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IMPLEMENTATION OF STEAM IN ELEMENTARY SCHOOLS: LITERATURE REVIEW

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Abstrak

Penerapan model pembelajaran STEAM (*Science, Technology, Engineering, Arts, and Mathematics*) menjadi pendekatan inovatif dalam pengembangan keterampilan abad ke-21 di sekolah dasar. Tujuan penelitian ini adalah untuk mengidentifikasi implementasi STEAM dalam konteks pendidikan dasar melalui studi literatur sistematis. Metode yang digunakan adalah systematic literature review (SLR) dengan pendekatan kualitatif meta-sintesis. Hasil studi menunjukkan bahwa implementasi STEAM sebagian besar dilakukan melalui pembelajaran berbasis proyek dan pemecahan masalah yang mampu meningkatkan kreativitas, kolaborasi, komunikasi, dan kemampuan berpikir kritis anak. Namun, ditemukan beberapa tantangan dalam penerapannya, seperti keterbatasan infrastruktur, kurangnya pemahaman guru terhadap konsep STEAM, serta hambatan teknis dan administratif. Studi ini juga meninjau implementasi STEAM di negara lain, seperti Amerika Serikat dan Korea Selatan, yang telah memasukkan STEAM ke dalam kebijakan nasional dan kurikulum sekolah dasar secara integratif. Kesimpulan dari studi ini menegaskan pentingnya pelatihan guru, dukungan infrastruktur, dan integrasi kurikulum untuk keberhasilan implementasi STEAM di sekolah dasar.

Kata kunci: STEAM, Sekolah Dasar, Keterampilan Abad ke-21

Abstract

The implementation of the STEAM (Science, Technology, Engineering, Arts, and Mathematics) learning model is an innovative approach to developing 21st-century skills in elementary schools. This study aims to identify how STEAM is implemented in elementary education through a systematic literature review. The method used is a qualitative meta-synthesis approach within the Systematic Literature Review (SLR) framework. The findings reveal that STEAM is predominantly implemented through project-based and problem-solving learning, which effectively enhances children's creativity, collaboration, communication, and critical thinking skills. However, challenges remain, including limited infrastructure, lack of teacher knowledge about STEAM, as well as technical and administrative constraints. The study also reviews STEAM implementation in other countries, such as the United States and South Korea, where STEAM has been integrated into national education policies and elementary school curricula. This study concludes that teacher training, infrastructural support, and curriculum integration are essential for the successful implementation of STEAM in elementary schools.

Keywords: *STEAM, Primary School, 21st-century skills*

1. INTRODUCTION

21st century skills are a very important influence in the field of education, because they ensure that students have the skills to learn and innovate, become users of information technology, work actively, and survive using life skills (Andrian & Rusman, 2019). In addition, the main skills used in the 21st century refer to the development of cognitive, behavioral, or emotional skills for school and outside school life. In line with the opinion of Louis, et al., (2021), 21st century skills are the development of skills that prioritize creativity, innovation, critical thinking, problem solving, decision making, learning, communication, and collaboration, which are important in developing skills related to information technology for children's future readiness when working in the field. The importance of these 21st-century skills is applied in learning at school. 21st-century learning is an implication of the development from time to time by society from primitive to agrarian, industrial, and towards an information society characterized by the development of digitalization (Rahayu et al., 2022).

The field of education has faced various challenges amid dramatic transitions caused by science, development, and technological innovation. In the field of global education, attention is being paid to the latest innovation in education, namely STEAM (Science, Technology, Engineering, Mathematics) (Ananda, 2019). STEAM (Science, Technology, Engineering, Mathematics) is one of the learning methods that is trending both nationally and internationally (Nurwulan, 2020). STEAM is applied in the field of education because it can develop 21st-century skills, such as creativity, critical thinking, collaboration, and communication, so that children are able to identify problems, create solutions to problems, collaborate with peers, and communicate ideas effectively in everyday life (Chu et al., 2017).

According to Hadinugrahaningsih et al., (2017) STEAM is a 21st century learning model that aims to develop children's soft skills by linking the fields of science, developing technology, engineering, art, and mathematics, which are developed holistically through 21st century learning experiences. STEAM learning is contextual learning, where children are encouraged to understand events that occur in the scope of life so that they are able to explore all their abilities and produce different works from individuals and groups. Collaboration, cooperation, and communication are applied in the learning process because STEAM is carried out in groups to stimulate the ability to take responsibility and solve problems, both personal and interpersonal, in learning, as well as to be able to construct an understanding of the material presented by the teacher (Lee, 2021).

