Science Technology Engineering Arts Mathematics (STEAM) Approach for Learning Science in Junior High School

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| Article Info	ABSTRACT
	This study aims to determine how the application of the STEAM approach to science learning in junior high school. The research was conducted by giving questionnaires to science subject teachers at the junior high school level in Surabaya, Sidoarjo, and several surrounding areas. Based on the results of the questionnaire given to the science teacher, it showed that 72% of the STEAM approach had been understood by the science teacher, 12% said they did not understand the STEAM approach and the remaining 16% answered doubtfully whether they understood the STEAM approach in science learning. However, only about 50% of science teachers who understand carry out learning using the STEAM approach. As many as 28% stated the lack of supporting articles for implementing the STEAM approach. Another result stated that 56% of teachers had difficulty in referencing learning tools with the STEAM approach which had to be adapted to school conditions and another 16% needed training to apply the STEAM approach to be applied in learning. Based on the results obtained, the largest percentage needed by teachers to help implement science learning using the STEAM approach is the need for learning tools. Therefore, STEAM-based learning tools really need to be developed, especially for the science teaching and learning process.

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INTRODUCTION

Several countries have implemented science and engineering-based education which produces qualified graduates in that field. The application of science and engineering-based education is considered capable to improve the quality of human resources to face the 21st century (OECD, 2010). Science and engineering skills have become common in several countries, especially in Asia. Science knowledge is acquired and developed based on a series of research conducted by scientists in search of answers to the questions "what?", "Why?", And "how?" from the symptoms of nature and its application in technology and daily life (Rahayu et al., 2012). Students' understanding of science must be built through educational levels thus as adults, they can make decisions related to various issues and solve those issues scientifically.

Science learning provides direct experience to students increasing the ability of students to construct, understand, and apply the concepts that have been learned. Trained students find themselves with various concepts in a holistic, meaningful, authentic, and applicable way for problem-solving purposes (Taufik et al., 2012). In line with the theory of constructivism which states that students can build knowledge based on personal experience. The experience is based on what he has experienced with other people and his environment.

Qualified human resources generated by education can be a major strength to face and overcome problems in the 21st century. Therefore, the application of education in the 21st
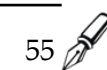
century requires a variety of skills that must be mastered by people. Thus, it is hoped that education can prepare students to master various skills thus they become successful individuals in life. Significant skills in the 21st century are still relevant to the four pillars of life which include learning to know, learning to do, learning to be, and learning to live together. Each of the four principles contains specific skill which needs to be empowered in learning activities, such as critical thinking skill, problem-solving, metacognition, communication skill, collaboration, innovation and creation, information literacy, and various other skills (Zubaidah, 2016).

To meet 21st-century education standards and prepare for the global world of work, innovations in education can be carried out, one of which is by integrating the STEAM approach into learning. The STEAM (Science Technology Engineering Art and Mathematics) approach is a development of the STEM (Science Technology Engineering Mathematics) approach with the addition of Art elements. Adding an artistic element to this STEM approach will be further enriched by several things that are connected to the art element. Arts can be applied arts (sculpture, graphics, crafts, painting), communication media (literature, advertising, multimedia, official media, etc.), performance (film, drama, theater, music, dance, etc.), lifestyle (fashion, interior design, product design, etc.), and character (culture, behavior, attitudes, etc.) (Liliawati et al., 2017). Integrating and implementing the STEAM approach in the curriculum in Indonesia is not an easy thing. It requires the creativity and skill of teachers to integrate the learning process based on the curriculum by integrating and implementing aspects of STEAM thus the learning outcomes can generate students who are ready to face the world in the 21st century. They are students who have the ability and proficiency in solving everyday problems that cannot be separated from the use of technology and innovation.

In line with the demand for qualified education, all aspects must be well prepared, apart from the curriculum aspect, as well as the abilities of the educators. Prospective educators must be well and professionally prepared to be able to realize students who master and be able to carry out the four pillars of life according to the skills needed in the 21st century, yet still, be able to carry out and follow the learning based on the applicable curriculum. Educators must be more creative, innovative, and skilled in the field of Communication and Technology). Educators must be able to stimulate students to use the four principles needed in the 21st century. The educators must not only master and have the skills and also apply them to the students, but they must be able to recognize the extent of students' ability to catch new things. Each student learns in different ways. Therefore, educators are challenged to find ways to help all students learn effectively.

