E-ISSN: 2502-3519 P-ISSN: 2798-3234
JGA, Vol. 9(4), December 2024 (689-702)
DOI: https://doi.org/10.14421/jga.2024.94-09

Golden Age
Jurnal Ilmiah Tumbuh Kembang Anak Usia Dini

OPEN ACCESS

Creative Freedom and Holistic Growth: Implementation of the STEAM Approach in Islamic Early Childhood Education

Nadlifah [1], **Muhammad Abdul Latif** [2]
[1] Islamic Early Childhood Education, Universitas Islam Negeri Sunan Kalijaga Yogyakarta, Indonesia, [2] Early Childhood Education, Universitas Trunojoyo Madura, Indonesia.

Keywords:
Children's Learning, STEAM Approach, Early childhood

Correspondence to
Nadlifah, Islamic Early Childhood Education, Universitas Islam Negeri Sunan Kalijaga Yogyakarta, Indonesia.
e-mail:
nadlifah@uin-suka.ac.id

Received 05 10 2024
Revised 25 11 2024
Accepted 25 12 2024
Published Online First 31 12 2024

Abstract
The rapid evolution of technology continues to drive the demand for highly skilled human resources capable of competing in an increasingly dynamic global environment. Preparing superior human resources from an early age is crucial to meeting these demands. This study investigates how the STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach is implemented and its impact on early childhood education at RA Fun Islamic School in Indonesia. Employing a qualitative case study methodology, data were gathered through observations, semi-structured interviews with educators, parents, and administrators, as well as an analysis of relevant documentation. The findings highlight STEAM's focus on nurturing creative freedom, critical thinking, and collaboration among young learners. Children participating in activities such as building structures and integrating arts with mathematics showed notable outcomes, including independent problem-solving and the development of unique solutions. The study also emphasizes the role of introducing simple engineering concepts and integrating technology to create dynamic and engaging learning environments. Despite these benefits, challenges like limited resources and the need for teacher training were identified. This research underscores the transformative potential of STEAM in promoting cognitive and social growth in early childhood education. Future studies should explore how this approach can be scaled to diverse educational settings and evaluate its long-term effects.

To cite: Nadlifah, & Abdul Latif, M. (2024). Creative freedom and holistic growth: Implementation of the STEAM approach in Islamic early childhood education. *Golden Age: Jurnal Ilmiah Tumbuh Kembang Anak Usia Dini, 9*(4), 689-702. *https://doi.org/10.14421/jga.2024.94-09*

Introduction

Early childhood education forms the foundation for lifelong learning and is crucial in fostering cognitive, social, and emotional development during a child's formative years (Morrison, 2016). In an era defined by the Industry 5.0 revolution, where digitalization and innovation dominate, education must adapt to equip learners with skills that meet future technological demands (Aristin et al., 2023; Isrofah et al., 2022). The Science, Technology, Engineering, Art, and Mathematics (STEAM) approach has emerged globally as a powerful pedagogical framework to address these needs by fostering creativity, critical thinking, problem-solving, and collaboration in learners (Belbase et al., 2021; Wahyuningsih et al., 2020). However, despite its recognized potential, early childhood education often relies on conventional teaching methods such as rote memorization and repetitive tasks, which fail to nurture creativity and curiosity in children (Rahayu et al., 2019). Addressing this gap is particularly relevant in Indonesia, where the integration of STEAM in early childhood education remains limited, requiring innovative approaches to modernize teaching practices and enhance developmental outcomes (Kesumaningsari et al., 2022; Putri & ., 2021).

The global relevance of STEAM education is evident in its implementation across various educational systems. For instance, South Korea has integrated STEAM into elementary and secondary schools, while Singapore has embedded it into all elementary school curricula by 2023, showcasing its success in fostering 21st-century skills (Belbase et al., 2021; Kim et al., 2015).

Studies reveal that STEAM methods enhance children's engagement, creativity, and engineering thinking through hands-on, interdisciplinary approaches (Hoi, 2021; Taibo & Liang, 2022). Moreover, STEAM-based learning modules have demonstrated significant benefits in academic achievement, particularly among underrepresented groups such as female students and those in disadvantaged contexts (Arpaci et al., 2023; Duo-Terron et al., 2022). These findings underscore the transformative potential of STEAM in promoting equity and inclusivity in education while fostering skills vital for the future workforce.

In the context of early childhood education, research emphasizes the importance of integrating play-based learning with STEAM concepts to align with children's developmental needs. For instance, project-based STEAM activities have been shown to enhance preschool children's social and cognitive skills, including teamwork and presentation abilities (Başaran & Bay, 2023). Additionally, introducing educational robotics in early childhood settings improves technological comfort and literacy outcomes, further highlighting the benefits of blending technology with STEAM approaches (Holmquist et al., 2024). Studies also indicate that teacher training significantly improves educators' confidence and pedagogical abilities in implementing STEAM, although resource limitations and gaps in teaching efficacy persist (Chang, 2023; Rossi et al., 2024). These findings suggest the need for sustained investment in professional development and infrastructure to support STEAM education in early childhood settings.

The integration of STEAM in early childhood education aligns with theoretical perspectives on interdisciplinary and play-based learning. As posited by Cohrssen and Garvis (Cohrssen & Garvis, 2021) in their theory of *Embedding STEAM in Early Childhood Education and Care*, this approach leverages connections between various disciplines to nurture creativity, problem-solving, and collaboration. This theory emphasizes that STEAM learning opportunities should be embedded in informal and formal curricula to create engaging, developmentally appropriate experiences for children. Furthermore, Aldemir and Kermani (Aldemir & Kermani, 2016) argue that structured STEAM activities in early childhood help children develop higher-order thinking skills, particularly when supported by well-planned and stimulating learning environments. Teachers play a pivotal role in designing these environments, serving as facilitators who bridge children's developmental needs with innovative pedagogical practices (Land, 2013). Grounding this study in these theoretical insights ensures a deeper understanding of how STEAM can transform educational outcomes in diverse contexts.

