STEAM-Based PjBL Learning During the COVID-19 Pandemic

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Abstrak. The world of education is one of the fundamental sectors affected by the COVID-19 pandemic. With the implementation of *social distancing,* the learning system that was originally face-to-face becomes *online* (in a network). The existence of a learning system from home or distance learning experiences various kinds of obstacles. Learning is not optimal due to limited access to teaching and learning. The selection of the right learning model is one of the keys to overcoming these obstacles. STEAM learning (*Science, Technology, Engineering, Arts, and Mathematics*) integrated with project-based learning (PjBL) is an alternative to online learning that has characteristics in line with teaching and learning situations and conditions that are dominated by the use of information and communication technology. The research method used is descriptive qualitative with a quantitative approach. The subjects in this study were students in the sixth grade of elementary school, as many as 30 people. The data was collected using observation and documentation techniques and then analyzed qualitatively and quantitatively related to the achievement of students objectively. The results showed that 74.1% of PjBL's integrated STEAM learning achievements were in the "good" category, meaning that they were effectively applied in online learning during the COVID-19 pandemic.

Keywords: Online Learning, STEAM, Project-Based Learning (PjBL).

INTRODUCTION ~ The COVID-19 pandemic has had a tremendous impact on all areas of human life. The education sector is no exception. All components of education, starting from teachers, students, parents, learning methods, learning facilities and infrastructure, including the educational curriculum, have also transformed drastically to adapt to the current situation and conditions. The government issued a policy through the Circular Letter of the Minister of Education and Culture Number 4 of 2020 concerning the Implementation of Education Policies in the Emergency Period for the Spread of COVID 19, which contained an appeal for Distance Learning, also known as the Learning From Home.

All activities in educational institutions are carried out by teachers and students in their respective homes. There are at least three learning methods during the COVID-19 pandemic, namely, online learning, offline learning, and *home visits.*

The Director General of Teachers and Education Personnel in Commemoration of World Teacher's Day said the current learning from home system indirectly accelerates the digitization of education. The positive impact as an advantage of the application of online learning that is most felt is that learning activities can be carried out without being bound by space and time, which means learning can be done anytime and anywhere, either synchronously or asynchronously.

So, with such conditions, teachers, parents, and students inevitably have to hone their skills in carrying out online learning that is conditional on the use of technology.

The government or educational institutions recommend the implementation of online learning to reduce crowds and maintain social *distancing*. This is certainly not a path that can be taken by the school in addition to the existing advantages and certainly not free from limitations. In fact, online learning is a dilemma for many parties, be they teachers, students, or parents. On the one hand, learning must continue. However, on the other hand, problems arise. According to the author's observations and reflections from the teaching place as well as the surrounding environment, several obstacles were encountered in online learning.

First, online learning requires skills and creativity in using technology as a medium to support learning activities. Meanwhile, there are still many teachers who have limitations in accessing or operating technological devices such as the internet, gadgets, laptops, computers, and so on. Second, students have not been able to independently carry out their duties and responsibilities in learning. Students tend to still depend on their parents. Another limitation is that not all students have facilities such as gadgets as the main tool for online learning, signals unstable, and expensive data quota pulses.

Third, parents often complain about the assignments given under the pretext that the tasks from the teacher are a burden for both students and accompanying parents. Not all parents are able to act as tutors of subject matter like a teacher.

The various difficulties that arise are a challenge for teachers, especially as the main director in the course of the learning process, having the authority to determine policies as an effort to overcome online learning problems. One of them is by formulating meaningful and effective learning. Effective learning during the COVID-19 pandemic is learning that involves collaboration, innovation, and experimentation. In line with this, quoting the speech of the Minister of Education and Culture in the Commemoration of National Teacher's Day 2020, he said that effective education requires effective collaboration of three things: teachers, students, and parents. According to him, teachers are advised to apply the learning method *Project-Based Learning* (PjBL).

Many studies have revealed that in learning using the *Project-Based Learning* (PjBL) model, in general, it will greatly affect students' creative thinking abilities during learning, especially in training students to always think creatively in achieving certain projects or goals that have been set (Subelli and Sapriya, 2019, p. 272)

Based on the description above, in order to achieve ideal learning conditions and high teaching quality, each subject must be organized with the right organizational model. One of the learning models with appropriate characteristics for overcoming current online learning problems is the STEAM model (Science, *Technology, Engineering, Art, and Mathematical*). STEAM is cooperative learning that is part of constructivism learning, where students actively build their own knowledge and understanding through projects (Hadinugrahaningsih, 2017).

STEAM is suitable for online thematic learning (*online learning*). The advantages of STEAM learning are based

on an inquiry model, collaboration, and an emphasis on process-based learning (Rachim, 2019). According to Abidin et al. (2020), through *online learning,* project-based students can go through meaningful learning so that the knowledge and knowledge gained have meaning that can be used as a provision for students to become *problem solvers* of the problems they face.

