FINDINGS AND DISCUSSION

Implementation of the Local Wisdom-Based STEAM Approach in the Learning Process in the Islamic Boarding School Environment

Education in the Industrial Revolution 4.0 era requires students to have 21st century skills, such as critical thinking, collaboration, creativity, and communication skills. To answer these challenges, the STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach is present as an innovative solution that integrates five main areas of learning to form students who are holistic and adaptive to the development of the times **(Ozkan & Umdu Topsakal, 2021).** However, the implementation of the STEAM approach is still largely centered on formal educational institutions based on general, while Islamic boarding schools as Islamic educational institutions that have unique characteristics, have not been widely targeted for the development of this approach systematically and contextually. Islamic boarding schools have so far been known as institutions that focus on strengthening religious values and forming morals. However, the development of the era encourages Islamic boarding schools to not only become centers of tafaqquh fiddin, but also become laboratories for integrated character education, entrepreneurship, and science. In this context, the STEAM approach needs to be implemented adaptively by

integrating local wisdom that develops in the Islamic boarding school environment **(Bertrand & Namukasa, 2020)**. This is important so that the learning that is implemented is not just a transfer of knowledge, but also a transformation of values that are in accordance with local culture and the lives of students.

The implementation of the STEAM approach based on local wisdom in the context of Islamic boarding schools is not simply a combination of five disciplines with local values **(Conradty, Sotiriou, & Bogner, 2020)**. Moreover, this approach requires teachers to design learning that prioritizes projects or solving real problems in the environment around the Islamic boarding school. For example, in the science and technology aspect, teachers can invite students to research and develop simple technology such as water filters from natural materials available around the Islamic boarding school. In this case, the values of independence, mutual cooperation, and love for the environment which are part of the local wisdom of the Islamic boarding school can be integrated as part of the learning process. In the arts aspect, the STEAM approach allows for the strengthening of students' creative expression through local culture-based works such as calligraphy, Islamic music, or Islamic boarding school handicrafts **(Kijima, Yang-Yoshihara, & Maekawa, 2021).** Meanwhile, in the aspect of mathematics and engineering, students can be invited to prepare a plan for the construction of Islamic boarding school facilities based on engineering calculations and cost efficiency, which hone logical and applicative thinking skills. With this kind of approach, students not only understand the theory, but are also able to apply it in real life while still adhering to the values of Islamic boarding school tradition.

Local wisdom referred to in this context includes noble values that have grown and developed in the pesantren environment, such as sincerity, togetherness, responsibility, discipline, and humility. This local wisdom can be a framework of values in directing the implementation of the STEAM approach so that it does not conflict with the principles of Islamic education **(Hsiao & Su, 2021)**. For example, in the implementation of STEAM-based projects, students are taught to work in groups by upholding Islamic brotherhood, and are encouraged to produce solutions that benefit the surrounding community. The application of the STEAM approach based on local wisdom also contributes to the transformation of the role of teachers in Islamic boarding schools. Teachers are no longer just conveyors of knowledge (teacher-centered), but become facilitators and guides in the learning process (student-centered). Teachers must

be able to manage project-based classes, integrate local resources, and evaluate learning outcomes with an authentic approach **(Susanto & Syahrudin, 2024).** Thus, learning in Islamic boarding schools becomes more active, creative, innovative and contextual.

However, the implementation of the STEAM approach in Islamic boarding schools is not without challenges. One of the main challenges is the readiness of human resources, especially teachers, in designing STEAM-based learning that is integrated with local wisdom. Many Islamic boarding school teachers do not yet have a comprehensive understanding of how to combine the five elements of STEAM in an integrated manner in one learning activity. In addition, limited facilities and infrastructure are also quite significant obstacles, especially in terms of technology and engineering. However, various studies have shown that the implementation of STEAM based on local contexts can increase students' learning motivation, conceptual understanding, and critical thinking skills. A study by Harun and Suparno (2021) stated that the integration of STEAM with local values can strengthen the connectivity between science and culture of the local community, so that learning becomes more meaningful. Similar findings were also expressed by Yahuda **(Yahuda & Susanto, 2022)** which states that the local project-based STEAM approach can build students' character to be independent and responsible for their social environment.

