

# **Integration of STEAM Method with Constructivism Approach in Graphic Design Subject for Information Technology Vocational High School: A Systematic Reviews**

**Alfarizky Mutrian Trisna, Puspanda Hatta and Cucuk Wawan Budiyanto**

Department of Informatics Education

The Faculty of Teacher Training and Education

Universitas Sebelas Maret

Surakarta, Indonesia

afarzky@student.uns.ac.id, hatta.puspanda@staff.uns.ac.id, cbudiyanto@staff.uns.ac.id

## **Abstract**

Online learning at the IT-Vocational High School (ITVHS) during a pandemic is considered less successful. A factor influencing this is the lack of student feedback. Various methods have been implemented to increase student interest and self-efficacy. One of them is STEAM method with a constructivist approach. STEAM has emerged as a new learning method due to developing STEM to meet the learning needs of students in science, technology, engineering, art, and mathematics. Art elements aim to increase creativity, innovation, and interest, promoting problem-solving skills and other cognitive interests. The constructivism approach makes students more dominant in their own learning. The finding in this article is exploring the use of the STEAM method combined with a constructivist approach, so it can improve several aspects of self in student's achievement. This paper reviews several studies in the field of STEM and STEAM education with a systematic review to evaluate the contemporary implementation of STEAM and how to it in teaching and learning. The meta-analysis will be used as the basis for research on the integration of the STEAM method with student basic competencies using a constructivism approach in online learning. The population in this research will be take in IT-VHS. The integration of this model will be applied to Graphic Design course with the aim of being able to stimulate students in practical activities to be more active, independent, creative, and collaborate well with fellow students.

## **Keywords**

Constructivism approach, implementation of STEAM, STEM education, STEAM Learning

## **1. Introduction**

Since the global pandemic, distance learning has evolved as an alternative used to replace traditional learning that cannot be implemented due to the restrictions on mass activities. The adoption of distance learning technology by educational institutions around the world is considered that the correct step is a solution to satisfy the needs of students during the pandemic (Qazi et al., 2021). But in its implementation, distance learning is considered less successful, the factors that influence the difficulties of teachers who maintain students' care in the material and the absence of feedback given by students to teachers, Because basically, the teacher needs student comments to find out if the student is getting the information that the teacher sent well (Abate et al., 2021) Furthermore, students also experience some problems at distance learning, since students have difficulty growing initiative and motivation to learn alone, Students are not used to carrying out the needs of remote learning, the learning objectives of students and the objectives are limited to the value obtained not from the experienced process during learning (Yulia & Putra, 2020).

Deciding the correct learning approach strategy for separate learning is considered exceptionally vital since it can influence the creation of collaborative learning exercises and great criticism between understudies and instructors, so that remove learning gets to be compelling with a conducive learning environment (Kanakana-Katumba & Maladzi, 2019). One strategy that can be connected in remove learning is the STEAM strategy with a constructivism approach. STEAM (Science, Technology, Engineering, Art, Mathematics) It developed as a modern learning strategy that was the result of the improvement of STEM with the joining of craftsmanship components in it. The term "Art" in STEAM itself has a few definitions, One of them is the term art. It is called the equivalent word for project-based learning, technology-based learning, and design-based learning. The integration of expressive elements in STEAM learning shows that commitment, ingenuity, development, problem-solving skills, and other cognitive benefits are enhanced twice (Perignat & Katz-Buonincontro, 2019), and to make strides work abilities such as collaboration, communication,

and versatility required within the career world (Colucci-Gray, L., Trowsdale, J., Cooke, C. F., Davies, R., Burnard, P., & Gray, 2017). In arranging for STEAM to create so that it can be received within the classroom and examined, the concept of STEAM learning must be set up at the side a compelling approach to create one of them, specifically with a constructivism approach (Perignat & Katz-Buonincontro, 2019).

