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Student Learning Outcome through STEAM Ecobrick Project

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ABSTRACT

The world of education is expected to produce students according to the Graduate Competency Standards. To achieve this, it is necessary to apply STEAM-based learning with the Project Based Learning model so that it can improve student learning outcomes related to material environmental pollution in KD 3.8. The main problem is related to non-biodegradable plastic waste, a solution is needed, namely the Ecobrick method in managing plastic waste. This study aims to determine students' cognitive learning outcomes by applying the STEAM Ecobrick Project to cognitive learning outcomes at SMP Muhammadiyah 1 Jember and SMP Muhammadiyah 6 Wuluhan. The method used in this research is quantitative with a comparative type. The sources of data or respondents in the study were seventh grade students of SMP Muhammadiyah 1 Jember and SMP Muhammadiyah 6 Jember. The data collection techniques used are observation, documentation, and questionnaires. The research data were analyzed using SPSS with decision making criteria based on the significance value indicated by the Mann Whitney test output. The results of the Mann Whitney test value of 0.77, meaning that there is no difference in cognitive learning outcomes by applying STEAM Ecobrick Project-based learning to students at SMP Muhammadiyah 1 Jember with students at SMP Muhammadiyah 6 Wuluhan. The average value of cognitive learning outcomes for students of SMP Muhammadiyah 1 Jember is 82.88 and students of SMP Muhammadiyah 6 Wuluhan are 79.81, the difference between the two is 3.07. By implementing STEAM Ecobrick Project-based learning it can improve students' cognitive learning outcomes.

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INTRODUCTION

One of the foundations to determine the resilience and progress of a nation is carried out through the education process. The government's efforts to improve the quality of education in Indonesia through improving the quality of human resources, improving the value system, using appropriate learning models, facilities and infrastructure and updating the curriculum (Luawo et al., 2017) (Putri et al., 2021). The requirements of the present curriculum call for students to be more engaged in their studies, have strong moral character, and possess real-world skills. In order for students to construct their own knowledge and be actively engaged in seeking information, the instructor, who currently serves as the primary source of information, will become a more ideal learner with genuine problems and student-oriented (Insyasiska et al., 2015).

In order to meet the high market demand for science and technology-based products, education that is able to address these challenges is required for 21st century learning, which calls for people to have technology skills and information management, learn and innovate, have a career and have global awareness, as well as have character. Science, Technology, Engineering, Arts, and Mathematics (STEAM)-based learning is one strategy that has qualities to meet the demands of 21st-century learning (Luthfiyatul Hasanah, 2019). The application of the STEAM approach in learning must be able to integrate all components, namely by using a learning model. The learning model that can integrate the components of science, technology, engineering, art and mathematics is Project Based Learning (PjBL). The PjBL learning approach places an emphasis on contextual learning through challenging activities including providing students the opportunity to experiment with organizing lessons, completing group projects, and eventually generating a product. PjBL is a method of teaching where students actively explore problems and difficulties from the real world in order to learn more (Annisa et al., 2018).

The material for class VII in junior high school is Basic Competence (KD). 3.8 Analyzing the occurrence of Environmental Pollution and its Impact on Ecosystems. In this KD discusses related to pollution that occurs in the environment, ranging from air pollution, water pollution, soil pollution, and the impact of pollution on the ecosystem. One of the learning outcomes in KD 3.8 is that students are able to collect information, analyze the causes of pollution in the air, water and soil and propose solutions to problems. One of the biggest problems in environmental pollution is plastic waste. Data in 2014, Indonesia's plastic waste reached 5.4 million tons per year. From year to year, Indonesia's plastic waste is increasing, with many retail beverage sellers using single-use plastic packaging. Plastic waste is a recycled material or material that can be recycled, so that's why there are many ways of processing plastic. In addition, plastic is also a chemical that is difficult to degrade or decompose by nature, it takes hundreds or even thousands of years to decompose plastic by nature. For many companies setting up a plastic waste treatment system requires massive investment and a complete restructuring that includes manufacturing, sourcing materials, and implementing new systems to absorb their products (Konten et al., 2019).