Several studies highlight the role of creativity in STEAM education and its impact on children's learning outcomes. For example, visualization of teaching content in kindergarten underscores the need to prioritize creativity in early childhood education (Du, 2024). Integrating art into STEM disciplines further enhances children's interest and engagement, making learning more accessible and enjoyable (Hunter-Doniger, 2021). Similarly, hands-on activities, such as nuclear science experiments, have demonstrated success in improving students' scientific literacy and enthusiasm for technology (Saengkaew et al., 2024). These findings emphasize the value of interdisciplinary and experiential learning in nurturing creativity and curiosity among young learners, key aspects of the STEAM approach.

Despite the promising outcomes associated with STEAM education, several gaps and limitations remain. For instance, while STEAM training improves teachers' knowledge and confidence, its impact on teaching efficacy and sustained implementation in classrooms is inconsistent (Chang, 2023; Gonadi et al., 2024). Furthermore, challenges related to resource availability, such as funding and access to technology, hinder the effective integration of STEAM in educational environments, particularly in underserved regions (Ovcharuk & Soroko, 2024). In Indonesia, the lack of structured frameworks for STEAM implementation in early childhood education exacerbates these issues, limiting opportunities for young learners to develop critical skills (Riad et al., 2023). Addressing these gaps requires a contextualized approach that considers local needs and capacities while leveraging global best practices.

The selection of RA Fun Islamic School Purworejo ass the research site is a strategic choice reflecting its status as a pioneering institution for early childhood STEAM education in Indonesia.

Despite widespread challenges in adopting STEAM, including limited infrastructure and teacher readiness, RA Fun Islamic School has successfully integrated this approach into its curriculum. As a model school in Purworejo, it offers a unique perspective on how STEAM can be implemented in local contexts to overcome systemic barriers. This institution's proactive response to the demands of 21st-century education serves as an inspiration for similar schools in the region. However, continuous improvement is essential to ensure the school remains at the forefront of innovation. Insights gained from studying this school's practices can guide policymakers, educators, and stakeholders in scaling STEAM-based learning models across Indonesia, contributing to national human resource development and addressing future challenges in education.

This study aims to analyze the implementation and impact of the STEAM approach in early childhood education at RA Fun Islamic School, with a particular focus on its effectiveness, challenges, and opportunities. By examining the integration of STEAM within an Indonesian context, this research seeks to contribute to the global discourse on early childhood education by providing insights into the applicability of STEAM in diverse educational settings. The findings are expected to inform policymakers, educators, and stakeholders on best practices for fostering creativity, critical thinking, and collaboration in young learners while addressing the systemic barriers to STEAM adoption. Ultimately, this study aspires to bridge the gap between theory and practice, advancing the field of early childhood education through innovative pedagogical strategies.

Methods

This study employed a qualitative research methodology (Bogdan & Biklen, 2007) using a case study approach to explore the implementation of the STEAM approach in early childhood education. Qualitative research was selected as it is grounded in the constructivist paradigm, which emphasizes the understanding of social phenomena from the perspectives of participants (Emzir, 2015). The case study design was chosen to enable an in-depth investigation of a specific phenomenon by collecting and analyzing diverse types of information (Louis et al., 2018). The study was conducted at RA Fun Islamic School, located at Jl. Letjend Soeprapto, Tuksongo, Purworejo, Central Java, Indonesia, focusing on its distinctive application of STEAM in early childhood education. Data sources were derived from both literature and field research. The literature data consisted of journals, books, and reports relevant to the STEAM approach in early childhood education, while the field data were obtained from the school principal, teachers, and parents associated with the institution.

Data collection in this research employs the following techniques: observation, interviews, and documentation. Observation is a data collection technique performed by directly observing what is happening in the field (Sukmadinata, 2010). In the context of this research, passive participant observation is conducted, where the researcher observes the conditions of STEAM approaches in early childhood education at RA Nurul Dzikri without participating in the teaching activities. Additionally, interviews involve a face-to-face meeting between the researcher and the interviewee followed by a question-and-answer process. The interviews in this research use a semi-structured format, meaning the researcher conducts interviews freely while adhering to the interview guidelines prepared by the researcher. These interviews are conducted with the headmaster, teachers, and parents/guardians to gather data related to early childhood education with STEAM approaches at RA Nurul Dzikri. Meanwhile, documentation is a data collection technique that focuses on reviewing existing literature related to the research focus (Wiersma & Jurs, 2009). Documentation in this research involves documenting events related to STEAM approaches in early childhood education at RA Nurul Dzikri.

The collected data were analyzed thematically, as described by (Braun & Clarke, 2006), in three stages: familiarizing with the data by reviewing notes and recordings from observations and interviews, coding to organize data into meaningful categories, and identifying themes to

highlight key findings that align with the research objectives (Louis et al., 2018). The thematic analysis process is illustrated in Figure 1, which visually represents the steps from data familiarization to theme identification.

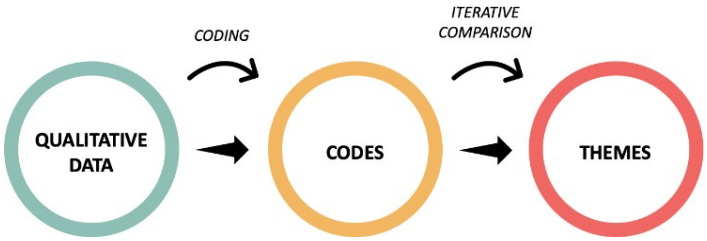

Figure 1 There showing the thematic analysis

To ensure the reliability and validity of the research findings, triangulation was used, incorporating multiple sources and methods of data collection (Sugiyono, 2019). Source triangulation was applied by comparing data obtained from literature, observations, and interviews, while methodological triangulation validated the findings through the use of complementary data collection techniques. These measures enhanced the credibility and rigor of the research and ensured the results accurately reflected the case under study.