Constructivism approach is an approach that centers on understudies within the disclosure of a concept by partner information that has been already having it permits learners to be able to decide their claim learning needs and give openings to meet their needs with the choice of the correct methodology. In this case, the teacher incorporates a huge part such as affecting or making conditions that can propel understudies, capable of making issue circumstances and empowering the procurement of past students' information (Gunduz & Hursen, 2015). There are several types of STEAM integrations used by some previous researchers such as integrating STEAM through project-based learning (Hadinugrahaningsih et al., 2017, Sukro et al., 2021, Mufida et al., 2020, Kuo et al., 2019, Adriyawati et al., 2020, Hawari & Noor, 2020, Rahmawati et al., 2019). However, there are some STEAM method researchers such as (Land, 2013, Henriksen, 2017, Choi et al., 2018, Hensel, 2015., Kim & Choi, 2018, Hong et al., 2020, Zhou et al., 2019, Capraro, Capraro, & Morgan, 2013, Lou, Shih, Diez, & Tseng, 2011, Liao, 2016, Conde et al., 2019). Utilizing inquire about with diverse STEAM integration strategies such as STEAM integration with plan and innovation, combining it with other interdisciplinary, utilizing learning media such as robots, piece building, and programming, and coordinates with challenge-based learning, problem-based learning, and integrator learning.

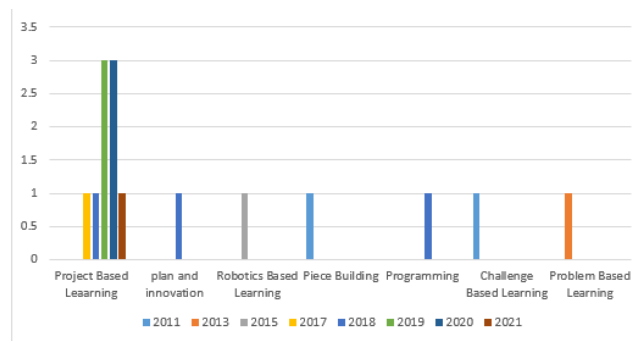


Figure 1. STEAM method integration researches

Despite numerous studies on STEAM/STEM integrated learning and the constructivism method, there appears to be a dearth of explanation on how to integrate STEAM and the constructivism approach in learning. Moreover, because STEAM-based education is still a new concept with many uncertainties and interpretations, STEAM's numerous definitions and interpretations allow practitioners to interpret them, student creativity, and others effectively. It can make it challenging to ensure the development of cognitive skills. In addition, lack of clarity makes research difficult for researchers. This review focuses on scientific, peer-reviewed, empirical, and descriptive articles published in English in several educational journals between 2013 and 2021, as well as a systematic literature review procedure conducted on 30 scientific works published between 2013 and 2021.

## 2. Methods

This research adopted a literature review approach as the method to provide a theoretical foundation for future research, to investigate the breadth of research on a specific topic, or to answer practical questions about the problem by understanding what existing research says about it. (Okoli dan Schabram 2010). Data is gathered by reading peer-reviewed articles on the topic, particularly those with the keywords STEAM learning, STEM, STEAM integration, STEAM implementation, constructivism approach, and distance learning. The initial review aggregated over 2679 articles indexed in Science Direct, Scopus, IEEE, Researchgate, and Google Scholar published between 2013 and 2021. Concepts were built upon the literature to answer two research questions:

- (RQ1) How does STEAM learning with a Constructivism approach affect students?
- (RQ2) How to integrate STEAM learning with a Constructivism approach in learning class?.

This study aims to help formulate the various learning methods used and how they affect developing students' learning skills.

## 2.1 Articles Searching Strategy

Data sources are taken from conference papers and journal articles. The article used only articles written in English, the main context set out in this study is education, as well as the main keywords used, are teaching methods using STEAM approach methods and constructivism. Databases used to search for articles: Science Direct, Scopus, IEEE, ResearchGate, and Google Scholar are used to achieve a wider scope. The publication year restrictions are 2013-2021 to keep data sources relevant to the current situation.

## 2.2 Study Selection

Articles were obtained through Science Direct, Scopus, IEEE, ResearchGate, and Google Scholar. The keyword "STEAM method integration, application of constructivism approach to learning" resulted in 28098 articles that appeared in the search, after which then selected again to be added to the matrix concept and produced 30 articles that addressed the topic of the problem sought specifically.