The PjBL learning approach places at KD 3.8 an emphasis on contextual learning through challenging activities including providing students the opportunity to experiment with organizing lessons, completing group projects, and eventually generating a product. PjBL is a teaching approach where pupils actively investigate issues and challenges from the real world to gain more knowledge (Kemdikbud, 2013). The final result in learning is a product which is the result of student group work (Kurniawan, 2011). Project-based learning (PBL) is an active student-centred form of instruction which is characterised by students' autonomy, constructive investigations, goal-setting, collaboration, communication and reflection within real-world practices (Kokotsaki et al., 2016). The PjBL model has a number of benefits, including enhancing students' problem-solving abilities, making them more engaged and successful in solving complex problems, giving students experience in learning and practice in project organization, setting time aside for projects, and allocating other resources like equipment. assignments, Give pupils a learning opportunity that involves them in a sophisticated way and is planned to help them advance in line with real-world needs. The PjBL model syntax identifies problems; create a project design and implementation schedule; carry out research; compiling product drafts; measure, assess, and improve products; and finalization and publication of products (Afifah et al., 2019).

In project-based learning, students work in groups to solve challenging problems that are authentic, curriculum-based, and often interdisciplinary. Learners decide how to approach a problem and what activities to pursue. They gather information from a variety of sources and synthesize, analyze, and derive knowledge from it. Their learning is inherently valuable because it's connected to something real and involves adult skills such as collaboration and reflection. At the end, students demonstrate their newly acquired knowledge and are judged by how much they've learned and how well they communicate it. Throughout this process, the teacher's role is to guide and advise, rather than to direct and manage, student work (Solomon, 2008). Teachers do Project Based by developing highly developed and highly specified

materials. The materials focus instruction on a driving question that students find meaning-ful and important, and around which students can develop an understanding of central learning goals. Using these materials, teachers can engage students in scientific investigations, make use of cognitive tools, promote collaboration, and teach them the deeper conceptual understanding that traditional methods of instructions cannot (Krajcik, Joseph S. and Blumenfeld, 2005)

The PjBL model has more value in this implementation, namely containing real problems, giving appreciation to student work, student autonomy in the learning process, supporting the learning process based on learning by doing, so that PjBL model will be better at improving critical thinking skills and performance student science (Thomas, 2000). The Project Based Learning model can train and improve students' critical thinking skills and scientific work abilities, because students are asked to learn by doing, by trying to find solutions to problem that exist in the surrounding environment and are given freedom in the learning process (Priantari et al., 2020). Learning with STEAM made STEAM educators can take inspiration from project-based learning, STEAM learning engages students in transformative learning, which is based on the five ways knowledge is interconnected: cultural knowledge, rational knowledge, critical knowledge, visionary and ethical knowledge, and knowledge in action (Taylor, 2016). According to (Priantari et al., 2020) stated that the STEAM and PjBL approaches show that these approaches and models make students have better critical thinking skills.

METHOD

This research is a quantitative descriptive study on the comparison of cognitive learning outcomes between 2 samples from different schools with the same treatment, namely applying STEAM learning with the Ecobrick Project on environmental pollution material for class VII. The population is class VII students from the selected schools, namely SMP Muhammadiyah 1 Jember and SMP Muhammadiyah 6 Jember. The selection of the two schools used a purposive sampling technique and 1 class was selected from each school by random sampling. The samples in this study were 32 students of class VII B from SMP Muhammadiyah 1 Jember and 33 students class VII A from SMP Muhammadiyah 6 Wuluhan.

This study in two classes from different schools used the same learning and assessment instruments. The activity was carried out in two meetings before the posttest was carried out in each test class. Student Worksheets on ecobricking projects were given to the two research sample classes. Both classes also use the same assessment sheet to determine their cognitive learning outcomes. The instruments used in this study had previously been declared valid by 2 lecturers and 2 teachers in the field of study. The questions used in the evaluation have also been declared reliable based on the results of the students' test results.

The research data were analyzed using SPSS with decision making criteria based on the significance value indicated by the Mann Whitney test output. The selection of the Mann Whitney test (Non-Parametric) was based on data that were declared normal using the Kolmogorov-Smirnov normality test. The null hypothesis (H0) which states that there is no difference in cognitive learning outcomes in the application of STEAM learning with the ecobrick project from class VII B SMP Muhammadiyah 1 Jember and class VII A SMP Muhammadiyah 6 Jember, will be accepted if the significance value is < 0.05 at confidence level in 95 %.

RESULTS and DISCUSSION

Based on the formulation of the problem that has been put forward, namely the cognitive learning outcomes of students at SMP Muhammadiyah 1 Jember with students at SMP Muhammadiyah 6 Wuluhan. Class VII B SMP Muhammadiyah1 Jember and class VII A SMP Muhammadiyah 6 Wuluhan have the same circumstances and conditions. Judging from the ability of students, facilities and infrastructure and gender.. To find out whether there is a comparison of students' cognitive learning outcomes at SMP Muhammadiyah 1 Jember with students at SMP Muhammadiyah 6 Wuluhan, the authors conducted quantitative data analysis. before testing the hypothesis, the normality test and the homogeneity of variance test are first performed as a prerequisite for testing the hypothesis. The hypothesis test used is the Mann Whitney test (Non Parametric). This was done to determine the difference in cognitive learning outcomes of students at SMP

Muhammadiyah 1 Jember and students at SMP Muhammadiyah 6 Wuluhan by using STEAM PjBL Ecobrick. Data processing is carried out using SPSS statistics.

