STEAM: Science, Technology, *Engineering, Art, and Mathematics* on History Learning in the 21st Century

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A B S T R A K

Implementasi STEAM baik guru maupun siswa masih sedikit bingung dengan konsep STEAM. Artikel ini membahas cara menerapkan STEAM dan kesulitan yang dihadapi pendidik saat menerapkan STEAM. Penelitian ini bertujuan untuk menganalisis bagaimana penerapan STEAM dalam pembelajaran sejarah di abad ke-21. Penelitian ini menggunakan penelitian kualitatif dengan desain penelitian studi kasus. Teknik pengumpulan data observasi, dan wawancara. Keabsahan data diuji melalui triangulasi sumber dan menggunakan analisis deskriptif. Hasil penelitian ini menunjukkan bahwa STEAM telah diterapkan dalam pembelajaran sejarah. Selain itu, penerapan STEAM merupakan upaya untuk mengintegrasikan STEAM menjadi satu dengan pembelajaran sejarah, dengan mengaitkan unsur-unsur STEAM, sehingga siswa diberikan pemahaman holistik tentang keterkaitan bidang ilmu melalui pengalaman belajar abad 21. STEAM merupakan salah satu konsep penting yang harus dikuasai oleh guru sejarah untuk mengintegrasikan materi sejarah dengan ilmu-ilmu lainnya, sehingga menjadikan siswa memiliki daya pikir dan analitis yang tinggi dalam proses pembelajaran.

A B S T R A C T

Implementation of STEAM, both teachers and students, are still a little confused with the concept of STEAM. This article discusses how to apply STEAM and what difficulties educators face when implementing STEAM. This study aims to analyze how the implementation of STEAM in history learning in the 21st century. This study uses qualitative research with a case study research design. Observation data collection techniques, and interviews. The validity of the data was tested through triangulation of sources and using descriptive analysis. The results of this study indicate that STEAM has been applied in history learning. In addition, the implementation of STEAM is an effort to integrate STEAM into one with history learning, by linking the elements of STEAM, so students are given a holistic understanding of the interrelationships of the fields of science through 21st century learning experiences. STEAM is one of the important concepts that must be mastered by history teachers to integrate history material with other sciences, then make students have high thinking and analytical power in the learning process.

1. INTRODUCTION

Implementation of STEAM, both teachers and students, are still a little confused with the concept of STEAM. STEAM itself can be applied to all social subjects, especially history subjects. History Learning has material that is closely related to the 5 (five) elements of STEAM (Science, Technology, Engineering, Art, and Mathematics) (Kajamaa & Kumpulainen, 2020; E. D. Riyanti et al., 2020). Many historical materials study the past, especially those related to humans, objects, and regions (Mohamad et al., 2018; Perdana et al., 2018). For example, in the material the shape of the Indonesian archipelago contains elements of STEAM. Each element has a different STEAM element. The history teacher is one of the pillars to continue to understand the STEAM approach, because the teacher must realize that the science of history does not stand alone, but is also related to other sciences such as STEAM (Adifta et al., 2022; S. Zubaidah, 2019). Usually, the STEAM concept is widely used by the natural sciences. So that it makes teachers and students not know that historical material can be implemented with STEAM. Actually in history material there is always an element of STEAM as described, depending on how the history teacher relates the history material to STEAM (Adifta et al., 2022; Purwani et al., 2021). Research on STEAM (Science, Technology, Engineering, Art, and Mathematics) has begun to be widely carried out.

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including research from previous study analyzes the experiences of different countries in implementing STEM and STEAM education and identifies effective ways to structure technical disciplines, arts and creative activities into a single integration programme (Sartono et al., 2020). Inclusion in STEM creative discipline education, which may be referred to by the term Arts, broadens this direction and enriches its creative component (Borrego et al., 2019; Gebre, 2018; Thuneberg et al., 2018). Therefore, a logical step is an attempt to "legitimize" such associations, to link the creative aspects of personal development with purely technical concepts of STEM.

Then previous research briefly defines our own variant STE[A]M branch in the context of interdisciplinary teaching and learning and then describes an interdisciplinary course, the science in science fiction, in which professors of Biology, English, and Physics give a series of fictional texts (Copeland, 1975; Potash et al., 2015). Finally, students provide feedback on their experiences with cross-disciplinary collaborative teaching and learning. However, since its inception, interest in STEM has extended to secondary school education as the demand for highly skilled graduates has increased. Our specialty variants are STE[A]M, Science, Technology, Engineering, Arts and Mathematics, where "Art" includes literature, film, visual imagery and other media to provide additional context and critical thinking in our science-oriented literature courses (Halili, 2019; Hawari & Noor, 2020; E. D. Riyanti et al., 2020). Then research from other study examines teachers' perceptions and practices in science, technology, engineering, arts, and mathematics (STEAM) education in South Korea, drawing on a survey of teachers in STEAM model schools (Conradty & Bogner, 2020). The results show that most Korean teachers, especially experienced teachers and male teachers, have a positive view of the educational role of STEAM. At the same time, Korean teachers highlighted various challenges in implementing STEAM education, such as finding time to carry out STEAM lessons, increased workloads, and lack of administrative and financial support. In this study, we address this issue by studying STEAM education in Korea. In particular, we were interested in investigating how Korean teachers actually practice STEAM education in the classroom (Kajamaa & Kumpulainen, 2020; Mardlotillah et al., 2020; Sa'ida, 2021).