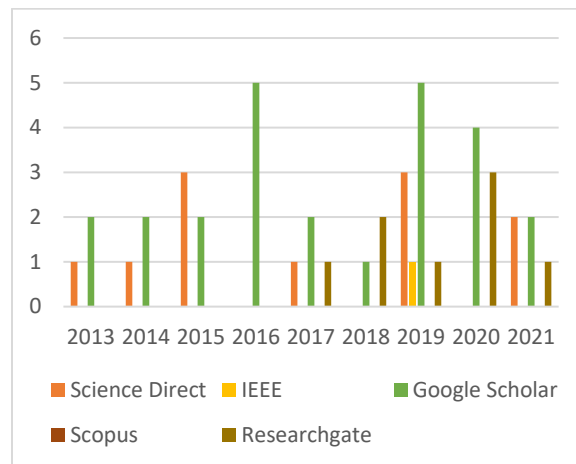


Figure 2. Articles Published by Journal Database

## 2.3 Initial Selection

The initial selection looked at the format and metadata of articles, focusing on some of the criteria listed below

- Article searches were conducted from 2013 to 2021.
- Studies must be written in English.
- Studies that do not have an abstract were not included.
- Studies that do not have methodological and participants descriptions were not included

## 3. Results

The systematic approach of the review literature conducted on the 30 articles mentioned in the previous section yielded three main categories, namely, student ability, STEAM learning strategies, and STEAM learning interaction with constructivism.

### 3.1 Student Ability

Learning that runs inefficiently can result in low interest in students following a learning; typically, students will feel unable to follow a learning because the learning feels boring and less capable of bringing students to be able to participate actively and collaborate in learning; additionally, a lack or even absence of approaches used can affect students in learning. STEAM learning activities can pique students' interest and encourage them to participate because the learning is based on five aspects of STEAM, namely science, technology, engineering, art, and mathematics, and its implementation will encourage students to participate actively (Hong et al., 2020). In addition, learning with STEAM integration can help students become more creative and innovative as they explore challenges and issues. In STEAM learning, students are also taught to think comprehensively (Blackley et al., 2018). Students who participate in STEAM integrated learning will develop good communication skills on their own (Hawari & Noor, 2020). It is well understood that each student's knowledge is formed from their unique self in the constructivism approach. It is

beneficial to be able to stimulate students so that the nature of independence in they will form on its own, allowing him to find various problem-solving solutions (Barger et al., 2018). The constructivism approach, as an experience that leads to learning, plays an important role in constructing the student experience in learning so that students become accustomed to evaluating what they have previously learned. Constructivist approaches can also boost students' learning motivation and encourage them to make their own choices (Gunduz & Hursen, 2015). Other abilities demonstrated by students while participating in STEAM integrated learning with a constructivism approach are listed in the table below.

Table 1. Student Ability

Author	Skills build on STEAM and Constructivism learning
Hong et al., 2020	Possess the ability to learn independently, increase interest in learning, collaborate, and participate actively in learning.
Rahmawati et al., 2019	Every student in STEAM learning will be given cross-science material with a focus on cooperation and high ability, which will encourage students to develop a strong sense of responsibility and independence.
Conde et al., 2019	In addition to soft skills, computational thinking is a capability that can be improved through STEAM integrated learning.
Adriyawati et al., 2020	Students can recognize the relevance of knowledge learned in daily life, develop curiosity, improve problem-solving skills, ask questions, and have the courage to explore various sources.
Serafin et al., 2015	Constructivism can help students develop their thinking so that they are more creative, active in their learning, and capable of solving problems. They can also process conclusions in each problem well.

### 3.2 STEAM Learning Strategies

Table 2. STEAM Learning Strategies

Author	Learning Approach
Rahmawati et al., 2019	A variety of learning approaches, such as problem-based learning and project-based learning, can benefit STEAM integrated learning.
Perignat & Katz-Buonincontro, 2019	Transdisciplinary, interdisciplinary, multidisciplinary, cross-disciplinary, and artistic integration are some of STEAM's disciplinary methods.
Sukro et al., 2021	Active learning, problem-based learning, and product-based learning are usually followed by STEAM learning. Depending on your environment, STEAM integration can also be project-based.
Rodríguez Estrada & Davis, 2015	When elements of design theory and practice are combined, science communicators in STEAM can be good visual communicators.
Hong et al., 2020	STEAM can also be combined with other forms of media such as robotics or building blocks.