Result

Implementation of STEAM Approach in Early Childhood Education

Learning in early childhood education differs from later stages of education. In early childhood, the emphasis is more on the process rather than the outcome, thus requiring a specific approach. According to Mrs. N,

"STEAM has been implemented for a long time, especially when applying the independent curriculum" (Interview with Mrs. N on October 8, 2023).

Learning in early childhood education (ECE) places a greater emphasis on the process of exploration, experimentation, and engagement rather than solely focusing on measurable outcomes. This process-oriented approach aligns with the developmental needs of young children, who learn best through active, hands-on experiences that stimulate their curiosity and creativity. The STEAM (Science, Technology, Engineering, Art, and Mathematics) approach embodies this philosophy, providing a framework for interdisciplinary learning that encourages children to think critically, solve problems, and collaborate effectively.

As highlighted in the interview with Mrs. N,

"STEAM has been implemented for a long time, especially when applying the independent curriculum."

This statement reflects the alignment between the STEAM approach and the principles of the independent curriculum, which prioritizes student-centered learning, flexibility, and creativity. By integrating STEAM into early childhood education, teachers can create rich learning environments where children explore concepts through play and inquiry. For example, activities such as building simple structures, experimenting with colors, or exploring natural phenomena allow children to engage in meaningful learning experiences that integrate multiple disciplines.

Mrs. N's observation also underscores the role of educators in adapting STEAM to the developmental levels of young learners. This requires a thoughtful balance between guided instruction and open-ended exploration, allowing children to develop foundational skills while fostering their natural curiosity. The successful implementation of STEAM in early childhood settings, as described, depends on the ability of teachers to design activities that are both age-appropriate and aligned with the curriculum goals.

The broader implication of this approach is its potential to lay a strong foundation for lifelong learning. By engaging children in STEAM-based activities early on, educators can nurture critical thinking, creativity, and a love for learning, which are essential for success in an increasingly complex and technology-driven world. This highlights the importance of continued

professional development for teachers and resource support to sustain the effective application of STEAM in ECE.

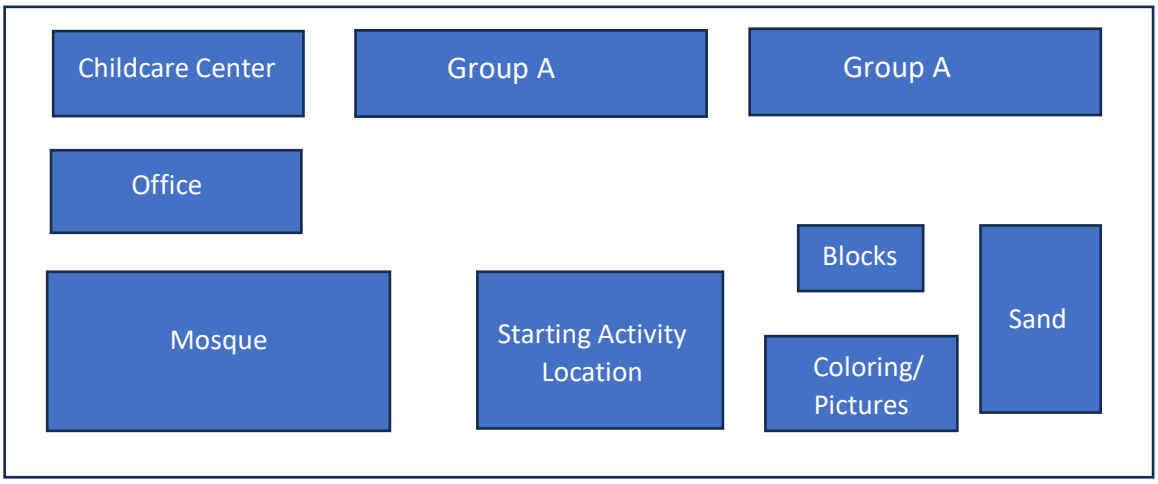

Figure 2. Setting a STEAM Approach Page

The learning activities are divided into three stages: initial activities, core activities, and closing activities. Before the activities begin, the teacher sets up the schoolyard as a playground for children according to the theme. The playground setup can be seen in Figure 2. First, before the learning activities commence, the children are gathered together, including those from the playgroup, group A, and group B, in the schoolyard. This activity involves movement and songs, gymnastics, and ice-breaking. This activity lasts for approximately 30 minutes. After this activity, the children gather in their respective classrooms to be briefed on the main activities of the day, such as the lesson plan for today. Some gather in the classroom, while others remain outside (Observation on October 8, 2023).

The learning activities in early childhood education are thoughtfully structured into three main stages: initial activities, core activities, and closing activities. This structure ensures that children experience a balanced and engaging learning process that caters to their developmental needs. The initial activities play a crucial role in setting the tone for the day, fostering a sense of community, and preparing children mentally and physically for the lessons ahead.

As observed on October 8, 2023, the teacher begins by transforming the schoolyard into a thematic playground, aligning with the day's theme. This setup demonstrates the integration of play as a central element of early childhood education, creating an environment that encourages exploration and active participation. The initial gathering of children from different age groups, including the playgroup, group A, and group B, in the schoolyard reflects an inclusive approach to fostering social interaction and collaboration.

During this phase, activities such as movement, singing, gymnastics, and ice-breaking exercises are conducted. These activities not only stimulate physical development but also support emotional and social growth by encouraging children to interact, express themselves, and build relationships. The incorporation of movement and songs aligns with the principles of kinesthetic and auditory learning, ensuring that children are engaged through multiple sensory modalities.

After the initial activities, children are divided into their respective classrooms for a briefing on the day's core activities. This transition from a communal to a focused setting helps children develop routines and understand the structure of their day. Some activities continue outdoors, reflecting the flexibility of the learning environment and the importance of integrating natural settings into the educational process.

This structured yet dynamic approach highlights the importance of creating a holistic learning experience that combines physical activity, social interaction, and cognitive

development. By fostering a seamless transition between activities, educators can support children's engagement and ensure that learning remains both meaningful and enjoyable.

