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Steam As An Alternative For Mathematics Learning In MI/SD The 21st Century

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Abstract

Mastery of science and technology is a must in facing the era of globalization. This requires various parties to be able to develop capabilities related to the development of capabilities in the field of technology. In the field of education, one of the educational breakthroughs in Indonesia that seeks to develop humans who can create a science and technology-based economy is STEAM (Science, Technology, Engineering, Arts, and Mathematics) learning. This study aims to describe STEAM as an alternative to learning mathematics in MI/SD in the 21st century. This study uses a literature review method. The library study method is a critical study of the discussion of a topic that has been written by researchers or scientists in various sources in the form of books, journals, ebooks, or other scientific articles. The results of this study indicate that it is very important to use learning methods and media in the world of education to support teaching and learning activities, especially at the MI/SD level. STEAM is one of the methods that can be used in learning but it is undeniable that this method cannot be applied in all madrasah/school circles. Madrasas/schools that have been able to use this method are those that are well-coordinated. Therefore, we really hope that this STEAM method can be implemented in all madrasah/school circles which also indicates that our education is developing to be better every day.

Keywords: 21st-century ability, mathematical learning, primary school, STEAM

1 Introduction

Life activities have been dominated by high-tech products in this modern era. Not a few of us can not live without technology. This indicates that the rapid development of science and technology cannot be avoided but must be faced and mastered.(Malik* & Ubaidillah, 2021) In facing the era of globalization, mastery of science and technology is a must. This requires various parties to be able to develop capabilities related to the development of capabilities in the field of technology.

The development of students' abilities in the field of education in mastering technology has been strived for in every curriculum update carried out by the government in order to obtain a generation of people who are ready and reliable in facing the era of globalization (Andrusova et al., 2020). One of the educational breakthroughs in Indonesia that seeks to develop humans who can create a science and technology-based economy is STEAM (Science, Technology, Engineering, Arts, and Mathematics) learning (Liu & Wu, 2022).

MI/SD is a period where students are taught several subjects and one of them is mathematics. Mathematics is a subject that is rarely interested by children because of the response that this lesson is a difficult and complicated lesson to understand because it presents many formulas that are difficult to memorize. Therefore, choosing the right method is necessary in order to make students understand and understand more about mathematics(Ferland & Kaszap, 2019).

STEAM learning is an integration of various disciplines, namely science, technology, engineering, art and mathematics which are in a unified learning approach. (Girdzijauskienė & Šmitienė, 2020). STEAM is defined as the integration of art disciplines into the curriculum and learning in the STEM fields (science, technology, engineering, and mathematics). STEAM (science, technology, engineering, art, and mathematics) is a meta-discipline that incorporates science, technology, engineering, art, and mathematics into an integrated approach that may be utilized in primary school instruction.

STEAM as a learning approach is a means for students to create science and technology-based ideas through thinking and exploring activities in solving problems based on five integrated scientific disciplines (Pitcher et al., 2016). If problem solving is carried out based on several disciplines, it will produce a very appropriate solution, not only solving mathematical problems but based on concepts related to other disciplines so that problem solving will be very interesting, effective and efficient.

States that as a result of the application of industry 4.0, the inequality is getting bigger, so that two important aspects that teachers must pay attention to are creativity and critical thinking (Ruiz-Rico Ruiz & Ruiz-Rico Ruiz, 2019). Therefore, in an effort to develop higher-order thinking skills as well as develop creativity, the implementation of STEAM in learning is very much needed, especially in learning mathematics in schools.

Implementation is the process of applying ideas, concepts, policies or innovations in a practical action so that it has an impact, either in the form of changes in knowledge, skills, as well as values and attitudes. The implementation of a learning approach is the process of applying the ideas and concepts of an approach in learning that will influence and improve education in a better direction. The implementation of STEAM in learning is a process of applying ideas, ideas and concepts contained in meta-disciplines in a learning which is expected to improve abilities both in cognitive, affective and psychomotor aspects of students in the face of technological advances(Wandari et al., 2018).

This study will discuss how the implementation of STEAM in learning in elementary schools, especially in learning mathematics(Navas-Anguita et al., 2020). The method used in this research is a literature review method. The literature review method is a critical study of the discussion of a topic that has been written by researchers or scientists in various sources (Isniah et al., 2020). Sources of information can be books, journals, ebooks, or other scientific articles. The writing steps taken were: a) collecting data on STEAM and how it is implemented in learning in elementary schools and the relationship of STEAM with 21st century abilities, b) analyzing the data obtained based on the author's thoughts, and c) concluding the results of the literature review analysis. What concepts and principles can be used in implementing STEAM in mathematics learning and how are examples of its application and the relationship of STEAM to 21st century abilities that will be studied in this research. This study aims to provide benefits of knowledge related to STEAM and its implementation in learning mathematics in elementary schools, both for teachers as learning facilitators and students.

