Implementation of STEAM-PjBL to Increase Learning Outcomes of Grade VI Elementary School Students

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Abstract

This research is motivated by the low level of learning outcomes of grade VI students. There are still many students who only memorize science material, but their abilities are low in applying the concepts that have been learned. So, it demands the teachers to make learning innovations. One of which is by implementing a STEAM-PjBL. That is learning where students completed a project to solve problems based on STEAM (Science, Technology, Engineering, Arts, and Math). The purpose of this research is to increased learning outcomes of 6th grade students using STEAM-PjBL. The data collection techniques using observation instruments and learning outcomes tests. The analysis data used in this research were quantitative descriptive. The results show that the STEAM-PjBL can increase the science learning outcomes of class VI SDN Dikir students, as indicated by the increase in students reaching KKM, namely 24 students out of 28 students with a percentage of 85,71%. STEAM-PjBL encourages students to be actively involved in learning, both cognitive, affective, and psychomotor, which have an impact on increase creative and innovative thinking skills in grade VI SDN Dikir students.

Keywords: STEAM; PjBL; Outcomes learning.

1. Intoduction

The development of technology and information in the 21st century has greatly influenced various areas of life, including in the world of education. Various attempts have can by the government to advance the quality of education in Indonesia, including by repeatedly changing the education curriculum in Indonesia. The 2013 curriculum, which is currently in effect, is considered an appropriate curriculum because it provides space for schools, teachers, and students to express creativity according to the characteristics of students in each school. In elementary school units, implementation of the 2013 curriculum on learning is implemented in an integrated thematic manner using a scientific approach that seeks to balance student competencies both cognitively, affective, and psychomotor.

Facing the industrial revolution 4.0, the world of education in Indonesia also continues to strive to develop following the demands of 21st-century learning. 21st-century learning develops creative and innovative skills, critical thinking and problem solving, collaborative and communicative skills. Students must have the minimum skills to face the challenges of globalization in the future (Rizqoh 2019), where mastery of

technology very important. The learning objectives no longer focus on how much students memorize the material but must be able to encourage students to have competencies that can be applied in everyday life. For students to be actively involved in developing learning experiences, learning must be in real/realistic situations as in the view of constructive learning theory (Yulaelawati 2019). So that the learning process must change from teacher-centered to student-centered, teaching is not just a transfer of knowledge. However, it must encourage students to be active and form real experiences that can used as provisions in the future.

However, in reality, there are still many teachers who have difficulty in designing learning according to the characteristics of students so that the learning experience that students get is only limited to memorizing the material. This also happens in learning science material. Even though in the content of science lessons there are concepts and materials that require skills to apply them directly. Science is connected to scientific literacy, where this demand is not only that students are able to memorize scientific concepts but must be able to apply them in everyday life, be able to become creative learners in solving problems. Science education has an important role in encouraging students to have scientific literacy, namely being able to think critically, creatively, logically, and take the initiative in dealing with societal issues regarding technological developments as an important part of science (Permanasari 2016) with the hope that students will be able to create innovative work.

One of the determining factors for the success of learning lies in the teacher in using models, methods, and learning approaches. In accordance with the 2013 curriculum, there are several learning models that are in accordance with the characteristics of the science subject content, including the PJBL learning model, the inquiry learning model, problem-based learning (Pamungkas, Subali and S 2017). Through Project-Based Learning, the inquiry process begins by raising a guiding question and guiding students in a collaborative project that integrates various subjects (materials) in the curriculum. Meanwhile, STEM (Science, Technology, Engineering, and Mathematics) is currently one of the breakthroughs in the world of education in Indonesia. STEM then developed into STEAM (Science, Technology, Engineering, Art, and Mathematics) into a learning approach that is considered ideal for preparing students to think critically, creatively, and innovatively. With the PJBL learning design that is integrated with STEAM, it is hoped that not only can develop students' skills in solving problems, but students are also able to master science concepts correctly.