In the context of Islamic boarding schools, this approach also has the potential to broaden the horizons of students so that they are not only competent in the field of religion, but also have 21st century skills that are relevant to the needs of the world of work. Therefore, the STEAM and local wisdom integration model can be the right learning formula for Islamic boarding schools to bridge tradition and modernity in education. The implementation of STEAM in Islamic boarding schools can begin with teacher training in designing STEAM-based RPP (Learning Implementation Plans), compiling contextual modules that explore local potential, and implementing project-based learning activities (project-based learning) or problem-based learning (problem-based learning) **(Susanto, Widodo, & Kolis, 2023).** The projects developed should contain collaborative, integrative and applicable elements that are appropriate to the real conditions of the students and the environment around the Islamic boarding school.

For example, a project to process kitchen waste into organic compost in a pesantren environment can be a STEAM activity that combines biology (decomposition process), technology (composting tools), engineering (compost

system design), art (packaging design), and mathematics (measurement and analysis of results). At the same time, this project also teaches the values of independence, love for the environment, and the spirit of mutual cooperation which are inseparable parts of the local wisdom of the pesantren. Thus, the implementation of the STEAM approach based on local wisdom is not only relevant to the demands of modern education, but is also able to strengthen the identity of the pesantren as an adaptive, contextual, and value-based educational institution. Learning is no longer only focused on the transfer of knowledge, but becomes a means of character formation, strengthening culture, and empowering society through an integrated and transdisciplinary approach. In the future, if this approach is implemented sustainably, the pesantren can become a holistic education model that not only produces pious students, but also innovative, creative, and highly competitive in the midst of dynamic changes in the era. STEAM does not only belong to public schools, but also to Islamic boarding schools that want to play an active role in building civilization through education that is rooted in tradition and open to innovation.

Student Learning Outcomes between Groups Using Local Wisdom-Based STEAM Approaches and Groups Using Conventional Learning

In the era of globalization and the Industrial Revolution 4.0, the world of education is required to be able to equip students with 21st century skills such as critical thinking, problem solving, creativity, communication, and collaboration. To answer these challenges, various innovative approaches have begun to be applied, one of which is the STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach. STEAM emphasizes cross-disciplinary integration in the learning process, not only to improve cognitive competence, but also to foster students' skills and character as a whole. However, this approach needs to be contextualized to suit the cultural environment and local values where the education process takes place, including in the Islamic boarding school environment. Islamic boarding schools as traditional Islamic educational institutions have unique characteristics that distinguish them from other formal educational institutions. Students are not only educated in intellectual aspects, but also spiritual, social, and moral aspects. Therefore, every learning innovation applied in Islamic boarding schools must maintain harmony with Islamic values and local wisdom that are the identity of the Islamic boarding school. In this context, the implementation of a local wisdom-based STEAM approach is an interesting alternative to bridge the need for educational modernization without

losing the cultural roots and spiritual values of Islamic boarding schools **(Bassachs et al., 2020).**

One of the main questions that arises from the implementation of learning innovations such as STEAM is how it impacts the learning outcomes of students compared to conventional approaches that have been used in Islamic boarding schools. To answer this question, an experimental study was conducted comparing two groups of students: an experimental group that learned using a STEAM approach based on local wisdom, and a control group that learned using conventional methods, namely lectures and linear memorization of texts. The STEAM approach based on local wisdom is designed in such a way as to be in line with the values that have been rooted in Islamic boarding school life. In its application, students are actively involved in projects that require problem solving based on real phenomena in the surrounding environment. For example, students are asked to design a simple irrigation system for the Islamic boarding school garden by considering aspects of science (evaporation and water flow), technology (utilization of simple tools), engineering (channel design), art (project visualization), and mathematics (calculation of water volume and slope angle). This project not only hones critical and creative thinking skills, but also strengthens the values of responsibility, cooperation, and concern for the environment—values that are part of the local wisdom of Islamic boarding schools **(Susanto, Widodo, et al., 2023).**

In contrast, the control group followed conventional learning which was more one-way, with the teacher as the center of information. Learning emphasized more on mastering the material textually and memorizing it. Students were given little space to discuss, explore, or relate learning to real life. Learning outcomes were measured through written tests and observations of learning attitudes during the process. The results of the analysis showed that students who learned using the local wisdom-based STEAM approach had higher achievements compared to the group using conventional learning. This difference was not only seen in cognitive values, but also in affective and psychomotor aspects. Students from the STEAM group showed higher enthusiasm in participating in learning, were able to explain concepts in a more meaningful way, and were able to apply their learning outcomes in the form of real products or solutions to problems faced in everyday life **(Purwowidodo & Zaini, 2024)**.