Table 2 provides an overview of STEAM's integrated learning strategies. STEAM can be combined with various learning strategies, including project-based learning, problem-based learning, challenging learning, robotic learning,

and chemistry learning. Project-based learning, on the other hand, is by far the most popular learning strategy. Project-based learning can be used to help students develop science process skills, allowing them to be more creative, active, and capable of producing a product (Nasir et al., 2019). STEAM project learning adaptation is thought to be important for improving graduate quality, particularly in terms of the ability and skills to produce products based on science and technology (Ishartono et al., 2021)

### 3.3 STEAM Learning Interaction with Constructivism

Table 3. STEAM learning interaction with constructivism

Author	Content of the Article
Nuraini & Muliawan, 2020	STEAM learning materials that can be linked to real-world problems pique the interest of students.
Perignat & Katz-Buonincontro, 2019	STEAM education has been shown to enhance students' involvement, creativity, innovation, problem-solving skills, and other cognitive interests in learning by incorporating elements of art into STEM learning.
Root-Bernstein, 2015	Teachers' development of creativity in STEAM learning, which includes activities such as group project-based learning, exploring and playing, observing and reflecting, creates a comfortable and conducive learning environment for students.
Pande & Bharathi, 2020	Students' creative thinking will be stimulated by a constructivism approach that emphasizes collaborative activities, which are at the heart of the constructivism learning approach.
Alsharif, 2014	When using a constructivist approach to learning, teachers should encourage students to use their thought processes to build knowledge and solve problems.

Learning that encourages creative thinking, such as collaborative activities, project-based learning, and exploring, can assist students in creating a welcoming and enjoyable learning environment (Perignat & Katz-Buonincontro, 2019). This is critical in a learning environment because students' natural tendency is to become bored quickly, and when students become bored, their interest in lessons decreases, resulting in learning not running as efficiently as it could. Learning with steam in conjunction with a constructivist approach has the potential to increase interaction between teachers and students because teachers will play an important role in encouraging students to think creatively in order to come up with unique ideas, take appropriate risks, and explore new materials. (Runco, 2014) (Perignat & Katz-Buonincontro, 2019). In addition to the findings (Swaminathan & Schellenberg, 2015) STEAM art elements help improve cognitive skills such as spatial thinking, abstract thinking, divergent thinking, creative self-efficacy, openness to experience, and curiosity.

## 5. Conclusion

Following a systematic review of several previous research articles discussing STEAM learning and constructivism approaches, it was discovered that STEAM can be integrated with several learning methods, with project-based learning methods being one of the most dominant methods for defining STEAM's integrated education objectives because project-based learning emphasizes the importance of learning. Increase interest in and assist students in developing the skills they will require in the workplace. Furthermore, constructivism-based learning outcomes produce nearly identical results for students, such as the ability to increase collaboration, independence, responsibility, comprehensive thinking, and cognitive abilities of other students. However, none of the articles organized by topic have comprehensively discussed how to integrate STEAM or the constructiveness approach, so more in-depth research on integrating STEAM with basic learning competencies using a constructivism approach with project-based learning methods will be conducted.

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## Biographies

**Alfarizky Mutrian Trisna** is a student of Informatics and computer engineering education study program at the Faculty of Teacher Training and Education of Universitas Sebelas Maret Surakarta in class 2017

**Puspanda Hatta, M.Eng** received his master degree in information technology from Universitas Gadjah Mada in 2014. He is currently a senior lecture at the Department of Informatics Education, Faculty of Teacher Training and Education, Universitas Sebelas Maret, Indonesia. He teaches majoring in computer networks discipline such as computer networking, wireless technology, cloud computing, and cybersecurity. His recent research is on applied computer networking and cybersecurity for IT vocational education.

**Cucuk Wawan Budiyanto, ST., Ph.D** is an assistant professor at the Department of Informatics Education, Faculty of Teacher Training and Education, Universitas Sebelas Maret, Indonesia. He also teaches at the Postgraduate of Vocational Teacher Education of the same faculty. His recent research is on Educational Robotics, Digital Transformation and Computational Thinking.