Learning that is relevant in preparing students to become innovators in an ever-developing world is very important, not only for the future of current students but for the future of the nation (Zubaidah 2019). STEM education is currently being developed in the world and in Indonesia. Learning with the STEM approach is able to help the successful achievement of 21st century thinking skills. STEM education is needed to face the era of the Industrial revolution 4.0 and be able to solve problems found in real life. With STEAM-based PJBL learning students are challenged to be critical, creative and innovative in solving real problems, involving collaborative group activities

This research will discuss how the implementation of STEAM in learning in elementary schools. Distance learning has significantly changed teaching and learning patterns. The various strategies used by the teacher adjust the conditions and characteristics of students, requiring teachers to innovate so that students do not get bored, but not only make students happy but also pay attention to the mastery of

competencies. With the STEAM-based PJBL method, teachers can design learning effectively, save time and at the same time strengthen students' understanding of concepts.

The purpose of writing this article is: (1) describe the implementation of STEAM-based PJBL in learning in grade 6 SDN Dikir; (2) Knowing the increased competence of some of the Globalization Themes learning content in grade 6 SDN Dikir with the existence of a STEAM-based PJBL; (3) Knowing the correlation between the implementation of the STEAM PJBL with an improvement of student learning outcomes both cognitive, affective, and psychomotor.

Learning innovation by implementing the STEAM-based PJBL approach for grade 6 SDN Dikir students is beneficial for several related elements, including: (1) For teachers, being able to provide answers to one form of STEAM that can be applied in classroom learning (2) For students or students, it can increase motivation and learning outcomes as well as increased activity in each learning process, as well as valuable experiences for students to be able to reduce, reuse, and recycle something that is considered worthless into something that can have economic value (3) Institutions can contribute to dealing with learning problems and increase learning innovations that can be used in the Institution.

2. Research Method

This research design with quantitative descriptive approach, because the focus observed is student learning outcomes in the form of numbers. The research subjects were grade 6 students consisting of 28 students consisting of 18 male students and 12 female students at SDN Dikir Tambakboyo District, Tuban Regency.

Data collection techniques using written test instruments and observation sheets. The observation sheet and writing test is used to observe student activities during the learning process. While the analysis of learning outcomes using a rubric is used to measure student achievement in skills. The instrument in this research is in the form of learning outcomes in the form of science knowledge questions. The form of knowledge test to measure the achievement of science learning outcomes is 10 multiple choice questions and a description of 5 questions. The test is carried out at the end of the lesson, then the results of the test are done to calculate the percentage of mastery of the learning material.

The analysis of learning outcomes was carried out using descriptive analysis, namely by describing the test results with KKM (minimum completeness criteria) of 70 and the class is called complete learning if in the class there are 65% of students who have achieved absorption. The percentage of mastery learning is used the following formula:

$$P = \frac{p\,si \qquad f \qquad h\,si}{\qquad\qquad} x\ 100\%$$

3. Result and Discussion

3.1 Implementation of STEAM Learning

Implementation is the process of applying ideas, concepts, policies or innovations in a practical action so as to have an impact, in the form of changes in knowledge, skills, and values, and attitudes. The implementation of a learning approach is the process,

applying the ideas and concepts of an approach in learning that will influence and increase education in a better direction. STEAM implementation in learning is a process of applying ideas, ideas, and concepts contained in meta-disciplines in learning which are expected to improve the abilities of both the cognitive, affective and psychomotor aspects of students in facing technological advances.

In the Basic Framework and Structure of the 2013 Primary School Curriculum (Kemdikbud 2013) it is explained that to prepare for the present and future lives of students, the 2013 Curriculum develops learning experiences that provide broad opportunities for students to master the competencies needed for life in the present. The future, and at the same time continue to develop their abilities as the cultural heirs of the nation and people who care about the problems of society and the nation today. The STEM approach integrates several subjects in learning that focus on solving problems in everyday life and professional life. Developing a STEM-integrated curriculum is considered challenging because it has to integrate various related conceptual ideas (Roehrig 2017). Although there are obstacles in its implementation because teachers held a limited understanding about STEM (Yanthi, et al. 2019). Australia is considered a developed knowledge economy, there are many barriers to pushing sufficient students into STEM education (Stoilescu 2019). Therefore, the teacher must design the learning steps in detail.

STEM education shows students how concepts, principles, technology, engineering, and mathematics are used in an integrated manner to develop products, processes, and systems that can benefit human life. The STEM approach can develop according to needs by adding other subject areas. For example, STERM with the addition of the religious field, STEAM with the addition of the Art field or STEAMS with the addition of the social field. The STEAM approach to learning can produce meaningful experiences while emphasizing the active involvement of students through the collaborative integration of knowledge, concepts, and skills (practice).