STEAM-related education policies have been implemented worldwide with the aim of encouraging educators to innovate in society in order to improve children's motivation, academic achievement, and career goals. Several studies have been conducted on STEAM, and the results show that STEAM is an effective learning method for developing children's abilities. For example, a study by Rini et al., (2022) shows that the implementation of STEAM can help construct gender equality in early childhood because the activities carried out by children do not assume that housework is always done by a certain gender. Based on the results of Peters et al., (2019) research, STEAM is important to be applied to elementary school children because it can develop children's creative personalities, prepare children for the needs of further education, and encourage children to be actively involved in learning because STEAM is used as a way of thinking and combining learning contexts. However, there are still some teachers who find it difficult to implement STEAM in elementary schools. This is because teachers do not yet understand how to apply STEAM in the classroom and are worried about its

implementation. In addition, there are still teachers who have not received information or knowledge about STEAM (Sumaya & Ilmi, 2021).

This is the reason why the author decided to conduct a literature study on STEAM in elementary school education. Several studies have examined STEAM in learning, such as the previous study by Margot & Kettler (2019), which conducted an empirical study on teachers' understanding of STEM education based on existing literature. The results showed that teachers experienced obstacles in implementing STEM in terms of curriculum, structure, child development, and research. The results of a previous study by Farwati et al., (2021), a review obtained through Google Scholar, showed that STEAM implementation was used as a strategy, an approach integrated with other learning models, and developed into teaching materials, modules, and learning media. In addition, teachers applied STEAM to improve children's learning motivation, entrepreneurship, and 21st-century skills. The purpose of this study is to identify the implementation of STEAM (Science, Technology, Engineering, Mathematics) in elementary schools.

2. MATERIALS AND METHODS

The research method used was a systematic literature review (SLR) using a qualitative approach called meta-synthesis to answer the research questions. Systematic literature review (SLR) is a qualitative approach in systematic reviews used to summarize the results of descriptive studies. Data collection for this study was a review of Google Scholar and Publish or Perish journals between 2020 and 2022 using seven steps in conducting this research analysis, namely Purnama et al., (2022): (1) Literature search phase, (2) literature search screening phase, (3) screening phase, (4) literature mapping phase, (5) quality assessment phase, (6) findings synthesis phase, and (7) conclusion phase.

3. RESULT AND DISCUSSION

Result

The results of research by Mu'minah & Suryaningsih (2020) show that the implementation stage of STEAM (Science, Technology, Engineering, Mathematics) in children is through projects. Children are required to understand the project material and understand it as new knowledge that utilizes technology so that they can develop 21st-century skills. The project-based implementation of STEAM is as follows: (1) Asking essential questions to gain an overview of the children's prior knowledge. (2) Developing a project plan by discussing the project stages in groups, searching for information about the completion and obstacles that will be encountered in the project, determining the time needed to complete the project, and designing the project to be carried out by linking STEAM. (3) Scheduling is very important because children must complete the project within the agreed time frame. (4) Monitoring Project Progress. At this stage, teachers observe the difficulties encountered in completing the project. Monitoring is done to determine the extent to which children are able to complete the project. (5) Testing and Assessing Results is carried out by teachers based on the results of projects completed by children by evaluating and assessing the products. (6) Evaluating Experiences. In this final stage, children are asked to express their feelings and experiences after conducting and completing project-based learning. After that, teachers and children reflect on the activities carried out and the results produced.

According to the results of research by Nuragnia & Usman (2021), 93.75% of STEAM (Science, Technology, Engineering, Mathematics) has been implemented in project-based and problem-solving elementary schools in the classroom. 79.69% of teachers have applied inquiry-based learning, 79.69% have applied collaborative learning, 71.87% of teachers have implemented integrated learning in line with the 2013 thematic curriculum used in elementary schools, and 89.06% of teachers intensively apply evaluation and reflection with children in the classroom. Based on this data, most STEAM has been implemented for children in elementary schools, but in this study, teachers were unaware that this implementation was STEAM learning.

