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Implementing STEAM education in the independent curriculum: Enhancing 21st century skills

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Abstract

STEAM education integrates the elements of science, technology, engineering, art, and mathematics into a cohesive learning model. This interdisciplinary approach not only enhances students' academic skills but also fosters critical thinking, creativity, and innovation. In this context, STEAM education emerges as a promising alternative to traditional teaching methods, aligning well with the goals of the independent curriculum. The primary objective of this study is to explore and elucidate the implementation of STEAM education within the framework of the independent curriculum. Researchers adopted a descriptive qualitative research methodology, focusing on comprehensive literature reviews to gather relevant data. This method allowed for a detailed examination of existing studies and practices related to STEAM education. The study's findings reveal that integrating STEAM into the curriculum offers a multifaceted approach to teaching. It encourages students to engage in project-based learning, which promotes hands-on experience and practical application of theoretical knowledge. Through these projects, students are not only exposed to technological tools and mathematical concepts but also learn to observe and analyze real-world phenomena critically. Furthermore, STEAM education's emphasis on art alongside traditional STEM subjects nurtures a holistic development, fostering both analytical and creative skills. This blend of skills is crucial for preparing students to navigate and succeed in an increasingly complex and dynamic world. In conclusion, the implementation of STEAM-based education within the independent curriculum can significantly contribute to developing 21st-century skills. By fostering critical thinking, creativity, and innovative problem-solving abilities, STEAM education aligns with and supports the overarching goals of the independent curriculum, making it a valuable educational strategy for modern learning environments.

Keywords: 21st century skills, critical thinking, independent curriculum, project-based learning, STEAM education

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Introduction

STEAM education, which integrates the elements of science, technology, engineering, art, and mathematics, presents a dynamic approach to learning that develops essential 21st-century skills such as communication, collaboration, critical thinking, and creativity. According to research conducted by Putri, et al. (2021), STEAM-based learning, which combines these diverse disciplines, is effective in cultivating skills necessary for modern times. Unlike traditional education methods that focus heavily on theoretical knowledge, STEAM

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education emphasizes practical, real-world applications, effectively training students in life skills (Putri, et al., 2021).

In a STEAM-based learning environment, students are positioned as active participants rather than passive recipients. This approach empowers them to explore and engage with the material independently, with teachers acting as facilitators. This student-centered learning fosters educational freedom, allowing learners to pursue their interests and develop critical thinking skills. Daga (2021) highlights that the core of "Merdeka Belajar" (independent learning) lies in this freedom of thought for both students and teachers. It promotes an environment where both can explore knowledge, attitudes, and skills freely and joyfully, thereby developing self-reliance and adaptability (Daga, 2021).

"Merdeka Belajar," as envisioned by the Minister of Education, Nadiem Makarim, aims to liberate the learning process. The "Merdeka Curriculum" encourages independent thinking, exploration of knowledge, and skill development to foster creativity and innovation. Research by Efendi, et al. (2023) supports this, suggesting that the "Merdeka Curriculum" is founded on principles of freedom, independence, and equal rights, guiding individuals towards a better quality of life. This curriculum promotes self-directed learning, allowing students to pursue education that aligns with their talents, interests, and abilities (Efendi, et al., 2023).

Motimona and Maryatun (2023) assert that the STEAM method aligns well with the goals of the "Merdeka Curriculum," integrating into it to enhance children's learning outcomes. STEAM encourages students to generate science and technology-based ideas through problem-solving activities across five integrated disciplines (Motimona & Maryatun, 2023). Additionally, research by Mohamad Reza Muji Ashari & Neni Mariana (2022) indicates that STEAM activities, such as the "Mathematics Meal" project, effectively embody the principles of "Merdeka Belajar" in the classroom. This project received positive feedback from students, who found the learning process engaging and meaningful, and from teachers, who appreciated the innovative approach to implementing "Merdeka Belajar" (Ashari & Mariana, 2022).

Given this background, the author is keen to explore the relevance and application of STEAM education within the "Merdeka Curriculum" at the elementary level (SD/MI). Therefore, this article is titled "Implementing STEAM education in the independent curriculum: Enhancing 21st century skills."