Second, the core activities. Core activities in early childhood education are central to achieving the objectives of the learning process. These activities are designed to engage children in meaningful, hands-on experiences that promote creativity, exploration, and problem-solving. This aligns with the insights shared during the interview.

According to Mrs. W (interview, October 8, 2023),

"The core activities *in our institution utilize the STEAM (Science, Technology, Engineering, Art, and Mathematics) approach in line with the independent curriculum, enabling children to produce something."*

This approach is implemented across all core activities, allowing children to select activities based on their interests.

This perspective is echoed by Mrs. S, who emphasized that

"The core activities *in our school always result in the production of something."*

The meaning of the products created varies for each child, depending on the activities they choose to engage in.

This approach is further supported by Mrs. S's observation that "the core activities in our school always produce something." The concept of "producing something" is not limited to physical creations but also encompasses ideas, solutions, or expressions that emerge from the children's engagement with the activities. The products created hold unique meanings for each child, reflecting their individual preferences, abilities, and interpretations.

The flexibility of the STEAM approach allows for differentiation within the core activities, ensuring that children across different age groups can participate meaningfully despite working with the same theme. For instance, younger children might engage in simpler tasks, such as painting or building basic structures, while older children may tackle more complex projects, like designing models or conducting experiments. This differentiation ensures that the activities are developmentally appropriate and cater to the diverse needs and interests of the children.

Observation reveals that the STEAM approach is integrated into all core activities, emphasizing interdisciplinary learning. By combining elements of science, technology, engineering, art, and mathematics, the activities encourage children to think critically, experiment with ideas, and collaborate with peers. This not only supports cognitive development but also nurtures creativity, communication, and problem-solving skills.

Overall, the integration of the STEAM approach in core activities demonstrates its potential to transform early childhood education by fostering a dynamic, child-centered learning environment that prepares children for future challenges.

In this approach, children actively participate in creating Mount Merapi using sand provided by the teacher, enhancing it with leaves to represent trees around the mountain. In the technological aspect, children are introduced to technology through video presentations displayed using computers, LCD screens, and sound systems. For example, under the theme of introducing tourism in Kaliurang, the teacher presents various attractions such as Mount Merapi and waterfalls through videos. After watching the videos, children are given the opportunity to engage in free play based on their preferences.

In the engineering aspect, children learn to design structures by building blocks into representations of Mount Merapi, complete with roads leading to the mountain. Mrs. W explained,

"Engineering doesn't always involve machines; it also includes designing something into a structure, which applies the engineering approach." Each child develops their own design concept, and collaborative play fosters teamwork and problem-solving skills (Interview with Mrs. W, October 8, 2023).

Artistic expression is encouraged as children mold mountains from sand in various shapes and colors, decorating them according to their preferences. Mathematics is integrated through the selection of geometric shapes, including triangles, cubes, half circles, and circles,

with some blocks featuring numbers to further enhance their understanding of mathematical concepts.

Lastly, in the concluding activity, the children gather together, and a recap related to the activities conducted is performed. The children enthusiastically share their experiences during the final activity, expressing happiness and joy in getting to know Mount Merapi through playing with sand or blocks.

The integration of the STEAM approach in early childhood education is evident in activities designed to introduce children to Mount Merapi and its surroundings. This approach allows children to engage with interdisciplinary learning in a hands-on, engaging manner. For example, children create a representation of Mount Merapi using sand, enhancing it with leaves to symbolize trees. This activity incorporates art, as children creatively shape and decorate their mountains, expressing individuality and aesthetic preferences.

Technology is integrated through video presentations showcasing attractions in Kaliurang, such as Mount Merapi and waterfalls. Using computers, LCD screens, and sound systems, teachers provide children with a visual and auditory understanding of the theme, enriching their learning experience.

In the engineering aspect, children design and construct block models of Mount Merapi, including roads leading to the mountain. As Mrs. W explained, engineering here involves designing structures, fostering creativity and problem-solving. Each child's unique design concept highlights their ability to innovate while learning teamwork through collaborative play.

Mathematics is embedded in the activity as children select and work with geometric shapes like triangles, cubes, and circles, some of which are numbered. This enhances their understanding of shapes and numbers in a playful context.

Finally, during the concluding activity, children share their experiences and express joy in their learning journey, reinforcing their understanding of Mount Merapi while fostering communication and social skills.

Table 1. Findings on the Implementation of the STEAM Approach at RA Fun Islamic School

Learning Stage	**Findings**	**Activity Examples**
Initial Activities	Early activities aim to create a joyful atmosphere and prepare children mentally and physically.	Gymnastics, singing, icebreaker games, thematic playground setup.
Core Activities	Activities integrate the STEAM approach with the independent curriculum, encouraging creativity, experimentation, and innovation.	- Building mountains from sand and leaves (Science & Art). - Watching videos about tourist attractions (Technology). - Designing structures using blocks (Engineering). - Using geometric shapes (Mathematics).
Closing Activities	Summarizing and reflecting on the day's activities while reinforcing learning through discussion and emotional expression.	Group discussions, sharing experiences, singing a closing song, and summarizing activities.
Integrated Approach	The STEAM approach promotes interdisciplinary learning, focusing on developing creativity, communication, and problem-solving skills.	Children design structures, watch educational videos, play with geometric shapes, and create art projects.
Teacher's Role	Teachers act as facilitators, providing guidance and creating activities appropriate to children's age and needs.	Providing explanations, offering learning materials, and monitoring children's engagement during activities.

doi: *https://doi.org/10.14421/jga.2024.94-09*

Learning Stage	Findings	Activity Examples
Learning Outcomes	Children produce physical works or ideas, enhancing understanding, creativity, and social skills.	Products such as sand mountains, structural models, and foundational concept comprehension through exploratory play.