2 What is STEAM?

Each expert has their own definition of STEAM. All of these definitions, however, point to the same conclusion: STEAM is a meta-discipline that combines science, technology, engineering, art, and mathematics into an integrated approach that may be used in classroom instruction. (Farwati et al., 2021). STEAM which stands for the term Science, Technology, Engineering, Arts and Mathematics is a breakthrough in the world of education that integrates several elements of science into one unified learning concept. STEAM was born and played a role after the concept of STEM (Science, Technology, Engineering and Mathematics) was first defined. STEAM was born and emerged after the addition of the integrated arts discipline into STEM (Muñoz-Rujas et al., 2018). Defines STEAM as the integration of the arts disciplines into the curriculum and learning in the areas of science, technology, engineering

and mathematics (STEM). Elements of art are integrated into STEM as a basis for other needs that are better and attractive for better outcomes or products. Resulting from STEAM-based learning contains elements of art which will certainly have a positive influence on anyone who enjoys it (Lyu et al., 2022).

The integration of art elements in STEAM can provide students with creativity and creativity in the form of artistic creativity that is integrated into learning outcomes(Garner et al., 2018). STEAM products do not only contain cognitive aspects, but will contain several other aspects, namely affective and psychomotor which can be developed in general by students in facing the era of the industrial revolution 4.0. The complexity of the 21st century today demands the ability to be diverse and STEAM-based learning can be a preparation and exercise for all of them. Therefore, cognitive abilities and creativity must continue to be developed in various forms, one of which is through STEAM-based learning that integrates design, creativity and innovation in the disciplines of science, technology, engineering and mathematics so that they can develop the skills needed to face and develop science knowledge and technology (Doiron & Asselin, 2021).

3 Implementation of STEAM in Mathematics Learning at MI/SD

STEAM-based learning is a new breakthrough in the world of education in Indonesia (Alic, 2017). Not too many teachers have implemented STEAM in learning in schools. Changes in the Indonesian curriculum from the previous year to the current year indicate that the government is working to enhance education. The 2013 curriculum, which incorporates theme learning, is well-suited to STEAM-based education. The level of educational units suited for adopting STEAM-based learning is stated to be elementary and junior high schools. This is due to the fact that at this level, each topic is taught in a thematically connected manner.

Each subject is taught based on a theme at the elementary school level (Ulumudin et al., 2020). Each theme can contain several concepts of scientific study, including: mathematics, science, social studies, Indonesian language, technology, and so on. So that learning based on these themes can be implemented with STEAM-based learning. At the end of the lesson, students can create learning outcomes related to the disciplines contained in STEAM (Balci Çömez et al., 2022).

A teacher will confront the difficulty of encouraging pupils to actively apply their understanding and reasoning, think critically and creatively, and employ abilities in problem solving in STEAM-based learning (Et al., 2021). The instructor is not simply a facilitator; he or she must also engage in the development of understanding in order to connect the disciplines in STEAM. Teachers can swap groups in STEAM group learning to watch, give stimuli in the form of questions, comments, and ideas, and add value to the final output. In the meanwhile, students and their study groups gain a knowledge of the topics being addressed and learn how to draw integrated linkages between disciplines in STEAM. They must be able to develop these concepts in other disciplines as well (Andresen et al., 2020).

In mathematics, for example, students are confronted with the idea of spatial organization, and they must be able to develop the concept across disciplines (May, 2019). Different approaches may be used to develop and design environments. Each construction area may also be customized by including an artistic aspect into each of its creations, such as adding color to each side of the structure. Geogebra is one of the mathematical software programs that may be used to create and study spatial structures. Implementing STEAM in the classroom can result in a complicated and excellent learning product, hence boosting educational quality (Lu et al., 2022).

4 The Relationship of STEAM with 21st Century Capabilities

STEAM learning supports the goals of Industry 4.0 with the 21st century skills. The model also shows that STEAM learning must be improved so that the community is ready to have a high-quality industry. 21st century skills and STEAM learning goals are very important so that a nation can face the times in the industrial revolution 4.0 (Azis et al., 2020). Another important indicator is the

importance of linking the goals of STEAM learning and with the much needed 21st century skills, so that STEAM learning can support industry 4.0.