The implementation of STEAM learning takes into account the characteristics of STEAM, namely:

a. Integrated several conceptual subjects with a focus on science problems in one learning experience. b. Project-based learning.

c. Contextual learning because it is associated with real-life (real-world application).

d. Prepare students to become resources (HR) who have integrative abilities.

e. Develop soft skills and technical skills.

3.2 STEAM-based PJBL Learning Design

To facilitate implementation, it is necessary to create a network of themes for the STEAM project. The theme networks for the STEAMS project combine Science Basic Competencies, Indonesian Language, Mathematics, and SBdP by using the basic IPA competencies as the basis for the project (core/based). The steps for creating a theme net are as follows:

a. Determine science problems in everyday life following the context of science subject matter in elementary schools.
b. Determining one problem sains by considering contextual aspects (problems known to students), essential (important problems to be solved), rational (can be

implemented for Elementary School level), availability of resources, the value of product usability.

c. Set success limits. In STEAM learning, solving problems is the diversity and creativity of students.
d. Based on the networks that have been prepared, it will continue to make STEAM learning by using design thinking, which is the frame of mind that a person has in deciding, considering, or producing something/product.

Plattner (Tim Departemen SD 2020) in his book "An Introduction to Design Thinking Process Guide" describes five stages in design thinking that a person/group must go through to be able to produce an innovative product that has been tailored to the needs of its users. Of course, all stages in design thinking must be passed in stage, systematically and thoroughly. The five stages are (1) empathy, (2) define, (3) ideate, (4) prototype, and (5) test.

Learning that is following the STEAM approach is problem-based learning (Problem Based Learning) and project-based learning (PJBL). The use of the project-based learning model is based on the assumption that problem-solving will not be complete if it is not viewed from various other subject areas (Mu'minah and Suryaningsih 2020). Each stage of STEAM which is integrated with project-based learning is expected to not only bring up 21st-century skills but also have an impact on conceptual mastery and increase student learning outcomes. However, STEAM can also be collaborated with other learning models, such as research conducted by Soldiana (Soldiana 2018) which uses Student Team Achievement (STAD) cooperative learning to improve Civics learning outcomes.

STEAM learning design is prepared by integrating thematic approaches, design thinking, and project-based learning. STEAM learning design is in the form of steps taken by teachers and students to design STEAM products. STEAM learning design is the same as learning in general, but it is not complete like the lesson plan because it is only a guide for implementing the applied learning model. The STEAM learning design includes a) Preliminary activities, b) Core activities, c) Closing activities.

In this implementation, STEAM learning, which integrated with project-based learning, is carried out through six stages, as follows:

Table 1. Syntax of STEAM-based PJBL learning

Student Activity Syntax	Teacher Activities	Student Activities
Fundamental Questions	The teacher presents the topic and asks questions how to solve the problem.	Asking basic questions what students should do about the topic/problem solving
Designing Product Plans	The teacher ensures that each student in the group chooses and knows the procedure for making the project/product that will be produced.	Students discuss preparing a plan for making a problem-solving project including the division of tasks, preparation of tools, materials, media, and resources needed.

Schedule	The teacher and students make an agreement about the project schedule (stages and collection)	Students arrange a schedule for completing the project by paying attention to the predetermined time limit.
Monitoring Project Activity and Progress	Teachers monitor student activity during project implementation, monitor progress realization and guide when experiencing difficulties.	Students make projects according to schedule, record each stage, discuss problems that arise during project completion with the teacher.
Test results	The teacher discusses the project prototype, monitors the involvement of students, measures the achievement of standards.	Discuss the feasibility of projects that have been created and make product/work reports to be presented to others.
Evaluation of Learning Experience	The teacher guides the project presentation process, responds to the results, then the teacher and students reflection/ conclusions.	Students present reports, other students provide responses, and together with the teacher conclude the project results