The table 1 above demonstrates that implementing the STEAM approach in early childhood education provides a holistic and interdisciplinary learning experience. Each stage of learning is designed to support children's overall development, including cognitive, social, emotional, and physical aspects. The activities emphasize not only the outcomes but also the exploration process and active participation of children. This aligns with the principles of early childhood education, which focus on learning through play. The teacher's role as a facilitator is crucial in creating a supportive learning environment by offering activities that match the children's developmental needs. Through this approach, children develop creativity, critical thinking, and collaborative skills, laying a foundation for lifelong learning.

Impact of the STEAM Approach on Early Childhood Learning

Every approach in early childhood education has an impact on the children themselves. According to interview data on the impact of the STEAM approach on early childhood learning, it includes critical thinking, creativity, activity, and collaboration.

Firstly, critical thinking. This impact arises after the implementation of the STEAM approach, where children can solve the problems they face, especially during core activities. For instance, as Mrs. N mentioned, the STEAM approach has a positive impact on children. They practice critical thinking when asked to make mountains from sand. Moreover, critical thinking is also observed in other activities.

The implementation of the STEAM approach in early childhood education has a significant impact on fostering critical thinking skills among children. Critical thinking is the ability to analyze, evaluate, and solve problems effectively, and it is a crucial skill for children to develop from an early age. This skill is particularly evident during core activities that challenge children to engage in problem-solving and creative exploration.

As Mrs. N highlighted, the STEAM approach positively impacts children's critical thinking abilities. For instance, when children are tasked with creating mountains from sand, they are required to think critically about the process and the materials needed to achieve the desired outcome. They must decide how to shape the sand, stabilize the structure, and enhance it with additional elements like leaves to represent trees. This hands-on activity encourages children to analyze their progress, make adjustments, and find solutions to any challenges they encounter.

Critical thinking is not limited to specific tasks but extends to various activities within the STEAM framework. For example, children may face challenges while constructing block structures or experimenting with different materials during science-based activities. In these scenarios, they learn to evaluate their options, test ideas, and collaborate with peers to find solutions. This iterative process of trial and error helps them build resilience and confidence in their problem-solving abilities.

The STEAM approach creates an environment where children are encouraged to ask questions, explore possibilities, and develop independent thinking. By integrating critical thinking into daily learning activities, children are better prepared to face complex problems in future educational stages and real-world scenarios. Furthermore, the emphasis on critical thinking aligns with the goals of 21st-century education, which prioritizes the development of skills essential for lifelong learning and innovation.

Secondly, the impact of creativity on children is significant through the STEAM approach. Teachers encourage children to be creative even when working with the same theme. Children's creativity increases because teachers provide a variety of activities without requiring children to follow specific forms, such as making two mountains and a sun. Teachers offer

materials like sand and blocks for building mountains, as well as natural materials such as leaves for creating mountain-shaped collages. As Mrs. W stated,

> *"All activities in our school aim to provide children with the freedom to be creative. This is because, in the independent curriculum, teachers must liberate children in their learning environment."*

The STEAM approach has a profound impact on fostering creativity in children, which is a vital skill for their overall development. Creativity involves the ability to think outside the box, generate new ideas, and express oneself in unique ways. The integration of the STEAM approach into early childhood education provides a supportive environment for nurturing these skills.

As stated by Mrs. W, school activities are designed to provide children with the freedom to express their creativity. This approach aligns with the principles of an independent curriculum that emphasizes liberating children in the learning process. Teachers create activities that allow children to explore, experiment, and express their ideas without the pressure of predetermined outcomes. For instance, in a theme about mountains, teachers provide materials such as sand, blocks, and natural elements like leaves. Using these materials, children can create collages or mountain-shaped structures reflecting their individual imagination.

Unlike traditional methods, which often specify the final outcomes (e.g., two mountains and one sun), the STEAM approach allows children to interpret themes in their own ways. This flexibility encourages creative thinking and the development of unique solutions or representations. It removes rigid limitations that often constrain children's expression, enabling them to freely explore ideas. As a result, children are trained to think independently, producing original and innovative work. Their creativity flourishes optimally because they are not bound by rigid expectations.

The variety of activities offered within the STEAM framework further enriches the development of creativity. By integrating elements of science, technology, engineering, arts, and mathematics, children are encouraged to see connections between various concepts. This interdisciplinary approach provides new perspectives for solving challenges, fostering critical and analytical thinking skills. Children are not only encouraged to generate new ideas but also to seek comprehensive solutions to problems. This method supports creative thinking as well as problem-solving abilities, both of which are crucial in the learning process.

In addition to fostering creativity, the STEAM approach encourages children to become active participants in learning. According to Mrs. S, tasks like creating mountains out of sand involve physical activities that stimulate various aspects of child development. When shaping, designing, and decorating, children practice fine and gross motor skills. Simultaneously, these activities hone their critical thinking skills in planning and executing designs. Active participation ensures that children are not merely passive recipients of knowledge but active contributors to their learning journey.

Collaboration is another key aspect emphasized in the STEAM approach. Activities such as building sand mountains naturally teach children to work together in groups. Children share materials, exchange ideas, and solve problems collectively. This interaction helps develop communication, negotiation, and teamwork skills, all of which are vital for their social development. For example, one child might suggest using leaves to represent trees, while another helps stabilize the sand structure, resulting in productive teamwork.