The application of learning using the STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach is one of the breakthroughs for education in Indonesia that seeks to develop people who can create science and technology-based economy. Through STEAM, students are encouraged to think comprehensively with problem-solving patterns based on five aspects. STEAM aims to teach students to think critically and have techniques or designs to solve problems obtained based on mathematics and other knowledge. This learning is one of the solutions to answer the challenges of the 21st century which require people to have technology and information management skills, learn and innovate, have a career and global awareness, and have character to meet the high market demand for products based on science, technology, and art.

This study aims to analyze the application of the STEAM approach, especially in science learning in junior high schools. The implementation of this research is expected to be useful for various circles, the schools, students, and of course the educators. It is hoped that this research will be able to provide an overview of how the STEAM approach is applied in Indonesia. Furthermore, it is hoped to help to figure out what is needed to apply the STEAM learning approach. The results of this study will become the evaluation of the STEAM application in Indonesia, especially in Sidoarjo, Surabaya, and the surrounding areas.

The application of learning with the STEAM approach is integrated with the field of science based on conditions in everyday life through a scientific approach that allows students to become individuals who take the initiative, are creative, and are innovative. Because the content of STEAM learning is connected across disciplines (Gunawan et al., 2019). STEAM can be a very important paradigm for teaching and learning science to be more creative and artistic. The STEAM approach is expected to be able to make students feel comfortable so that they can better understand the concept to be conveyed and apply it in their daily life and can explore their potential in themselves. Through STEAM, participants not only strengthen their learning in all of these disciplines, but through these disciplines students also get the opportunity to explore and make connections between technology, art, engineering, science, and mathematics (Henriksen, 2014).

RESEARCH METHOD

This research involved science educator respondents from various junior high schools in Sidoarjo, Surabaya, and areas around East Java, Indonesia. This study used a descriptive quantitative approach using instruments created by the researchers through Google forms which were distributed online. The data analysis used descriptive analysis, based on questionnaires distributed to science teachers at junior high schools level. The questionnaire given to the junior high school science teachers included (1) Teachers' understanding of the STEAM approach, (2) Application of the STEAM approach to science learning, and (3) Hindrance in applying the STEAM approach to the implementation of science learning.

RESULTS AND DISCUSSION

The questionnaire was given to junior high school science teachers in Sidoarjo, Surabaya, and surrounding areas. The subjects were filled by 25 science teachers with the following presentations:

Table 1. Percentage of junior high school science teacher respondents

Areas	Percentage
Sidoarjo	56%
Surabaya	32%
Other areas	12%

Based on the results of the questionnaires that had been distributed to junior high school science teachers, in the first indicator (1) junior high school science teachers' understanding of the STEAM approach, it is known that 80% of them have understood the STEAM approach, while 11% of teachers answered that they did not understand the STEAM approach, and 9% expressed doubts about understanding what is meant by the STEAM approach. The following is a diagram of the results of the question of whether the educators have previously known about the STEAM approach.
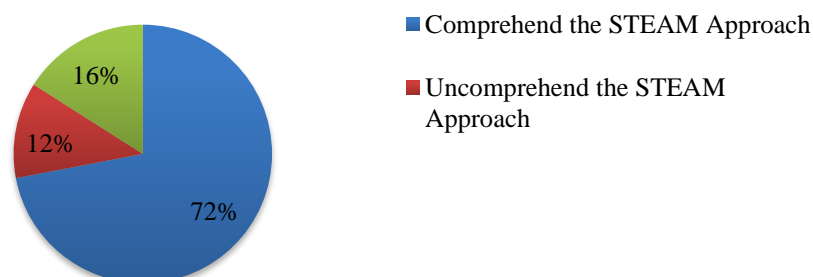

Figure 1. Junior high school science teachers' responses regarding the STEAM approach comprehension

The STEAM approach itself is a development of STEM (Science, Technology, Engineering, Mathematics) approach. (Katz-Buonincontro, 2018) defines STEAM as the integration of art disciplines into the curriculum and learning in the areas of science, technology, engineering, and mathematics (STEM). Art elements are combined in STEM as the basis for other better and more interesting needs thus the outcomes or products resulting from STEAM-based learning contain elements of art in the learning process. The integration of artistic elements in STEAM can provide opportunities for students to create and innovate in the form of artistic creativity which is integrated into learning outcomes. Creativity means the imaginative thinking power of students in realizing the products obtained from learning in accordance with the indicators used. Applicable indicators may include, problem finding, product effectiveness, scientific work, problem-solving ability through science, experimentation, and product design (Dwikoranto et al., 2020)

STEAM products do not only contain cognitive aspects but they will contain several others such as affective and psychomotor aspects which can be developed in general by students in facing the era of the industrial revolution 4.0. One of the subjects that can be implemented based on STEAM is Science. The concept of STEAM-based education emerged as a model of how the boundaries between traditional academic subjects can be removed thus science, technology, engineering, arts, and mathematics can be structured into an integrated curriculum (Connor et al., 2015). Therefore, the process of combining the existing education and STEAM programs must be carried out without causing any conflict (Bati et al., 2018).