STEAM is designed to develop 21st century skills that can be used in all areas of everyday life, such as reasoning, problem solving, critical thinking, creative and investigative skills, independent learning, technological literacy, teamwork and collaboration, and many other skills (Doğan & Batdı, 2021). STEAM learning is intended to integrate various subjects into an integrated curriculum. Through STEAM learning, if it is implemented properly and designed in the right learning, students are more capable solve everyday problems. Students can study the engineering design process, in which they identify and define a problem, conduct research, develop several ideas for solutions, and arrive at one idea which they prototype. Students can then test prototypes, plan and evaluate designs, and redesign to make improvements (Rivera-Chang, 2021). Through this process, students can learn many social, collaborative, teamwork, and leadership skills.

Achieving successful implementation of STEAM learning requires more than just improvements in pedagogy and curriculum. Changes are needed in a variety of ways including professional development for teachers, mentoring opportunities for teachers and students. Stimulating creativity in STEAM learning is needed to improve students' thinking to be more independent and flexible, as well as creative self-efficacy and creative problem-solving skills (Golding & Batiibwe, 2020). Research has shown that creativity can be learned through example and practice. Therefore, teachers are expected to be able to model the values and behavior of creativity while maintaining a supportive classroom atmosphere (Suroso et al., 2021). Creativity can also be developed through a supportive environment where students feel encouraged to think independently, explore and play, observe and reflect, and ask unusual questions. Creativity can also be grown through examples and practice, therefore teachers must model creative behavior and build creative student independence through feedback that supports and encourages the creative process (Steinhagen & Said, 2021)

5 Conclusion

It is very important to use learning methods and media in the world of education to support teaching and learning activities, especially at the MI/SD level. STEAM is one of the methods that can be used in learning but it is undeniable that this method cannot be applied in all madrasas/schools. Madrasas/schools that have been able to use this method are those that are well-coordinated. Therefore, we really hope that this STEAM method can be implemented in all madrasas/schools which also indicates that our education is developing to be better every day.

References

Alic, J. A. (2017). Energy Innovation and Policy. In Oxford Research Encyclopedia of Climate Science. https://doi.org/10.1093/acrefore/9780190228620.013.56

Andresen, M., Brewster, C., & Suutari, V. (2020). Self-initiated expatriates in context: Recognizing space, time, and institutions. In Self-Initiated Expatriates in Context: Recognizing Space, Time, and Institutions. https://doi.org/10.4324/9780429352690

Andrusova, I. V., Smirnova, Z. V., Chelnokova, E. A., Nikeitseva, O. N., & Tsaregorodtseva, A. N. (2020). Health-saving technologies in teacher's activity. Revista de La Universidad Del Zulia, 11(31). https://doi.org/10.46925//rdluz.31.29

Azis, A., Komalasari, K., & Masyitoh, I. S. (2020). Strengthening Young Generation Characters In The Disruption Era Through The Internalization Of Wayang Golek Values. Sosiohumaniora, 22(3). https://doi.org/10.24198/sosiohumaniora.v22i3.26162

Balci Çömez, C., Çavumirza, E., & Yildirim, M. (2022). Investigation of the effect of web 2.0 supported 5e learning model on students' success and opinion in teaching pressure unit in distance education. Participatory Educational Research, 9(1). https://doi.org/10.17275/per.22.5.9.1

Doğan, Y., & Batdı, V. (2021). Revisiting brainstorming within an educational context: A meta-thematic analysis. Journal of Learning for Development, 8(3).

Doiron, R., & Asselin, M. (2021). Confronting the 'Crisis of Significance' in 21st Century School Libraries. IASL Annual Conference Proceedings. https://doi.org/10.29173/iasl7778

Et al., I. N. S. D. (2021). The Effect of PBL-based STEAM Approach on The Cognitive and Affective Learning Outcomesof Primary School. Turkish Journal of Computer and Mathematics Education (TURCOMAT), 12(6). https://doi.org/10.17762/turcomat.v12i6.5521

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). https://doi.org/10.53889/ijses.v1i1.2

Ferland, Y., & Kaszap, M. (2019). Geoliteracy, cartology, and a mobile serious game. Abstracts of the ICA, 1. https://doi.org/10.5194/ica-abs-1-75-2019

Garner, P. W., Gabitova, N., Gupta, A., & Wood, T. (2018). Innovations in science education: infusing social emotional principles into early STEM learning. Cultural Studies of Science Education, 13(4). https://doi.org/10.1007/s11422-017-9826-0