Finally, the STEAM approach aligns with 21st-century education principles, emphasizing adaptability and teamwork. By teaching collaboration early, this approach prepares children to face future environments requiring effective communication and joint problem-solving. The combination of creativity, active participation, and collaboration supports holistic child development. Furthermore, this approach equips children with essential skills for academic success and life. With this method, children not only learn but also grow into innovative, independent, and cooperative individuals.

doi: *https://doi.org/10.14421/jga.2024.94-09*

Table 2. The Impact of the STEAM Approach on Early Childhood Learning at RA Fun Islamic School

Aspect	Key Observations	Added Value
Critical Thinking	Children are able to analyze, evaluate, and solve problems during core activities.	Activities such as building mountains out of sand motivate them to think creatively and collaborate to overcome challenges.
Creativity	Children freely express ideas with flexibility in the final outcomes.	Teachers provide various materials such as sand, blocks, and leaves, encouraging exploration and innovation in each child.
Active Participation	Activities stimulate fine and gross motor skills through tasks like shaping and decorating.	Children become active participants in the learning process, directly contributing to the design and execution of activities.
Collaboration	Children learn to share, exchange ideas, and work together to complete group tasks.	Example: One child suggests using leaves for trees, while others help stabilize the sand structure.
Reinforcing 21st-Century Skills	Children are exposed to adaptive thinking, teamwork, and problem-solving skills.	The STEAM approach strengthens communication, innovation, and collaboration, which form the foundation of future competencies.
Independent Curriculum	Children have the freedom to explore ideas and engage in learning processes not tied to specific outcomes.	Teachers provide creative spaces for children to interpret learning themes according to their imagination.

This table highlights how the STEAM approach supports the development of essential skills such as critical thinking and creativity while preparing children for future challenges through a holistic methodology.

Discussion

This study aimed to analyze the implementation and impact of the STEAM (Science, Technology, Engineering, Art, and Mathematics) approach in early childhood education, particularly its alignment with the independent curriculum. The STEAM approach emphasizes interdisciplinary, hands-on activities designed to foster creativity, problem-solving, and holistic development. Findings highlight its role in encouraging young learners to explore, experiment, and collaborate meaningfully, aligning with the principles of experiential learning (Jazariyah et al., 2023; Najanuddin et al., 2023). Previous research supports the effectiveness of early STEAM interventions in developing foundational skills and promoting a lifelong love for learning (Maarang et al., 2023; Rianti et al., 2022). This study contributes to the growing body of literature on innovative pedagogies that prioritize both academic and socio-emotional development in early education.

The study's main results underscore the STEAM approach's ability to enhance creativity, critical thinking, collaboration, and independence. A particularly interesting finding is the freedom children are given to produce unique creations, such as designing sand mountains or structures using blocks and leaves. This freedom fosters originality and innovative thinking, as children interpret tasks differently based on their interests and abilities. Another notable discovery is the successful integration of engineering concepts through simple tasks like constructing stable structures, which introduces technical thinking in an accessible way. The emphasis on open-ended processes rather than specific outcomes allows children to engage deeply with activities, reflecting the core philosophy of STEAM-based learning.

The findings align with previous research demonstrating the positive impact of STEAM on early childhood development. For example, project-based STEAM activities have been shown to promote critical thinking, problem-solving, and teamwork among young learners (Başaran & Bay, 2023; Taibo & Liang, 2022). Furthermore, the integration of technology, as observed in this study, supports earlier findings that digital tools enhance creativity and computational skills in early learners (An & Shin, 2024; Ragusa, 2024). The emphasis on social interaction, where

children collaborate and share ideas, mirrors evidence from studies highlighting teamwork and communication as core outcomes of STEAM education(Duo-Terron et al., 2022; Purwaningsih et al., 2022).

Interestingly, the unique finding regarding children's freedom to create and interpret tasks independently adds depth to the current literature. While earlier studies focus on specific learning outcomes, such as literacy and numeracy gains (Duo-Terron et al., 2022; Holmquist et al., 2024), this study emphasizes the intrinsic value of personal expression and open-ended exploration. Additionally, the incorporation of art in STEAM activities, such as using geometric shapes to build aesthetically pleasing structures, supports the notion that creativity and mathematics can be taught simultaneously (Maarang et al., 2023). These findings not only validate prior research but also introduce new perspectives on the pedagogical benefits of combining freedom with structured learning objectives.

The effectiveness of the STEAM approach in fostering critical skills can be attributed to its emphasis on interdisciplinary and exploratory learning. By engaging children in tasks that require creativity and innovation, the approach supports cognitive flexibility and resilience. The meaningful production of diverse outputs by children reflects the potential for personalized learning, where each child can thrive according to their interests and abilities. However, successful implementation relies heavily on well-trained educators and access to sufficient resources. Studies have shown that teacher confidence and pedagogical skills significantly influence the quality of STEAM education, highlighting the need for professional development (Camacho-Tamayo & Bernal-Ballen, 2023; Rossi et al., 2024).

Despite its benefits, certain challenges warrant cautious interpretation of these findings. The study was conducted in a single educational setting, limiting the generalizability of the results to other contexts with different resources or curricula. Additionally, systemic factors such as funding and technology access, previously noted as barriers in STEAM implementation, must be addressed to ensure equitable opportunities for all children (Ovcharuk & Soroko, 2024; Xue, 2022). Future research could explore the scalability of this approach across diverse educational and cultural environments, as well as its long-term impact on learners' academic and social trajectories.

The findings of this study have significant implications for early childhood education. By demonstrating the effectiveness of the STEAM approach, this research advocates for its integration into national curricula as a strategy for fostering creativity, problem-solving, and collaboration. Policymakers should prioritize resource allocation and professional development to support educators in adopting this approach. For practitioners, the results emphasize the importance of designing open-ended, interdisciplinary activities that allow for meaningful learning experiences. Furthermore, the emphasis on personal expression and the production of unique outputs highlights the need to value process-oriented learning over rigid outcome measures. By addressing these considerations, the STEAM approach has the potential to transform early childhood education and prepare children for future academic and professional challenges.

Conclusion

The research explored the implementation and impact of the STEAM approach in early childhood education at RA Fun Islamic School, highlighting its effectiveness, challenges, and potential opportunities. The findings indicate that integrating STEAM with the Merdeka Curriculum fosters active learning through exploration, experimentation, and creativity, aligning well with children's developmental stages. The approach emphasizes the learning process over measurable outcomes, allowing children to freely express their creativity and develop critical thinking, problem-solving, and teamwork skills. Notably, STEAM activities such as building structures, integrating arts and mathematics, and collaborative group tasks enhance both cognitive and social development. The use of technology, simple engineering concepts,

and interdisciplinary activities provides a dynamic, engaging learning environment, supporting children's holistic growth.