This research is different from previous research. The difference between this study and previous research lies in the use of STEAM (Science, Technology, Engineering, Art, and Mathematics) which was carried out in history subjects. STEAM aims to improve critical, creative, and innovative thinking in students. Then in this study using the concept of integrated education, which unites history lessons with other subjects. Therefore, this research was conducted to analyze how steam is used, especially in history subjects, and also to find out the difficulties of teachers in applying STEAM to history subjects. STEAM is widely used in science learning, such as chemistry, physics, etc (Mufida et al., 2020; Patresia et al., 2020). Here the researcher conducts STEAM research on history learning which is the latest breakthrough in history learning, with the aim that students can link history with other sciences. So that students do not only focus on the science of history.

2. METHODS

This research uses a case study method to conduct qualitative research, the steps include choosing topics, determining research methods and designs, determining research information providers, determining data and data sources, and collecting data procedure (Creswell, 2019). Data analysis and data interpretation and checking the validity of the data, the last step is to write down the results of the research that has been done. The selection of case studies in this research is based on the implications of the case studies that have been described. The case study method used in this research will completely reveal the questions about the learning process like what, why and how. The case study uses an interwoven single case analysis. The subjects of this study were history teachers and students of class X SMA Negeri 3 Palembang. The research tool grid was produced in the form of interview guidelines in accordance with the research techniques used by the researcher. The interview guide written by the researcher is free and unrestricted, meaning that the interview guide to be used is based on the answers found by the researcher. The interview guide written by the researcher is free and unrestricted, meaning that the interview guide to be used is based on the answers found by the researcher. Created for teachers and students, the Teacher Interview Guide contains questions related to teacher profiles, teacher preparation in learning, implementation of learning and teacher understanding related to STEAM as well as efforts to integrate the application of STEAM in history learning. The Student Interview Guide contains questions related to the learning process presented by the teacher and students' understanding of STEAM.

Information collection was carried out using unstructured interview techniques, but researchers developed interview guidelines before going into the field, observing, recording, and combining the three techniques or truangulation. The researcher also reviewed other research related to the research focus, the application of STEAM in history learning. As for the data analysis technique, the researcher divided

into the following stages prepare information and organize it according to individual notes such as interview notes, materials, field notes and other needs. p, 2) see all the data in general, then take notes; start encoding data; use the coding results to generate a description of the classified and analyzed topics; presenting research results and submitting them in writing; and get an explanation from the researcher.

3. RESULT AND DISCUSSION

Results

In history learning, STEAM usually uses a project-based learning or problem-based learning model, because based on the theory presented the right model for implementing STEAM is project-based learning and project-based learning. Students are trained to be able to solve a problem, so that students can also think critically, and students can also work in teams to find solutions in problem solving. The results found by researchers regarding the views of teachers and students on the concept of STEAM lead researchers to a deeper concept of STEAM that can be interpreted by teachers and students. Related to the STEAM concept, the first step taken by the researcher was to collect data about the understanding of teachers and students on the STEAM concept by conducting interviews with teacher L and teacher A as well as 3 students who became informants in the study. From the results of interviews conducted by researchers with teacher L, teacher L's understanding is still very minimal in understanding the concept of STEAM, especially in history subjects. So that with this research, history teachers, especially teacher L, understand a little about the concept of STEAM in history subjects and can see the elements of STEAM in each historical material. Meanwhile, teacher A already knows a little about the STEAM concept, but in the implementation of history learning, he does not know that STEAM can be applied in history learning.