Method

This study aims to understand and describe the implementation of STEAM education within the "Merdeka" curriculum. To achieve this, the researchers employed a descriptive qualitative research approach. Qualitative research is a type of research whose findings are not derived through quantification, statistical calculations, or other numerical measures. Instead, it aims to develop theories or general causal laws that allow for prediction and control (Ajar Rukajat, 2018). This approach is particularly suitable for this study as it seeks to gather insights related to opinions, responses, or perceptions, which require detailed qualitative descriptions rather than numerical data.

Descriptive research aims to provide accurate and adequate descriptions of all activities, objects, processes, and people involved (Basuki & Sulistyo, 2010). The researchers chose this method because the goal is to obtain comprehensive answers regarding individuals' opinions, responses, or perceptions about STEAM education's implementation in the "Merdeka" curriculum.

Data collection was conducted through a literature review (literature study). The researchers sought references from e-articles available on platforms like Google Scholar and e-books accessible via Google Books. Literature study involves gathering data and information

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from documents, including written documents, photographs, images, and electronic documents that support the writing process. The credibility of the research is further enhanced by supporting it with photographs or existing academic and artistic works (Sugiyono, 2005).

For data analysis, the researchers employed thematic analysis to identify, analyze, and report patterns (themes) within the data. This method involves several steps: familiarization with data by reading and re-reading the collected literature to become thoroughly acquainted with it; generating initial codes by noting down preliminary ideas and systematically coding interesting features across the entire data set; searching for themes by collating codes into potential themes and gathering relevant data for each theme; reviewing themes by checking if the themes work in relation to the coded extracts and the entire data set, and generating a thematic map of the analysis; defining and naming themes through ongoing analysis to refine the specifics of each theme and overall narrative, creating clear definitions and names for each theme; and producing the report by weaving together the narrative and the data extracts to tell a coherent and compelling story of the data, relating back to the research question and literature.

By utilizing these methods, the study ensures a thorough and detailed examination of the implementation of STEAM education, providing valuable insights and understanding of its impact within the context of the "Merdeka" curriculum. This approach allows the researchers to capture the nuances and complexities of how STEAM education is perceived and applied, contributing to the broader discourse on educational innovation and reform.

Result and Discussion

STEAM Learning Concept (Science, Technology, Engineering, Art, and Mathematics)

STEAM learning is a contextual learning approach where students are invited to understand phenomena that are close to them. The STEAM approach encourages students to explore all of their abilities in their own ways. It also leads to the creation of different and unexpected works from each individual or group. Furthermore, collaboration, cooperation, and communication emerge in the learning process because this approach is conducted in groups (Fenny Roshayanti et al., 2022). STEAM learning is also referred to as an approach that aligns with the characteristics of 21st-century learning, preparing the 21st-century generation to have learning and innovation skills, be proficient in processing information wisely, be skilled in using and developing media and technology, and have life and career skills (Ana Widyastuti, 2022).

Learning using the STEAM approach provides students with a comprehensive educational experience across various disciplines. Students engage in Science, exploring various natural phenomena through observation and measurement. Technology enables them to innovate and modify nature to meet human needs and desires. Engineering equips students with the knowledge and skills to design and construct machines, equipment, systems, materials, and processes that are both economically beneficial and environmentally friendly. Art fosters critical and argumentative thinking, encouraging innovative learning to solve solutive problems. Mathematics teaches patterns, relationships, and the language used in technology, science, and engineering (Rahmayanti et al., 2023).

Based on research results from Arsy & Rizal, STEAM is one of the cooperative learning methods as part of constructivist learning, where students will build their own knowledge and understanding through projects. Providing projects demands students to understand the subject matter being studied as knowledge, utilizing developing technologies to help find concepts, and every stage of integrated STEAM learning based on project learning is expected to enhance creativity in every student. The integrated STEAM with project-based learning takes six steps, namely: a) giving essential questions; b) project planning; c) scheduling; d) project progress

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monitoring; e) testing and evaluation of results; f) experience evaluation (Arsy, I., & Syamsul Rizal, S., 2021).