However, this study is limited to the specific context of RA Fun Islamic School, which may affect its generalizability to other educational settings with different resources and cultural contexts. To further develop this field, future research should explore the scalability of the STEAM approach in diverse environments and assess its long-term impact on academic and social outcomes. Additionally, effective implementation will require ongoing teacher training, adequate resources, and technology integration to ensure this innovative pedagogy can be sustained and widely adopted.

Acknowledgment

The researcher would like to express gratitude to the LPPM UIN Sunan Kalijaga Yogyakarta for providing financial support through the BOPTN grant for this research.

References

Aldemir, J., & Kermani, H. (2016). Integrated STEM curriculum: Improving educational outcomes for Head Start children. *Early Child Development and Care*, *187*(11), 1694–1706. https://doi.org/10.1080/03004430.2016.1185102

Aristin, N. F., Hastuti, K. P., Arisanty, D., Adyatma, S., & Donna, C. (2023). Effectiveness of problem-based learning models to improve learning outcomes of geography in the new normal learning era. *Journal of Education and Learning*, *17*(4), 623–632. https://doi.org/10.11591/edulearn.v17i4.20834

Arpaci, I., Dogru, M. S., Kanj, H., Ali, N., & Bahari, M. (2023). An Experimental Study on the Implementation of a STEAM-Based Learning Module in Science Education. *Sustainability (Switzerland)*, *15*(8). Scopus. https://doi.org/10.3390/su15086807

Belbase, S., Mainali, B. R., Kasemsukpipat, W., Tairab, H., Gochoo, M., & Jarrah, A. (2021). At the dawn of science, technology, engineering, arts, and mathematics (STEAM) education: Prospects, priorities, processes, and problems. *International Journal of Mathematical Education in Science and Technology*, 1–37. https://doi.org/10.1080/0020739X.2021.1922943

Bogdan, R., & Biklen, S. K. (2007). *Qualitative research for education: An introduction to theories and methods*. Alien and Bacon, Inc, New York. Pearson A & B.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Camacho-Tamayo, E., & Bernal-Ballen, A. (2023). Validation of an Instrument to Measure Natural Science Teachers' Self-Perception about Implementing STEAM Approach in Pedagogical Practices. *Education Sciences*, *13*(8). Scopus. https://doi.org/10.3390/educsci13080764

Chang, W.-C. (2023). The Impact of Preschool Teacher Training on STEAM Education: Professional Preparedness and Confidence. In Shih J.-L., Kashihara A., Chen W., Chen W., Ogata H., Baker R., Chang B., Dianati S., Madathil J., Yousef A.M.F., Yang Y., & Zarzour H. (Eds.), *Int. Conf. Comput. Educ., ICCE - Proc.* (Vol. 1, pp. 898–900). Asia-Pacific Society for Computers in Education; Scopus. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85181534815&partnerID=40&md5=376563943b218ae850fb52cad3cb3b32

Cohrssen, C., & Garvis, S. (2021). *Embedding STEAM in early childhood education and care*. Springer Nature Switzerland.

Du, X. (2024). A study on visualization of kindergarten teaching content assisted by big data technology. *Applied Mathematics and Nonlinear Sciences*, *9*(1). Scopus. https://doi.org/10.2478/amns-2024-3365

Duo-Terron, P., Hinojo-Lucena, F.-J., Moreno-Guerrero, A.-J., & López-Núñez, J.-A. (2022). STEAM in Primary Education. Impact on Linguistic and Mathematical Competences in a Disadvantaged Context. *Frontiers in Education*, *7*. Scopus. https://doi.org/10.3389/feduc.2022.792656

Emzir. (2015). *Metodologi Penelitian Pendidikan Kualitatif dan Kuantitatif*. Rajawali.

Gonadi, L., Mohammed, H. B., & Samah, N. A. (2024). SPS Teacher's Perception of STEAM Concepts. *Int. STEM Educ. Conf., iSTEM-Ed - Proc.* 9th International STEM Education Conference, iSTEM-Ed 2024 - Proceedings. Scopus. https://doi.org/10.1109/iSTEM-Ed62750.2024.10663116

Hoi, H. T. (2021). Applying STEAM Teaching Method to Primary Schools to Improve the Quality of Teaching and Learning for Children. *International Journal of Early Childhood Special Education*, *13*(2), 1051–1055. Scopus. https://doi.org/10.9756/INT-JECSE/V13I2.211149

Holmquist, S., Catlin, D., & Hicks, F. K. (2024). Using Simple Educational Robots as a Technology for Teaching Early Childhood and Primary Education Literacy in the United States. In Balogh R., Obdržálek D., & Fislake M. (Eds.), *Lect. Notes Networks Syst.: Vol. 1084 LNNS* (pp. 165–176). Springer Science and Business Media Deutschland GmbH; Scopus. https://doi.org/10.1007/978-3-031-67059-6_15

Hunter-Doniger, T. (2021). Early Childhood STEAM Education: The Joy of Creativity, Autonomy, and Play. *Art Education*, *74*(4), 22–27. https://doi.org/10.1080/00043125.2021.1905419

Isrofah, I., Sitisaharia, S., & Hamida, H. (2022). Pembelajaran Berbasis Media Digital pada Anak Usia Dini di Era Revolusi Industri. *JIIP - Jurnal Ilmiah Ilmu Pendidikan*, *5*(6), 1748–1756. https://doi.org/10.54371/jiip.v5i6.626

Jazariyah, J., Athifah, N. Z., Purnamasari, Y. M., & Lita. (2023). Fostering Creative Thinking in Early Learners through STEAM-Based Ecoprint Projects. *Golden Age: Jurnal Ilmiah Tumbuh Kembang Anak Usia Dini*, *8*(4), 311–322. https://doi.org/10.14421/jga.2023.84-10

Kesumaningsari, N. P. A., Pudjibudojo, J. K., & Louk, M. H. L. (2022). Teaching experience on online learning in higher education: Generational analysis. *Journal of Education and Learning (EduLearn)*, *16*(3), 318–329. https://doi.org/10.11591/edulearn.v16i3.20508

Kim, S.-W., Kim, S.-W., & Lee, Y. (2015). The Analysis on Research Trends for STEAM education in Korea. *EdMedia + Innovate Learning*, *2015*(1), 1800–1805.