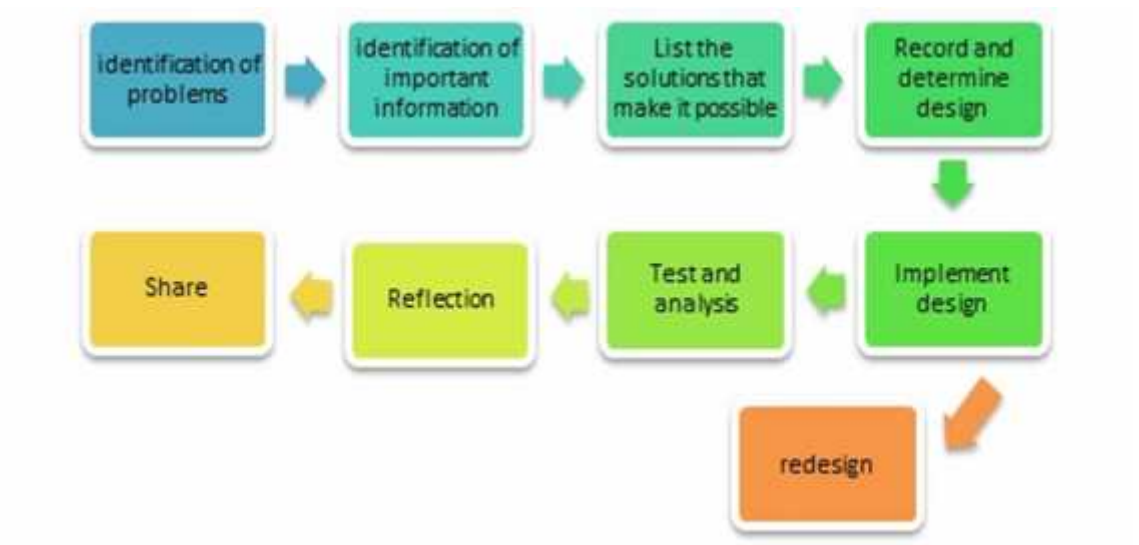

Fig. 1. Plot of EDP

An important step that characterizes STEAM is the Engineering Design Process (EDP). The Engineering Design Process is a series of steps that guide the group when solving a problem (Sukiyani 2021). This design process occurs iteratively as many times as needed so that the team in the group can make improvements along the process, learn from failures and possibly find new designs to arrive at the right solution. The emphasis in the Engineering Design Process is open problem solving and encourages students to learn from failures so that teachers no longer master learning. The teacher only monitors and provides guidance, but does not directly show how to solve the problem. This process will be able to familiarize students with the ability to create innovative solutions to challenges in any subject based on the concepts they have understood. In the EDP process there is a flow that can be used as a guide (Fig 1):

3.2 STEAM Learning Assessment

The learning process certainly cannot be separated from the assessment. In project-based STEAM learning includes the assessment of knowledge, skills, and attitudes. However, the focus of the assessment on this best practice is knowledge assessment. Observations made by the teacher are the main elements for attitude assessment to observe changes in attitudes that occur in STEAMS learning. Changes in student behavior were observed through observation instruments to be compared with predetermined criteria/standards of success using rubrics, instruments, scoring guidelines, and assessment criteria.

While the writing test uses to measure the achievement of students' knowledge competencies using a written test of 10 multiple choice questions and five essay questions. The test was held after the project series finished according to the timeline. Based on the results of the written test analysis, there were 24 (85.71%) students who scored above the KKM of the 28 grade VI students of SDN Dikir. Where the KKM in science subject is 75. The increase in student learning outcomes is quite significant when compared with student scores in project-based learning in the previous period that did not use the STEAM approach. The scores obtained by students on the previous test results were very low, they spent a lot of time completing projects, they had fun producing products but forgot to understand the material. Consequently, the conclusion that applying STEAM-based project learning can improve student learning outcomes. Likewise, based on the results of the analysis of observations, it was found that there were positive behavioral changes in students' skills and attitudes. STEAM-PjBL encourages students to be actively involved in learning, both cognitive, affective, and psychomotor, which have an impact on increase creative and innovative thinking skills in grade VI SDN Dikir students.

4. Conclusion

Based on the results of the research and discussion presented, it can be a conclusion that: The results of the research show that the STEAM-PJBL model can increase the science learning outcomes of class VI SDN Dikir students, as indicated by the increase in students reaching KKM, namely 24 students out of 28 students with a percentage of 85,71%., STEAM-based PJBL encourages students to be actively involved in learning,

both cognitive, affective, and psychomotor, which have an impact on increase creative and innovative thinking skills in grade VI SDN Dikir students. The emphasis on STEAM is the existence of an Engineering Design Process where the teacher is no longer in control of learning. the task of the teacher is only to monitor and provide guidance, but does not directly show how to solve the problem.

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