METHOD

This research framework refers to qualitative with an analytical descriptive method using a quantitative approach. Research aims to reveal events or facts, phenomena, variables, and circumstances that occurred during the research by presenting what actually happened.

Based on this information, the relevance of the descriptive method in this study is in accordance with the problems to be explored with regard to phenomena, events, or conditions that are currently taking place that are related to the learning process, especially in elementary schools in the midst of the COVID-19 pandemic outbreak. The research sample consisted of 30 elementary school grade VI students. The technique for research data analysis proposed by Miles and Huberman (1992, 16) consists of three activity lines, namely: data reduction, data presentation, and conclusion drawing or verification.

RESULTS

This online application of STEAM learning integrates each component of STEAM into project-based learning (PjBL). STEAM is a learning environment that uses five fields of science, namely *science*, technology, technique, art, and mathematics, which are comprehensive and related to each other as patterns for problem-solving. The stages of STEAM-based PjBL learning consist of six stages (Lucas, 2007), as described below.

1. Giving the Essential Questions
   Questions are used to get an overview of the initial knowledge that students have. This essential question is used as a teacher's exploration material to understand the concept that will be implanted by conducting questions and answers through the LKPD (worksheet).
2. Preparation of The Project Plan
   The stage of preparing the project plan is contained in the LKPD in the Let's Be Creative section with the title "My Project Plan." Students are given the freedom to choose one project to be made from the three types of projects that the teacher has provided. The goal is for students to be able to learn to determine the priority scale.
3. Timetable for Preparation
   This roject-based learning It prioritizes autonomy, choice, uncomplicated working time, and responsibility. In compiling the schedule, students are directed to plan the timeline of activities. timeline serves as a benchmark for students to complete projects on time. In addition, the timeline aims to arrange scheduling to make it easier and more focused in accordance with the project stages and the agreed project completion deadline. In the LKPD (students worksheet), there are also tables that facilitate students' learning to estimate both in terms of time and cost efficiently.
4. Monitoring Project Progress

This phase of monitoring project progress is carried out during the learning process of students in completing the project from the beginning to the end of the activity. Students are monitored by the teacher, especially on the progress of project assignments. The teacher sees the suitability of the project completion time. Monitoring student activities is done by looking at project developments to find out the extent to which students can complete a predetermined project, including the obstacles experienced.

5. Testing and Assessment of Results

This stage is done by testing and evaluating the product or project that has been made. Each student tested each other's projects. This test aims to determine the level of project success among students. In the 2013 curriculum, there are three areas of competence that are required, including knowledge, attitudes, and skills. In addition, the 2013 curriculum seeks to improve balance, continuity, and linkages between hard and soft skills (Permendikbud, 2014). In project-based STEAM learning, the emphasis is on two main aspects of assessment, namely writing explanatory texts and project performance appraisals. Project assessment includes criteria that are realistic and authentic project.

6. Experience Evaluation

The experience evaluation stage is a reflection of students' feelings and experiences during learning, including how they think about project assignments, reasons for choosing projects, obstacles experienced and solutions made, advantages and disadvantages of the projects made, as well as the benefits of projects that have been made by students.

The application of this learning approach integrates each component of STEAM in project-based integrated thematic learning (PjBL). In accordance with the Learning From Home safety principle, project work is carried out individually. This is in accordance with the opinion of Hadinugrahaningsih (2017) who explains the idea of a project approach according to Dewey, learning by doing which means that the learning process is obtained through activities or activities carried out alone or in groups. The principle of collaboration built through this learning is cooperation between students and parents at home.

The subject matter organized in STEAM learning is broadly integrated thematic with Social Science content about new discoveries bringing socio-cultural changes in society and Indonesian language content about explaining information based on the structure of explanatory texts.

Based on the project learning that has been implemented, the integration of each component or element of STEAM with project-based thematic learning activities using online methods is mapped in the table below.

Table 1. The Integration of Subject in STEAM Learning

Elements	Information
Science	Mapping of social studies material about new discoveries during the COVID-19 pandemic and Indonesian material on the structure of explanatory texts and the use of standard vocabulary in effective sentences.
Technology	Use of smartphones and internet media includes using a web browser as a tool to find information sources, using a WhatsApp Group for discussions, using Google Classroom for assignment submission, and using an application video editor for presenting projects.
Engineering	Problem-solving techniques, work procedures in making projects using various materials, designing project schedules, and managing schedules.
Art	Adding aesthetic value by paying attention to the elements in audio-visual art, namely videos and *slide shows* accompanied by musical accompaniment as an attraction.
Mathematic	Calculation of the dose of materials needed and the estimated time used to complete the project.