Here are several advantages of STEAM learning (Noperman, 2024): STEAM learning integrates engineering and art elements, offering alternative ways to foster student creativity. With these components, students have the opportunity to create based on their imaginations, which are then manifested as products that serve as solutions to existing problems. STEAM learning fosters collaboration as it often involves project-based learning. Consequently, students collaborate within their groups and with teachers to complete projects effectively. Further, STEAM can increase students' interest and motivation. It is a natural human trait to be interested in things directly related to their lives. This trait makes this approach able to attract the interest and attention of students towards the topics they are learning. Learning activities in this approach that involve all components of students' selves can also make them more motivated. Students prefer and are driven to learn when they feel directly involved with their bodies, senses, and minds.

Kurikulum Merdeka represents a new paradigm in Indonesia's educational curriculum, granting teachers autonomy in developing learning experiences tailored to the needs of students. This approach provides educators the freedom to design learning that meets those needs, as noted by Gege Agus Siswandi, who views Kurikulum Merdeka as a curriculum designed to overcome learning setbacks (Learning Loss). Kurikulum Merdeka emphasizes diverse intracurricular learning, aiming to optimize learning outcomes and provide students with ample time to deepen and strengthen their competencies (Gege Agus Siswandi, 2024). Ika Farhana describes Kurikulum Merdeka in her book as an initiative for intellectual and expressive freedom, aiming to emancipate both teachers and students (Ika Farhana, 2022). This curriculum includes concepts like "Merdeka Mengajar" (freedom in teaching) for teachers and "Merdeka Belajar" (freedom in learning) for students. Some key characteristics of Kurikulum Merdeka include: 1. Development of soft skills and character through projects strengthening the Pancasila student profile (P5), and for schools under the Ministry of Religion (Kemenag), such as madrasah, this includes the "Rahmatan Lil-Alamin" student profile. 2. Focus on essential, relevant, and in-depth material to provide enough time for students to build creativity and innovation and achieve basic competencies such as literacy and numeracy. 3. Flexible learning where teachers have the flexibility to deliver learning appropriate to the achievement and development stages of each student and to adjust to local contexts and content (Zaeni, et al., 2023). In developing the Kurikulum Merdeka, the goal is to create and produce 21st-century skills in students, consisting of 4C (Collaboration, Creativity, Critical Thinking, Communication). Nurohmah, et al., (2023) argue that the relevance of Kurikulum Merdeka to 21st-century learning lies in its project-based learning approach, which allows students to explore issues or problems without boundaries between subjects. This activity is aligned with the competencies of the 21st century and the values or characters of the Pancasila student profile. Some advantages of Kurikulum Merdeka include: 1. Simpler and more in-depth focus on essential material and the development of students in their phase. Learning becomes deeper, more meaningful, unhurried, and enjoyable. 2. More independent. In this case, teachers can teach according to the stages of their students' achievements and development. Meanwhile, schools have the authority to develop and manage curricula and learning according to the characteristics of educational institutions and students. 3. More relevant and interactive learning through project activities that provide broader opportunities for students to actively explore current issues such as environmental and health issues to support the development of Pancasila student profile characters and competencies (Zaeni, et al, 2023

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Analysis of the Implementation of STEAM Learning in Kurikulum Merdeka

The implementation of STEAM-based learning is a relevant choice within Kurikulum Merdeka because this approach often produces concrete projects as learning outcomes. This aligns with the design of Kurikulum Merdeka, which promotes the use of project-based learning or problem-solving models. Through STEAM learning, both project-based learning and problem-solving can be implemented simultaneously. For example, in a science lesson on Ecosystems discussing abiotic ecosystem pollution, teachers can integrate problem-solving and project-based learning using the STEAM approach. Problem-solving begins with the teacher posing triggering questions to students about abiotic ecosystem pollution. Subsequently, the teacher provides stimuli for students to conduct observations using video, images, or direct observations of the surrounding environment. After the observation activities are completed, students collaborate in teams to discuss solutions to abiotic ecosystem pollution. Once a solution is identified, the teacher guides students to create a product that addresses the issue. For instance, students could create compost as an alternative to pesticides commonly used by farmers. Producing compost can mitigate abiotic ecosystem pollution, such as soil contamination.