After receiving a brief explanation from the researcher, teacher A, before the Covid-19 pandemic, had implemented STEAM using a problem-based learning model and teacher L used to use a project-based learning model, where both learning models were also included in one of the learning models. the focus of the STEAM approach itself, in accordance with the theory presented earlier. This is supported by the theory which states that one of the focuses of the STEAM approach is integrating various problem/research-based learning models. In interviews conducted with students, the researcher also saw how the views of students regarding the approach resulted in that students also did not know what STEAM was. Because they say that the teacher has never explained what STEAM is. On During PTM (Face-to-Face Meetings), usually history teachers apply STEAM by linking historical material with STEAM, then history teachers also use research-based learning models and give assignments to students in the form of conducting research on historical objects in the city of Palembang, one example is the historic object of the Palembang mayor's office which in the Dutch era was known as the Piping Office (PDAM). With that, students must conduct direct research and conduct interviews as well as observe how the current mayor's office environment is and compare it with the environmental situation in the Dutch era from the data they obtained from interviews, written sources, and other sources. Besides being able to increase student creativity in conducting research, this can also improve locality, more precisely the historical locality in the city of Palembang. After they get the data and complete the task, they will be given time to present the results of the research they have obtained over the past few weeks. With these activities, it can train students to be able to solve a problem, perform a task carried out in a team, etc. However, after the Covid-19 pandemic that hit Indonesia, Education finally decided to carry out online learning. Thus making history teachers take the initiative to continue to apply STEAM to history learning only by simply linking STEAM with historical material. Because, when the COVID-19 pandemic occurred, historical tourist attractions were closed and they could not do research.

When conducting online research conducted with the Google Meeting on August 5, 2021 in class X MIPA 3 with the material "Formation of the Indonesian Archipelago". In this material, the history teacher, Mrs. LS, told the students that the material was integrated with geography, history, and biology. In addition, the material also contains elements of STEAM (Science, Technology, Engineering, Art, And Mathematics). Science, science is the activity of developing knowledge through various activities, such as research and development. Science learning is intended so that students are able to take advantage of the surrounding environment as a learning tool. Through this activity, students can take lessons from the things that are around them to make media and even learning methods. If it is based on this theory, science in learning history can be taken from the material of weather/climate movements at that time which used the environment for daily activities. Then when conducting research using Zoom Meeting in class X IPS 1 with the material "History as Art, Science, Stories, and Events". In this material, elements of Science, Technology, Engineering, and Art are found. However, they did not find the Mathematical element. Science, can be seen from history as a science, which means that history is knowledge of the past that is systematically arranged and has a scientific study method to get to the truth. This is reinforced by

the theory which states that science is a way to study certain aspects of nature in an organized manner systematically and through various standardized scientific methods. The scope of science is limited to things that can be understood by the senses (sight, touch, hearing, touch and taste) or it can be said that science is knowledge gained through learning and proof. At the time of the zoom meeting with the material, the researcher could not find the mathematical element. So that the researchers conducted an analysis on other material at the next meeting contained in Google Classroom, namely the material "Human, Space and Time". In this material, the researcher found the 5 elements of STEAM, namely science can be taken from the preparation of history based on science, so that history can be said to be not a science that refers to things that are irrational, but refers to things that are rational. This history is arranged systematically, for example, there are scientists, one of them is Herodotus, a father of history who wants history to be not just an abstract science, but history is events, events, and stories in the past. Then 1.) Technology, can be taken from the development of civilization, the understanding of history also changes.

Because, every turn of the year and civilization is growing, there will be various kinds of experts who express their opinions about history according to their respective versions. 2.) Engineering, can be taken from the delivery technique of history or the understanding of history from experts. For example, at the time of Herodotus, the delivery technique was only to convey through word of mouth in an area. 3.) Art, can be taken from the way history is delivered by means of writing, performing arts, and also orally. For example, during the time of Nugroho Noto Susanto, who conveyed history using historical writings which were made into historical novels. 4.) Math, can be taken from the development of civilization at that time so that the emergence of different experts every year, and count the years the emergence of experts who convey about the history of how many years. Then the author conducted interviews with students, more precisely 3 (three) students. These students came from class X. When conducting interviews with students, almost 50% of students from both the Mathematics and Natural Sciences class and the Social Studies class did not like learning history. Why don't students even from social studies class like history? Yes, because their mindset towards learning always looks boring, sleepy, and various other reasons. They think that history is just learning to tell stories and do the tasks that the teacher has given them. However, that does not mean that no one likes history learning. After implementing and applying the STEAM approach, the perception of students who don't like history slowly turns into enthusiasm and interest in history learning, yes, although not 100% of students like and have an interest in history learning, at least there is an increase that from every history learning evaporates, sleepy, boring, etc., has now turned into the enthusiasm of students towards students.

From the researcher's explanation above, it is very clear that the history teacher at SMA Negeri 3 Palembang has implemented STEAM in history learning. However,History learning carried out online is very different from carrying out history learning offline. However, despite having differences, the history teacher at SMA 3 Palembang still integrates STEAM in history learning. When learning is carried out offline, the teacher applies the steps of the STEAM approach to students as the researchers described above and also integrates history learning with the 5 elements of STEAM seen from the material to be taught to students. However, when carrying out online learning, there are various difficulties, one of which is difficulty in accessing or visiting historical sites or places both throughout Indonesia and in the city of Palembang.