The data processing of the STEAM learning outcomes of project-based learning integration (PjBL) is obtained from the overall assessment. Based on the results of the data analysis, the results are presented in the diagram below.
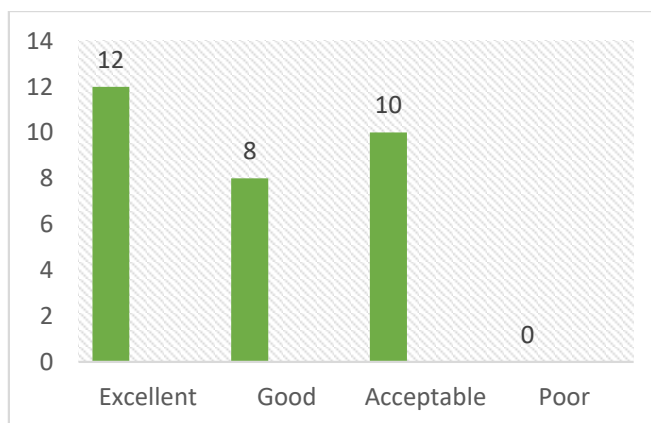

Figure 1. Student Learning Outcomes

The graph above shows the categories of student learning outcomes in PjBL integrated STEAM learning as much as 40% very good, 27% good, 33% quite. Meanwhile, there are no students who are in the less category. After obtaining the data above, then the results are classified with the classification of assessment as follows.

Table 2. Benchmarks of Project Performance Assessment

Score Range	Criteria
80% – 100%	Excellent
60 % - 79,9 %	Good
40 % - 59,9 %	Acceptable
≤ 39,9%	Poor

Source: Suryaningsih (2017, p. 60)

The overall percentage of learning outcomes obtained is 74.1%, according to the assessment benchmark above, which can be said to be good. If the percentage of data obtained is converted into an assessment with a Likert scale (1-4) with reference to Permendikbud No 81A of 2013, a score of 3.0 is obtained, which is still in the good category. The data obtained is used to reflect the achievements of learners in learning activities.

Based on the results of the evaluation of learning, students are very enthusiastic about participating in STEAM learning, feel challenged, and learning activities become fun regardless of old habits that tend to be monotonous, fixated on textbooks or regular discussion methods.

DISCUSSION

Learning by integrating each component of STEAM into project-based integrated thematic learning (PjBL). In accordance with the Learning From Home safety principle, project work is carried out individually. This is in accordance with the idea of a project approach according to Dewey (in Hadinugrahaningsih 2017), learning by doing, which means that the learning process is obtained through activities or activities carried out alone or in groups. The principle of collaboration

that is built through this learning is in the form of collaboration between students and their respective parents at home.

Kaymakci (2012) explains that teaching materials play an important role in ensuring the effectiveness of teaching and learning activities, one of which is the Student Worksheet (LKS). The teacher designs LKPD (student worksheet) as a guide material for students to be able to take distance learning and be able to complete their project assignments well. The feasibility aspect of the content of an LKS (student worksheet) is determined by the material presented. Quoting from Haifaturrahmah, et al. (2020), it includes indicators consisting of: 1) containing enrichment materials; 2) supporting the achievement of core competencies and basic competencies; 3) accuracy; 4) insight and productivity; 5) can stimulate curiosity (curiousity); and 6) can develop life skills (life skills).

According to Hadinugrahaningsih (2017), projects built around thematic units or a combination of topics, projects involving students in constructive investigations can be in the form of design, decision making, problem finding, solving problems, discovery or model building processes, and projects encourage students to gain learning experiences to a

significant degree. Therefore, project-based learning is suitable to be integrated into STEAM learning during the current pandemic. Furthermore, Permanasari (2016) demonstrates that STEAM can train students to apply their knowledge in the creation of designs as a method of solving related problems.

In addition to the right learning approach, the use of teaching materials must also be appropriate so that students' critical thinking skills can be trained. Students' critical thinking skills can be improved through a routine learning habituation process related to the problem solving process (Haifaturrahman, Maryati, and Fujiaturrahman, 2018). In addition, this STEAM learning utilizes the use of technology, one of which is WhatsApp, which can affect student's critical thinking skills. As Amalia and Sapriya (2010) concluded in their research related to WhatsApp group-based blended learning, it affects the critical thinking skills of elementary school students in social studies subjects. This is shown during learning activities where all students are involved in discussions conducted through WhatsApp Group media. This means that there is good enthusiasm from students when participating in learning.

CONCLUSION

STEAM learning which is integrated with project-based learning (PjBL) is developed based on everyday issues in learning, the impact of learning becomes more meaningful because students are more interested and feel the benefits of real learning. In addition, STEAM learning encourages collaboration of people, teachers, and students to be empowered to learn in dealing with emergency situations due to the COVID-19 pandemic.

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