The main objective of implementing education with an environmental science approach is to develop environmental-based insights (Orion, 2007). An approach to science learning is needed to train students to bring up their skills scientifically. The approach to learning will arouse curiosity and motivate students to carry out scientific process skills and be able to solve problems through a scientific approach (Utami & Murti, 2018).

The result of indicator (2) the application of the STEAM approach to science learning in junior high schools is different from the acquisition of the first indicator. Although the diagram above states that as many as 72% of teachers understand STEAM, however, only 50% of them have implemented the STEAM approach. This result can be seen in the following diagram:
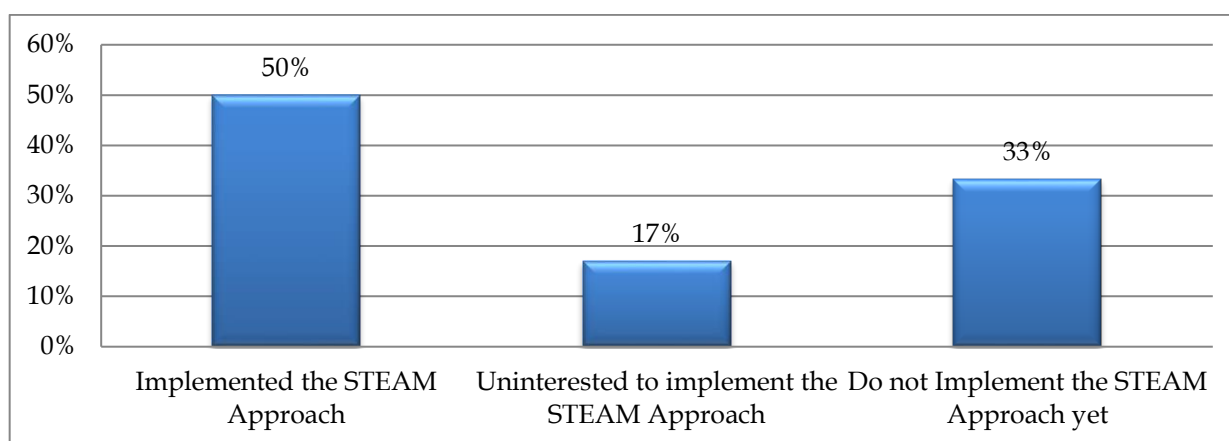

Figure 2. Implementation of the STEAM approach in science learning

The STEM approach has been known since 2000 in the United States and then this approach was developed by adding elements of arts. The addition of art elements to this approach is expected to be able to encourage students to foster a high sense of creativity. STEAM education aims to increase students' success, self-confidence, and interest in science, facilitate integrated understanding of science, technology, engineering, arts, and mathematics, and nurture creativity and talents they have (Kim & Chae, 2016).

The results of the questionnaires distributed to junior high school science teachers in Sidoarjo, Surabaya, and surrounding areas in the province of East Java, Indonesia show that not

many of them have implemented learning using the STEAM approach. The data obtained from the questionnaire found that 33% of teachers have never applied learning using the STEAM approach, from the questionnaire which was given; it does not indicate that the teachers are still interested in implementing learning using the STEAM approach. Based on the percentage results, it was found that 50% of them have applied the STEAM approach to learning, and as many as 3 out of 25 people or a percentage of 17% are not interested in implementing the STEAM approach to learning.