Table 1. Statistical Analysis Results

Sumber	F Hitung	Nilai Sig. (2-tailed)	Kriteria	Keputusan Uji H_0
STEAM Ecobrick Project	0,74	0,07	> 0,05	H_0 diterima

Table 2. Range of Cognitive Learning Outcomes

School / Score Range	60-70	71-80	81-90	91-100	Mean
SMP Muhammadiyah 1 Jember	1	12	20	0	82,88
SMP Muhammadiyah 6 Wuluhan	5	11	13	3	79,81

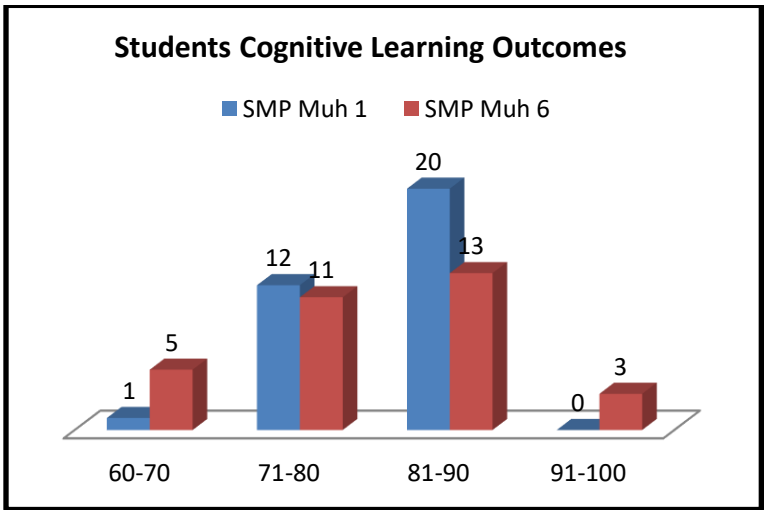

Figure 1. Students' Cognitive Learning Outcomes

The following circumstances are used to compare the cognitive learning results of students at SMP Muhammadiyah 1 Jember and SMP Muhammadiyah 6 Wuluhan utilizing STEAM PjBL Ecobrick: H0 = Using STEAM PjBL Ecobrick, students at SMP Muhammadiyah 1 Jember and SMP Muhammadiyah 6 Wuluhan produce similar cognitive learning outcomes; H1 = there are differences in cognitive learning outcomes of students at SMP Muhammadiyah 1 Jember and students at SMP Muhammadiyah 6 Wuluhan using STEAM PjBL Ecobrick. Decision criteria: a. accept H0 if the probability value (Sig.)>0.05; reject H0 if the probability value (Sig.) < 0.05. It is known that the t-count is greater than 0.05, the cognitive learning outcomes of students at SMP Muhammadiyah 1 Jember and students at SMP Muhammadiyah 6 Wuluhan using STEAM PjBL Ecobrick is 0.77 with probability (sig.) 0.05. Based on the data processing, it can be concluded that there is no significant difference in cognitive learning outcomes of students at SMP Muhammadiyah 1 Jember and students at SMP Muhammadiyah 6 Wuluhan using STEAM PjBL Ecobrick.

Figure 2. Explaining to Student to Plan the Ecobrick Project

Figure 3. Doing the Project of Ecobrick by filling the bottle with plastic waste

STEAM is a meta-discipline that integrates science, technology, engineering, art and mathematics into an integrated approach that is implemented in school trips (Rahmadana & Agnesa, 2022). STEAM is a learning approach by integrating it with various models, methods and techniques in learning. The results of the analysis show that biology learning with STEAM is taught from a multidisciplinary perspective, by trying to integrate the biology learning topics being taught with various activities related to the five aspects of STEAM. The Science aspect is represented by the material Analyzing the occurrence of Environmental Pollution and its Impact on Ecosystems. This material discusses pollution that occurs in the environment, starting from air pollution, water pollution, soil pollution, and the impact of pollution on ecosystems. One of the main problems is related to plastic waste which is increasingly piling up. Because plastic cannot decompose by itself, students are asked to make projects related to plastic waste management, namely with Ecobrick. Each group of students is asked to make their own projects according to the ideas formed together. The student group designs related to waste management with ecobrick, starting from what form will be developed, what tools and materials are needed, the division of tasks in groups, and must complete with certain targets according to the time given by the teacher (Priantari et al., 2020).