Girdzijauskienė, R., & Šmitienė, G. (2020). Integration Of Arts In Steam Projects: Experience Of Primary School Teachers. GAMTAMOKSLINIS UGDYMAS / NATURAL SCIENCE EDUCATION, 17(2). https://doi.org/10.48127/gu-nse/20.17.74

Golding, J., & Batiibwe, M. S. K. (2020). A design approach to mathematics teacher educator development in East Africa. JRAMathEdu (Journal of Research and Advances in Mathematics Education), 6(1). https://doi.org/10.23917/jramathedu.v6i1.11898

Isniah, S., Hardi Purba, H., & Debora, F. (2020). Plan do check action (PDCA) method: literature review and research issues. Jurnal Sistem Dan Manajemen Industri, 4(1). https://doi.org/10.30656/jsmi.v4i1.2186

Liu, C. Y., & Wu, C. J. (2022). STEM without art: A ship without a sail. Thinking Skills and Creativity, 43. https://doi.org/10.1016/j.tsc.2021.100977

Lu, W., Zhang, R., Toan, S., Xu, R., Zhou, F., Sun, Z., & Sun, Z. (2022). Microchannel structure design for hydrogen supply from methanol steam reforming. Chemical Engineering Journal, 429. https://doi.org/10.1016/j.cej.2021.132286

Lyu, X., Liu, H., Tian, J., Zheng, Q., & Zhao, W. (2022). Influence of top water on SAGD steam chamber growth in heavy oil reservoirs: An experimental study. Journal of Petroleum Science and Engineering, 208. https://doi.org/10.1016/j.petrol.2021.109372

Malik*, A., & Ubaidillah, M. (2021). The Use of Smartphone Applications in Laboratory Activities in Developing Scientific Communication Skills of Students. Jurnal Pendidikan Sains Indonesia, 9(1). https://doi.org/10.24815/jpsi.v9i1.18628

May, B. N. (2019). Full STEAM Ahead With a Space-Age Sound Artist. General Music Today, 33(1). https://doi.org/10.1177/1048371319863797

Muñoz-Rujas, N., Díez-Ojeda, M., Greca, I. M., & Montero, E. A. (2018). Application Of Educational Robot To Solve Engineering Problems As Case Study Within The Frame Of Steam Education. EDULEARN18 Proceedings, 1. https://doi.org/10.21125/edulearn.2018.1033

Navas-Anguita, Z., García-Gusano, D., & Iribarren, D. (2020). Long-term production technology mix of alternative fuels for road transport: A focus on Spain. Energy Conversion and Management, 226. https://doi.org/10.1016/j.enconman.2020.113498

Pitcher, M. T., Espinoza, P. A., Gomez, H., Anaya, R. H., Nevarez, H. E. L., Hemmitt, H., & Perez, O. A. (2016). The building blocks for a successful STEAM camp: How to utilize learning blocks to make engagement happen (evaluation). ASEE Annual Conference and Exposition, Conference Proceedings, 2016-June. https://doi.org/10.18260/p.26096

Rivera-Chang, J. (2021). Case Study: How Industrial Design Students Develop Videos to Connect with Potential Investors and Promote Their Ideas. Lecture Notes in Networks and Systems, 260. https://doi.org/10.1007/978-3-030-80829-7_2

Ruiz-Rico Ruiz, G. J., & Ruiz-Rico Ruiz, G. (2019). Legislative guidelines for the future social policies in the new sport act of Andalusia. REVISTA DE ESTUDIOS REGIONALES, 115.

Steinhagen, T. G., & Said, F. (2021). "We should not bury our language by our hands": Crafting creative translanguaging spaces in higher education in the UAE. In Applied Linguistics Research and Good Practices for Multicultural and Multilingual Classrooms.

Suroso, J., Indrawati, Sutarto, S., Mudakir, I., & Chotib, M. (2021). Analysis of high school students' skills in solving science problems in the environment. AIP Conference Proceedings, 2330. https://doi.org/10.1063/5.0044038

Ulumudin, I., Aisha, A., & Widiputera, F. (2020). The Implementation of Knowledge Assessment In Curriculum 2013 in Elementary Schools. Technium Social Sciences Journal, 7. https://doi.org/10.47577/tssj.v7i1.442

Wandari, G. A., Wijaya, A. F. C., & Agustin, R. R. (2018). The Effect of STEAM-based Learning on Students' Concept Mastery and Creativity in Learning Light And Optics. Journal of Science Learning, 2(1). https://doi.org/10.17509/jsl.v2i1.12878