In the cognitive aspect, STEAM group students were able to demonstrate a deeper understanding of the material. They were not only able to mention

definitions or formulas, but also understand concepts conceptually and applicatively. For example, when asked to explain about water flow in a simple physics lesson, STEAM group students were able to relate the concept to the irrigation system they designed, so that learning became more contextual. In the affective aspect, the STEAM approach encourages students to have a high curiosity, an open attitude towards differences of opinion, and a sense of responsibility in completing group assignments. The collaboration process in STEAM projects also fosters social skills such as mutual respect, listening, and contributing to discussions. This is different from conventional groups which are more passive and tend to wait for direction from the teacher **(Machmud, 2014).**

In terms of psychomotor, the STEAM group showed better abilities in designing, making, and presenting the products of their learning outcomes. They were more skilled in using simple tools, drawing sketches, or measuring objects accurately. The work produced by the students also reflected creativity and a deep understanding of the local context, for example the use of natural materials such as bamboo, coconut shells, or clay in making prototypes. This finding is in line with several previous research results. According to Wahyuningsi **(Wahyuningsih et al., 2020)**, The STEAM approach can significantly improve student learning outcomes because it involves high-level thinking processes and experiential learning. Meanwhile, Roni Susanto et al. **(Susanto, Ali, & Hidayat, 2024)** in his research in religious-based schools concluded that the project-based learning approach contextualized with local values is able to improve student learning outcomes as a whole. This indicates that the STEAM approach, if applied appropriately and in accordance with the cultural context, has great potential to improve the quality of education, including in Islamic boarding schools.

However, the implementation of this approach also has several challenges, such as teacher readiness in designing and managing STEAM learning, limited facilities and infrastructure, and the need for policy support that encourages curriculum innovation based on the integration of local knowledge and culture. Therefore, continuous teacher training is needed, the preparation of STEAM learning guidelines based on Islamic boarding schools, and collaboration between Islamic boarding schools, education offices, and other relevant parties. From the description above, it can be concluded that the STEAM approach based on local wisdom can provide a significant positive impact on the learning outcomes of students compared to conventional learning. This approach not only improves academic competence, but also strengthens the character and life

skills of students in accordance with the values of the Islamic boarding school. Therefore, Islamic boarding schools as traditional Islamic educational institutions need to be open to learning innovations that are relevant to the times, but still based on the cultural roots and spiritual values that have become their identity.

The Influence of Integration of Local Wisdom Values on Students' Interest and Participation in STEAM-Based Learning

Education in the 21st century is no longer only oriented towards mastering material, but also demands critical, collaborative, creative, and communicative thinking skills. To meet these demands, the STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach is one of the strategies that is widely developed **(Zeyad et al., 2022)**. This approach integrates various disciplines in the learning process to form students who are able to solve complex problems holistically. However, the implementation of STEAM in traditional educational environments such as Islamic boarding schools requires contextual adaptation to remain relevant to the values embraced by the community. In this context, the integration of local wisdom values in STEAM learning becomes very important. Local wisdom is the values, knowledge, traditions, and practices that have developed and been passed down by the community from generation to generation. In the Islamic boarding school environment, local wisdom is reflected in the culture of mutual cooperation, manners towards teachers, social responsibility, simplicity, and spirituality. These values have been the foundation in shaping the character of students for centuries. Therefore, when the STEAM approach is introduced into the Islamic boarding school curriculum, the integration of local wisdom becomes a strategic effort to maintain the continuity of values while still keeping up with the times **(Mustoip, Lestari, & Purwati, 2024).**

The interest and participation of students in learning are important indicators of the success of the educational process. Interest refers to the inner tendency to pay attention and be interested in an object or activity, while participation indicates the level of active involvement of students in the learning process. In the context of STEAM learning which is constructivist and project-based, success is largely determined by the level of motivation and involvement of students. Therefore, it is necessary to examine the extent to which the integration of local wisdom values can influence these two aspects. Integrating local wisdom into STEAM learning does not mean simply adding cultural elements as a complement, but rather making it an integral part of the scientific

thinking and problem-solving process. For example, in a STEAM-based environmental engineering project, students are asked to design a water purification system using natural materials available around the boarding school such as coconut shell charcoal, river sand, and palm fiber. This activity not only hones scientific and technological knowledge, but also strengthens understanding of local potential and sustainability values contained in the traditions of the surrounding community **(Marín-Marín et al., 2021).**

Another example, in mathematics learning, teachers associate geometric concepts with local batik motifs or wood carvings typical of the Islamic boarding school area. In the field of art, students are trained to make illustrations of the results of science experiments using Arabic calligraphy or local ornaments. Meanwhile, in the context of technology, students are invited to reuse used goods in accordance with the values of simplicity and social responsibility taught in Islamic boarding schools. This kind of approach has been able to arouse students' interest in learning. This is due to the connection between the material being studied and their daily lives. Students feel that learning is closer, more meaningful, and more relevant. They do not feel like they are studying something foreign, but instead realize that the local values they have been living have a correlation with modern science. This emotional and spiritual involvement that is built is a strong driving factor in building interest in learning.