Land, M. H. (2013). Full STEAM ahead: The benefits of integrating the arts into STEM. *Procedia Computer Science*, *20*, 547–552. https://doi.org/10.1016/j.procs.2013.09.317

Louis, C., Lawrence, M., & Keith, M. (2018). *Reaserch Methods In Education*. Routledge.

Maarang, M., Khotimah, N., & Maria Lily, N. (2023). Analisis Peningkatan Kreativitas Anak Usia Dini melalui Pembelajaran STEAM Berbasis Loose Parts. *Murhum : Jurnal Pendidikan Anak Usia Dini*, *4*(1), 309–320. https://doi.org/10.37985/murhum.v4i1.215

Morrison, G. S. (2016). *Early Childhood Education diterjemahkan oleh Yudi Santoso* (13th ed.). Pustaka Pelajar.

Najanuddin, N., Setiani, R. E., & Listyowati, A. (2023). Redefining Early Literacy: A STEAM Approach at AZ Zahra NU Kindergarten, Magelang. *Golden Age: Jurnal Ilmiah Tumbuh Kembang Anak Usia Dini*, *8*(4), 285–296. https://doi.org/10.14421/jga.2023.84-08

Ovcharuk, O. V., & Soroko, N. V. (2024). Monitoring the effectiveness of the STEAM-oriented environment in general secondary education institutions: Approaches to defining criteria. In Papadakis S. & G. C. University of Crete Crete (Eds.), *CEUR Workshop Proc.* (Vol. 3781, pp. 78–87). CEUR-WS; Scopus. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85207051815&partnerID=40&md5=477efbeed55a71c577b53109bcbaed6e

Purwaningsih, P., Munawar, M., & Prasetiyawati Dyah Hariyanti, D. (2022). Analisis Pembelajaran Lingkungan Sosial Berbasis STEAM pada Anak Usia Dini. *Murhum : Jurnal Pendidikan Anak Usia Dini*, *3*(1), 13–23. https://doi.org/10.37985/murhum.v3i1.68

Putri, M. S., & . C. (2021). Transformasi Lingkungan Pembelajaran Berbasis Literasi Digital Pada Anak Usia Dini. *Jurnal Pendidikan Anak Usia Dini Undiksha*, *9*(3), 408. https://doi.org/10.23887/paud.v9i3.38491

Rahayu, A. F., Syaodih, E., & Romadona, N. F. (2019). Meningkatkan Kemampuan Mengenal Konsep Bilangan Anak Melalui Pendekatan Experiential Learning. *Edukids: Junal Pertumbuhan, Perkembangan, Dan Pendidikan Anak Usia Dini*, *16*(1), 11–23. https://doi.org/10.17509/EDUKIDS.V16I1.20725

Riad, M., Qbadou, M., Aoula, E.-S., & Gouraguine, S. (2023). The new e-learning adaptation technique based on learner's learning style and motivation. *Journal of Education and Learning (EduLearn)*, *17*(3), 472–482. https://doi.org/10.11591/edulearn.v17i3.20826

Rianti, R., Nurjanah, I., Latifah, D., Alifah, N., & Asyiah, A. (2022). Freedom Learning on Early Childhood Education: Implementation of STEAM Method with Loose Parts Media. *Golden Age: Jurnal Ilmiah Tumbuh Kembang Anak Usia Dini*, *7*(2), 99–108. https://doi.org/10.14421/jga.2022.72-05

Rossi, M. J., Saimon, M., Leoste, J., Fenyvesi, K., & Lavicza, Z. (2024). The Impact of a Transdisciplinary STEAM Teacher Training Course on the Integration of Robotics in Early Childhood Education. In Balogh R., Obdržálek D., & Fislake M. (Eds.), *Lect. Notes Networks Syst.: Vol. 1084 LNNS* (pp. 114–125). Springer Science and Business Media Deutschland GmbH; Scopus. https://doi.org/10.1007/978-3-031-67059-6_11

Saengkaew, P., Chanyotha, S., Pengvanich, P., Srijaroen, B., Phruksarojanakun, P., Cherdchu, C., Takaki, R., & Iimoto, T. (2024). Advancing Sustainable Development Goals through Enhanced Literacy in Nuclear Science and Technology: Emphasizing Hands-On Experiences. *Perspectives on Global Development and Technology*, *23*(1–2), 32–44. Scopus. https://doi.org/10.1163/15691497-12341672

Sugiyono. (2019). *Metode Penelitian Pendidikan*. CV. Alfabeta.

Sukmadinata, N. S. (2010). *Metodologi Penelitian Pendidikan*. PT Remaja Rosdakarya.

Taibo, H., & Liang, C. (2022). Research on the Training Mode of Children's Engineering Thinking with the Concept of STEAM Education. *Journal of Curriculum and Teaching*, *11*(7), 7–14. Scopus. https://doi.org/10.5430/JCT.V11N7P7

Wahyuningsih, S., Nurjanah, N. E., Rasmani, U. E. E., Hafidah, R., Pudyaningtyas, A. R., & Syamsuddin, M. M. (2020). STEAM Learning in Early Childhood Education: A Literature Review. *International Journal of Pedagogy and Teacher Education*, *4*(1), 33–44. https://doi.org/10.20961/IJPTE.V4I1.39855

Wiersma, W., & Jurs, S. G. (2009). *Research Methods in Education: An Introduction* (9th Edition, Ed.). Pearson.

Xue, H. (2022). New Integrated Teaching Mode for Labor Education Course Based on STEAM Education. *International Journal of Emerging Technologies in Learning*, *17*(2), 128–142. Scopus. https://doi.org/10.3991/IJET.V17I02.28461