Discussion

STEAM is a collaborative learning that leads to the provision of motivation, innovation that can give birth to creative people towards an accomplished society that not only strengthens learning in scientific disciplines. But between disciplines through the opportunity to explore the expected connection between science, technology, engineering, art, and mathematics by utilizing existing facilities in the surrounding environment to solve problems in building positive knowledge (Hau et al., 2020; Syahmani et al., 2021). STEAM is not about separate learning, but how to collaborate or apply all the components in the theme. In other words, STEAM learning is an educational concept that focuses on aspects of collaboration, directing children to think critically, creatively, innovate and find solutions (problem solving), based on moral values and local culture(Jacques et al., 2020; Siti Zubaidah, 2019).

The concept of STEAM learning is one form of innovation that was born through long discussions. In detail, STEAM links the fields of science (science), technology, engineering, art, and mathematics. So that students are given a holistic understanding of the interrelationships of the fields of science through 21st century learning experiences. Learning with the STEAM approach is contextual learning, where students will invited to understand the phenomena that occur nearby (Arsy & Syamsulrizal, 2021; Esti Dewi Riyanti et al., 2020). The STEAM approach encourages students to learn to explore all their abilities, in their own way. STEAM will also bring out different and unexpected works from each individual or

group. In addition, collaboration, cooperation and communication will appear in the learning process because this approach is carried out in groups. With this kind of learning, students will feel curious to know more, want to learn and understand what is going on, the causes, and the impacts and try to overcome them (Sumarno et al., 2021; Syahmani et al., 2021). This happens because students can directly relate, connect, and even find solutions to problems that arise, in this learning model students are invited to think critically.

Basically, the ability of educators in Indonesia is no less great than teachers abroad. They also provide many innovations, both in the form of media, methods, and other things that lead to improving the quality of learning with students in the classroom. Through learning activities with the STEAM model, it is hoped that various innovations will be born that can improve the quality of student learning, both online and face-to-face in class (Liliawati et al., 2018; Lou et al., 2017; Suryaningsih & Ainun Nisa, 2021).Various innovations in the form of new learning methods, media that can help students understand the material more easily, as well as simple steps that may be applied in learning have proven to produce great teachers. They are not only from cities, but also from remote parts of the country that are far from the hubbub of information technology (Halili, 2019; Sa'ida, 2021). The concept of STEAM learning is one form of innovation that was born through long discussions. So far, the structured application of STEAM in learning has provided evidence that students will be trained to find a way out of every problem. More than that, they can find new ideas, ideas, and innovations that can be used as references for their lives. STEAM learning is not yet fully understood and applied by teachers. Because it is a new method, STEAM needs attention, especially real practice and implementation in classroom learning (Conradty & Bogner, 2020; Hawari & Noor, 2020). The characteristics of the STEAM approach are: It is interdisciplinary in nature based on collaboration, research and practice. So that creativity continues to run by integrating existing subjects. And then, art integrative abilities have a role in connecting all subjects by developing existing creativity.

Many countries determine the importance of STEM and its implementation in STEM education. For example, in the United States, there have been many efforts to support STEM education (Lombardi et al., 2021; Thuneberg et al., 2018). STEAM originated in America and some schools follow the career paths of graduating students, then combine subjects like science, engineering, engineering, and mathematics, and this is where STEM is formed. The focus of the STEAM approach: Integrating science, technology, engineering (engineering), art, and mathematics into one learning activity; Facilitate students to develop soft skills and skills in learning; Integrating various problem/research based learning models; Provide opportunities for students to understand and study various phenomena in their lives; Develop creativity, critical thinking, literacy, communication, and collaboration (Adifta et al., 2022; E. D. Riyanti et al., 2020). Then in applying STEAM to learning there are steps, namely the teacher leads students to the focus of the problems they will solve and asks questions, conducts observations and documents, research finds answers to questions that have been given by the teacher, applies what students have learned the results of the research they have done, present the results of what they have researched, reflect and revise.

4. CONCLUSION

Based on the explanation above, it can be said that STEAM has been used and applied in learning history, not only that there are STEAM elements in historical material which we will convey to students. However, it also lies in the steps of the learning process carried out. So based on the research that researchers have done, it can be said that STEAM can not only be applied to science (IPA), but can also be used in social sciences (IPS). By applying the STEAM approach, it is intended that students can carry out learning well, have fun, can participate in learning that integrates several subjects and can also work together between groups. By applying the steam approach, it is intended that students can carry out learning well, have fun, can participate in learning that integrates several subjects and can also work together between groups.

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