Furthermore, the integration of local wisdom also encourages active participation of students. In conventional learning, students tend to be passive recipients of information. However, with a project-based and culturally contextualized STEAM approach, students have the space to explore, work together in groups, discuss, design, and create real products. The value of mutual cooperation that has been embedded in the life of Islamic boarding schools becomes a strong social capital in forming productive and participatory group dynamics. Experimental research conducted at an Islamic boarding school in East Java showed that groups of students who received STEAM learning based on local wisdom showed a significant increase in aspects of interest and participation compared to groups of students who received conventional learning. Indicators of interest such as curiosity, enthusiasm, and perseverance in learning increased significantly. Likewise, indicators of participation such as initiative, collaboration, and contribution of ideas in group discussions also increased significantly **(Purwowidodo & Zaini, 2024)**.

In addition to quantitative data, in-depth interviews with students also revealed that they felt more valued because knowledge was not delivered dogmatically, but through an approach that recognized their potential and cultural identity. Students stated that they felt happy because they could learn in a more creative way, and felt more confident when they were able to complete projects that were directly related to the life of the Islamic boarding school and the surrounding community. The integration of local wisdom also had a positive impact on teachers. Teachers who were previously hesitant to apply the STEAM approach because it was considered too modern and complicated, became more enthusiastic after seeing the positive results of this culture-based approach. They felt helped because they had local references that could be used in learning, and at the same time could still follow the development of modern pedagogy **(Yahuda, Susanto, Widodo, & Kolis, 2024).**

However, there are several challenges in implementing this integration. One of them is the need for adequate teacher training in designing locally relevant STEAM learning. In addition, the provision of project tools and materials sourced from the surrounding environment also requires good logistical planning. Islamic boarding schools also need to build partnerships with external institutions, such as universities or research institutions, to strengthen teacher capacity and learning infrastructure. From the description, it can be concluded that the integration of local wisdom values in STEAM-based learning has a positive influence on the interest and participation of students. This approach allows students to learn in a more enjoyable, meaningful, and relevant way to their lives, thus indirectly increasing the effectiveness of learning. Through this integration, Islamic boarding schools are able to bridge traditional values with the needs of modern education, making learning not only a transfer of knowledge, but also a process of empowerment and preservation of culture **(Marín-Marín et al., 2021; Susanto, Yahuda, Basuki, & Kadir, 2023).**

Thus, it is time for the STEAM approach to be understood not only as a transformation of methodology, but also as a bridge between modern science and traditional wisdom. In Islamic boarding schools, where spirituality and local values are highly valued, this approach can be a transformative educational strategy, responding to the challenges of the times without sacrificing the identity and noble values that have been passed down from generation to generation.

4. CONCLUSION

This study proves that the STEAM approach based on local wisdom is able to provide a significant positive impact on learning outcomes, interests, and participation of students in the learning process in the Islamic boarding school environment. Students who take part in learning with this approach show a deeper understanding of concepts, high enthusiasm, and active involvement in learning activities. Local values such as mutual cooperation, responsibility, and concern for the environment are able to strengthen the connection between scientific materials and the daily lives of students. In addition, this approach also supports the transformation of the role of teachers from merely conveying information to facilitators of contextual learning. Thus, the integration of STEAM and local wisdom can be an effective strategy in updating the Islamic boarding school curriculum to be more adaptive to the challenges of the times without eliminating the spiritual and cultural identity of the Islamic boarding school itself. For further research, it is recommended that the STEAM approach based on local wisdom be developed over a longer period of time to see the medium and long-term impacts on the development of the character and creativity of students. In addition, it would be more optimal if the research was conducted with a more geographically and culturally diverse scope of Islamic boarding schools, so that the implementation model can be adjusted to the variety of local traditions. The development of more comprehensive evaluation instruments, including aspects of spirituality and social skills, is also important to support a more holistic assessment. Further researchers are also advised to explore more deeply the involvement of teachers and its influence on the effectiveness of the STEAM approach in the context of traditional Islamic education.

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