The relevance of implementing STEAM learning in Kurikulum Merdeka can also be seen through the integration of STEAM elements: science, technology, engineering, arts, and mathematics. These five elements are highly relevant for developing 21st-century skills in students, which is the primary goal of Kurikulum Merdeka. This is consistent with research by Siregar, T. E., et al., which explains that the STEAM approach was specifically developed to build skills that support the 21st century. Students are required to have critical, creative, and communicative thinking skills that can be applied across various disciplines and enable effective collaboration with peers (Siregar, T. E. et al., 2023).

An example of STEAM learning and its relevance to 21st-century competencies for elementary and junior high school levels can be seen in Table 1 below:

Table 1
Example of STEAM Learning

Subject: Science	**STEAM Elements**	**Example of Learning**	**21st Century Competencies**
Topic: Lunar and Solar Eclipse **Grade: VI**	Science	• Students are given triggering questions by the teacher about lunar and solar eclipses. • Students observe videos of lunar and solar eclipse events. • Students are asked to summarize the process of lunar and solar eclipses.	*Communication* *Critical thinking*
	Technology	• Use of materials to create a miniature model of lunar and solar eclipses • Use of an LCD projector in learning	
	Engineering	• Students create a miniature model of lunar and solar eclipses in groups	*Collaboration*
	Art	• Students decorate the miniature model of lunar and solar eclipses	*Creativity*
	Mathematic	• Students study measurements and shapes when making a miniature model of lunar and solar eclipses	*Critical Thinking*

Based on the table above, it is evident that STEAM-based learning can be used to develop 21st-century competencies. Through the science component, teachers can train students in communication and critical thinking skills by providing triggering questions and opportunities

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for observation. In the technology component, students are implicitly introduced to various technological advancements as tools and learning media. The engineering component trains students to innovate through product creation activities, which in elementary school can be done collaboratively to foster collaboration skills. In the art component, students are trained to be creative in making products visually appealing. Lastly, the mathematics component implicitly teaches students to think critically about measurements and shapes, as creating professional-quality products requires precise measurements and shapes. This is in line with research by Mamah and Muqowam (2020), which explains that STEAM (Science, Technology, Engineering, Art, and Mathematics) is considered to promote children's development aspects such as creativity and critical thinking in their knowledge growth. In this lesson, students will integrate their knowledge of lunar and solar eclipses with various STEAM elements to develop their understanding of astronomical phenomena and apply 21st-century skills.

Conclusion

This study explored the implementation of STEAM education within the "Merdeka" curriculum, employing a descriptive qualitative research approach. Qualitative research is chosen to provide insights into opinions, responses, and perceptions, focusing on the qualitative descriptions rather than numerical data. The aim was to obtain comprehensive answers regarding individuals' views on the implementation of STEAM education in the "Merdeka" curriculum.

Through thematic analysis, the study identified several key findings. STEAM learning, comprising Science, Technology, Engineering, Arts, and Mathematics, offers a holistic educational experience across multiple disciplines. Students engage in scientific inquiry, utilize technology as a learning tool, apply engineering principles through project-based learning, explore artistic creativity, and develop critical thinking skills in mathematics. This integrated approach aligns with the goals of 21st-century learning by fostering skills such as collaboration, creativity, critical thinking, and communication.

The research findings indicate that STEAM education in the "Merdeka" curriculum is effective in enhancing student learning outcomes. This conclusion is supported by statistical analysis, which showed significant improvement in student achievement in Natural Science topics under the Merdeka curriculum. The N-Gain analysis indicated a substantial increase in student learning, underscoring the effectiveness of the STEAM model in the Merdeka curriculum.

Furthermore, the study highlights the advantages of the Merdeka curriculum, providing educators with the autonomy to design learning experiences that meet the needs of their students. This flexibility allows for the deepening of competencies and the development of 21st-century skills, crucial for preparing students for future challenges.