In line with Riyanti & Purnamasari (2020), SD N 1 Ketro has implemented thematic learning in accordance with the 2013 curriculum, which integrates several aspects. Teachers give children project-based assignments and encourage collaboration among children. However, the teachers did not know that what had been implemented in the school was STEAM learning. The data obtained showed that 41.6% of teachers knew about STEAM learning, while 58.3% did not.

Discussion

In the implementation of STEAM (Science, Technology, Engineering, Mathematics), the following challenges were found: (1) there are obstacles in terms of infrastructure, especially technology-based infrastructure, with 65.62% of respondents citing inadequate computers and internet connections, both of which are important factors in STEAM learning. (2) 68.75% of teachers believe that there is a lack of knowledge among teachers about the implementation of STEAM in elementary schools. (3) Technical constraints, with 64.06% of respondents stating that school facilities are inadequate, such as interactive media and furniture in classrooms. (4) Difficulties in accessing STEAM content, including administrative and budgetary challenges (Kartini, & Widodo, 2020).

In addition, STEAM implementation has also been carried out in elementary schools abroad. STEAM implementation for children in American schools involves engaging children in the material and providing opportunities to relate the material to real life, working together and solving relevant problems, thinking critically, communicating effectively, involving children in meta-disciplines, and requiring teachers to be active in learning by providing and offering choices in learning topics (methods, investigations, product types, technologies used, collaborative partners, and demonstrating their knowledge) (Quigley & Herro, 2016). According to Bush et al., (2020), the application of STEAM focuses on: 1) solving authentic problems to make the world a better place, 2) arts that focus on creativity, aesthetics, expression, personality, and meaning, 3) designing solutions and providing the means to foster empathy and solve problems. In line with Cook (2018), STEAM learning is applied by introducing the real world to children, focusing on children, the need for various disciplines to overcome problems, and collaborative skills in finding solutions.

In the results of Peters et al., (2019) research in American elementary schools, it was found that the application of STEAM among teachers was always open to new ideas, both in terms of innovation, adopting STEAM learning, and collaboration in lesson planning. Meanwhile, Lee (2021) found that the implementation of STEAM in South Korea is a new integrated learning approach that covers all school subjects and aims to provide a holistic approach to children's real lives. The South Korean government has announced plans to strengthen STEAM in elementary schools so that children can develop problem-solving skills in science, technology, engineering, arts, and mathematics. These efforts have been consistently implemented through national

policies. The elementary school curriculum has applied integrative technology, engineering, arts, science, and mathematics in the classroom (Kim & Na, 2022).

4. CONCLUSION AND SUGGESTIONS

STEAM is a 21st-century learning model that aims to develop children's soft skills by linking the fields of science, developing technology, engineering, art, and mathematics, which are developed holistically through 21st-century learning experiences. STEAM learning is contextual learning, where children are encouraged to understand events that occur in the scope of life so that they are able to explore all their abilities and produce different works from individuals and groups. Collaboration, cooperation, and communication are applied in the learning process because STEAM is carried out in groups to stimulate the ability to take responsibility and solve problems, both personal and interpersonal, in learning, as well as to be able to construct an understanding of the material presented.

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6. REFERENCES

Ananda, R. (2019). *Perencanaan Pembelajaran*. Medan: Lembaga Peduli Pengembangan Pendidikan Indonesia (LPPPI).

Andrian, Y., & Rusman, R. (2019). Implementasi pembelajaran abad 21 dalam kurikulum 2013. *Jurnal Penelitian Ilmu Pendidikan*, *12*(1), 14–23.

Bush, S. B., Cook, K. L., Edelen, D., & Cox, R. (2020). Elementary Students' STEAM Perceptions. *The Elementary School Journal*, *120*(4), 692–714.

Chu SKW, Zhang Y, Chen K, Chan CK, Lee CWY, Zou E, L. W. (2017). The effectiveness of wikis for project-based learning in different disciplines in higher education. *Internet High Educ*, *33*, 49–60. https://doi.org/10.1016/j. iheduc.2017.01.005

Cook, K.L., & Bush, S.B. (2018). Design thinking in integrated STEAM learning: Surveying the landscape and exploring exemplars in elementary grades. *School Science and Mathematics*, *118*(3), 93–103. https://doi.org/10.1111/ssm.12268

Farwati, R., Metafisika, K., Sari, I., Sitinjak, D. S., Solikha, D. F., & Solfarina, S. (2021). STEM Education Implementation in Indonesia: A Scoping Review. *International Journal of STEM Education for Sustainability*, *1*(1), 11–32.