Based on the results of the responses given, there are some factors causing teachers to be not interested or less interested when implementing STEAM-based learning. It is hoped that in its implementation, the STEAM approach will not only give benefit to the students. STEAM is also expected to increase the activeness of educators during the learning process. One of the factors is the lack of specific literacy for learning related to the STEAM approach since the STEAM approach itself seems still new, even though it has been frequently adapted for school learning in other countries. The factors that make the STEAM approach less implemented can be seen in the teachers' response to the questionnaire given to indicator 3 regarding the obstacles to implementing the STEAM approach in learning. The questionnaire result is attached in Figure 3.
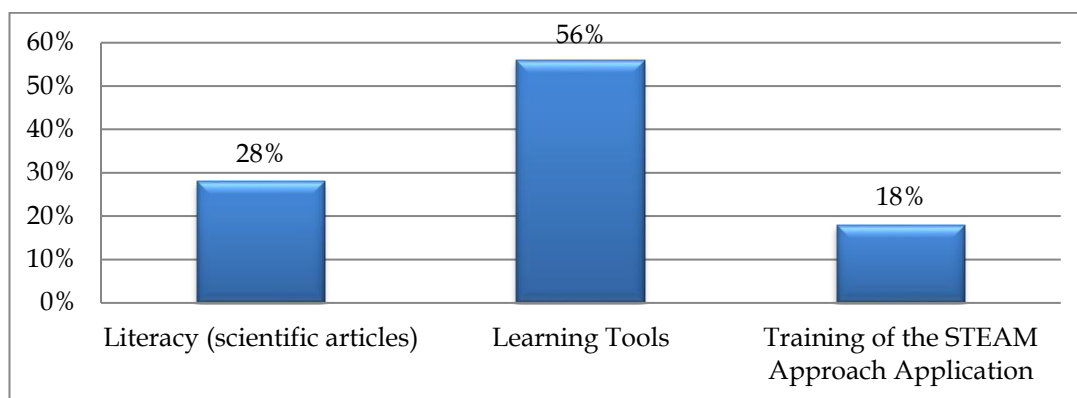

Figure 3. Obstacles of the application of the STEAM approach

Based on the data generated, it is known that as many as 56% of teachers need guidance on developing learning tools using the STEAM approach. 18% of them stated that the application of the STEAM approach requires particular training in implementing STEAM-based learning. Furthermore, about 28% of teachers need literacy such as articles, journals, or books related to the application of STEAM learning.

The main need for teachers in implementing the STEAM-based approach is learning tools, then literacy and the last is the need for training to apply the STEAM approach. Tools are devices or equipment, while learning is a process or way of making people to learn (Prasetyo, 2011). Permendikbud No. 65 of 2013 concerning Standard of Elementary and Junior High School Education Process states that the preparation of learning tools is part of learning planning. Learning planning is designed in the form of a syllabus and lesson plans (RPP) which refer to the standard of the content. Besides that, learning planning also includes the preparation of media and learning resources, assessment tools, and learning scenarios. According to Permendikbud No. 81 A of 2013 concerning the Implementation of the General Guidelines for Learning Curriculum, the first stage in learning according to the standard process is learning planning which is realized by the preparation of a Learning Implementation Plan (RPP). Furthermore, it is explained that the lesson plan is a learning plan developed in detail from a specific subject matter or theme that refers to the syllabus. RPP includes several things, namely: (1) School data, subjects, and classes/semesters; (2) Main Material; (3) Time allocation; (4) learning objectives, basic competency, and indicators of competency achievement;

(5) learning materials; learning methods; (6) Media, tools and learning resources; (7) the steps for learning activities; and (8) Assessment.

Learning tools are needed when the teaching and learning process takes place. In applying the STEAM approach, special developments are required that must be in accordance with the conditions of the school and the environment the student lives in. While the media itself is an intermediary or conveyor of messages from sender to recipient of messages. Media can be humans, materials, or events that build conditions that enable students to acquire knowledge, skills, or attitudes (Hamruni, 2013). Learning media is a means to build communication interactions from educators to students that are educational (Arsyad, 2011) and channel messages or content, stimulate thoughts, feelings, attention, and abilities, thus encouraging teaching and learning. The learning media referred to are books, recording devices, tapes, video cameras, video recorders, films, slides (pictures), photos, pictures, graphics, television, and computers.

CONCLUSION

Based on the research that has been done, it can be concluded that of the 25 teachers who filled out the questionnaire stated that 72% knew and understood the STEAM approach. However, in practice, only 50% of teachers are able to apply this approach in science learning. Based on the descriptions obtained, the teacher explains the obstacles faced in implementing the STEAM approach in learning. Some of the factors that cause it include the lack of articles related to the STEAM approach, the need for the development of STEAM-based tools, and the lack of training in the implementation of STEAM in schools. Based on the statements described, as many as 56% stated that the need for reference devices with the STEAM approach was very much needed. Therefore, it can be concluded that there is a need for a STEAM-based learning tool to be developed so that it can be a reference in the application of the STEAM approach in each school.

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