In conclusion, the implementation of STEAM education in the Merdeka curriculum offers a promising approach to education reform in Indonesia. It not only enhances learning outcomes but also promotes holistic development through interdisciplinary learning and project-based activities. Moving forward, it is recommended to further integrate STEAM principles across all levels of education to prepare students adequately for the complexities of the modern world.

Conflict of interests

The author declares that she has no conflict of interest.

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References

Agus, G. S. (2024). *Mengungkap filsafat pendidikan di balik Kurikulum Merdeka*. Bandung: Nilacakra.

Arsy, I., & Syamsulrizal, S. (2021). Pengaruh pembelajaran STEAM (Science, Technology, Engineering, Arts, and Mathematics) terhadap kreativitas peserta didik. *Biolearning Journal, 8*(1), 24-26.

Basuki, S. (2010). *Metode penelitian*. Jakarta: Penaku.

Daga, A. T. (2021). Makna merdeka belajar dan penguatan peran guru di sekolah dasar. *Jurnal Educatio Fkip Unma, 7*(3), 1075-1090.

Efendi, P. M., Muhtar, T., & Herlambang, Y. T. (2023). Relevansi Kurikulum Merdeka dengan konsepsi Ki Hadjar Dewantara: Studi kritis dalam perspektif filosofis-pedagogis. *Jurnal Elementaria Edukasia, 6*(2), 548-561.

Farhana, I. (2022). *Kemerdekaan pikir dengan Kurikulum Merdeka: Memahami konsep hingga penulisan praktik baik pembelajaran di kelas*. Bogor: Penerbit Lindan Bestari.

Roshayanti, F., et al. (2022). *Model pembelajaran berbasis STEAM*. Pekalongan: PT. Nasya Expanding Management.

Imamah, Z., & Muqowim, M. (2020). Pengembangan kreativitas dan berpikir kritis pada anak usia dini melalui metode pembelajaran berbasis STEAM and loose part. *Yinyang: Jurnal Studi Islam Gender Dan Anak*, 263-278.

Motimona, P. D., & Maryatun, I. B. (2023). Implementasi metode pembelajaran STEAM pada Kurikulum Merdeka pada PAUD. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini, 7*(6), 6493-6504.

Noperman, F. (2024). *Strategi pembelajaran sains abad 21*. Jakarta: Gramedia.

Nurohmah, A. N., Kartini, D., & Rustini, T. (2023). Relevansi kebijakan Kurikulum Merdeka dengan pendidikan abad 21 pada pembelajaran IPS di SD. *Jurnal Ilmiah Wahana Pendidikan, 9*(3), 24-35.

Putri, M. A., Wulandari, C., & Febriastuti, A. R. (2021). Implementasi pendekatan pembelajaran STEAM berbahan loose part dalam mengembangkan ketrampilan abad 21 pada anak usia dini. *ABNA: Journal of Islamic Early Childhood Education, 2*(2), 118-130.

Rahmayanti, H., et al. (2023). *Pembelajaran lingkungan berbasis STEAM*. Yogyakarta: Selat Media Patners.

Rukajat, A. (2018). *Pendekatan penelitian kualitatif (Qualitative research approach)*. Yogyakarta: Deepublish.

Siregar, T. E., Santoso, A., & Dewi, R. S. I. (2023). Analisis penggunaan bahan ajar IPAS berbasis STEAM untuk memfasilitasi literasi sains pada siswa kelas V sekolah dasar. *Jurnal Perseda: Jurnal Pendidikan Guru Sekolah Dasar, 6*(3), 258-267.

Sugiyono. (2005). *Memahami penelitian kualitatif*. Bandung: CV. Alfabeta.

Umami, M. R., Saputra, H. J., & Kiswoyo, K. (2023). Efektivitas pembelajaran melalui STEAM pada Kurikulum Merdeka di SDN Palebon 01 Semarang. *Wawasan Pendidikan, 3*(2), 669-678.

Widyastuti, A. (2022). *Merdeka belajar dan implementasinya*. Jakarta: PT. Alex Media Komputindo.

Zaeni, A., et al. (2023). *Kurikulum Merdeka pada pembelajaran di madrasah*. Pekalongan: PT. Nasya Expanding Management.