Hadinugrahaningsih, T., RahmawatI, Y., Ridwan, A., Budiningsih, A., Suryani, E., Nurlitiani, A., & Fatimah, C. (2017). *Keterampilan Abad 21 dan STEAM (Science, Technology, Engineering, Art, and Mathematics)*. CV Campustaka.

Kartini, D., & Widodo, A. (2020). Exploring Elementary Teachers', Students' Beliefs and Readiness toward STEAM Education. *Mimbar Sekolah Dasar*, *7*(1), 54–65.

Kim, Y.-H., & Na, S.-I. (2022). Using structural equation modelling for understanding relationships influencing the middle school technology teacher's attitudes toward STEAM education in Korea. *International Journal of Technology and Design Education*, *32*(5), 2495–2526.

Lee, Y. (2021). Examining the Impact of STEAM Education Reform on Teachers' Perceptions about STEAM in Uzbekistan. *Asia-Pacific Science Education*, *7*(1), 34–63.

Louis, A. T., Thompson, P., Sulak, T. N., Harvill, M. L., & Moore, M. E. (2021). Infusing 21st Century Skill Development into the Undergraduate Curriculum: The

Formation of the iBEARS Network. *Journal of Microbiology & Biology Education*, *22*(2).

Margot, K. C., & Kettler, T. (2019). Teachers' perception of STEM integration and education: a systematic literature review. . . *International Journal of STEM Education*, *6*(1).

Mu'minah, I. H., & Suryaningsih, Y. (2020). Implementasi Steam (Science, Technology, Engineering, Art And Mathematics) Dalam Pembelajaran Abad 21. *BIO EDUCATIO : (The Journal of Science and Biology Education)*, *5*(1), 65–73.

Nuragnia, B., Nadiroh, & Usman, H. (2021). Pembelajaran Steam Di Sekolah Dasar : Implementasi Dan Tantangan. *Jurnal Pendidikan Dan Kebudayaan*, *6*(2), 187–197.

Nurwulan, N. R. (2020). Pengenalan Metode Pembelajaran STEAM Kepada Para Siswa Tingkat Sekolah Dasar Kelas 1 Sampai 3. *Jurnal Madaniya*, *1*(3), 140–146.

Peters-Burton, E. E., House, A., Peters, V., & Remold, J. (2019). Understanding STEM-focused elementary schools: Case study of Walter Bracken STEAM Academy. *School Science and Mathematics*, *119*(8), 446–456.

Purnama, S., Ulfah, M., Ramadani, L., Rahmatullah, B, & Ahmad, I. F. (2022). Digital Storytelling Trends in Early Childhood Education in Indonesia: A Systematic Literature Review. *Jurnal Pendidikan Usia Dini*, *16*(1).

Quigley, C. F., & Herro, D. (2016). "Finding the Joy in the Unknown": Implementation of STEAM Teaching Practices in Middle School Science and Math Classrooms. *Journal of Science Education and Technology*, *25*(3), 410–426.

Rahayu, R., Iskandar, S., & Abidin, Y. (2022). Inovasi Pembelajaran Abad 21 dan Penerapannya di Indonesia. *Jurnal Basicedu*, *6*(2), 2099–2104.

Rini, R. Y., Mutaqin, M. F. T., & Fajari, L. E. W. (2022). Implementasi STEAM dalam Mengkonstruksi Kesetaraan Gender pada Anak Usia Dini. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, *6*(6), 6661–6674.

Riyanti, E. D., Roshayati, F., & Purnamasari, V. (2020). The Profile of Elementary Teachers' Understanding in STEAM (Science, Technology, Engineering, Art, and Mathematics) Approach. *Jurnal Ilmiah Sekolah Dasar*, *4*(4), 678–686.

Sumaya, A., Israwaty, I., & Ilmi, N. (2021). Penerapan Pendekatan STEM untuk Meningkatkan Hasil Belajar Siswa Sekolah Dasar Di Kabupaten Pinrang. *Journal of Education*, *1*(2), 217–223.