Technology aspects in this study by utilizing the internet to find material. looking for material related to plastic waste management and creating ecobrick. Plastic waste is a recyclable material or material that can be recycled, that's why there are many ways to process plastic. For the Engineering aspect, which is related to waste management, namely using Ecobrick. Ecobrick is one of the creative efforts to manage plastic waste into useful objects, reducing pollution and toxins caused by plastic waste. Ecobrick is one of the creative efforts for handling plastic waste. Its function is not to destroy plastic waste, but to extend the life of these plastics and process them into something useful, which can be used for the benefit of humanity in general. Making ecobrick is still not very popular among the general public. Most people still treat used plastic as household plastic waste, polluting the environment, rivers and contaminating everyday life without any self-awareness (Suminto, 2017).

Figure 4. Doing the Project by Filling the Bottles with Plastic Waste

Figure 5. Ordering the Plastic Bottles to Create Vase

Figure 6. The Vase as the Results of the Ecobrick Project

The Art aspect as part of STEAM in biology learning in Indonesia is projected as how students make creative products in terms of form, function and aesthetics. Application of artistic aspects as well as integration of STEAM aspects and forming a fair distribution so that the amount of learning is the same for each aspect. Ultimately, presentation and learning synthesis can be data visualizations that represent personally collected data through the use of colors and icons and other art forms guided by art teachers. The artistic aspect of STEAM learning encourages student creativity as learning outcomes, such as creativity in thinking, creative skills, creative and innovative processes (Miller et al., 2019) (Conradty & Bogner, 2019). The application of STEAM PjBL can also improve students' creative abilities because there is an art aspect (Ismayani, 2016) (Harahap et al., 2022). The artistic aspect in this study is related to the creativity of students in making various forms of ecobrick. There are various forms of ecobrick among others, for example chairs, tables, flower vases will be formed (Sunandar et

al., 2020). Mathematical aspects are seen from shapes, numbers, and amounts (Rahmadana & Agnesa, 2022). In this research, the mathematical aspect is demonstrated by calculating the need for plastic waste materials to become ecobrick raw materials and determining the type of ecobrick space so that it can support the Art aspect.

The use of the PjBL model based on STEAM can increase the students' knowledge learning test results in the first cycle by 63.15 in the low category and in the second cycle by 92.10 in the very high category (Rahman et al., 2020), the use of the STEAM-based PBL model has increased from cycle I to cycle II, so it can be seen that there is an increase in students' cognitive learning outcomes (Putri et al., 2021). This methodology incorporates all of the STEAM disciplines into project-based learning. The PjBL approach of learning involves students actively exploring issues and problems from the real world in order to achieve greater knowledge. The use of the STEAM methodology allows students to comprehend each STEAM component while learning chemistry in order to construct a project. Planning, developing, working together, and transferring are the five learning phases that make up the STEAM learning strategy that is incorporated into the PjBL paradigm. Starting with crucial questions, creating project plans, creating schedules, keeping track of students' progress and projects, testing and evaluating outcomes, and evaluating experiences are all stages of learning that the PjBL model will encourage students to engage in (Annisa et al., 2018). the integration of STEAM-PjBL into science learning encourages students to be able to see the relevance of scientific knowledge about phenomena in everyday life, develop curiosity and problem-solving skills and increase the courage to ask questions and explore various sources of information (Lestari, 2022)

The arts can help pupils develop their creativity, critical thinking, innovation, teamwork, and interpersonal skills, according to empirical studies (Margot & Kettler, 2019) in (Priantari et al., 2020). When students engage in STEAM learning, they become more appreciative of how art and science interact when they comprehend real-world issues and use a variety of critical thinking techniques, creativity, and imagination (Miller et al., 2019). Several significant STEAM learning points include: Project-based learning can serve as an example for STEAM instructors. Several significant STEAM learning points include: Project-based learning can serve as an example for STEAM instructors. STEAM learning involves students in transformative learning, which is founded on five interconnected knowledge modalities: cultural knowledge, logical knowledge, critical knowledge, visionary and ethical knowledge, and knowledge in action (Taylor, 2016).

CONCLUSION

The research data were analyzed using SPSS with decision making criteria based on the significance value indicated by the Mann Whitney test output. The results of the Mann Whitney test value of 0.77, meaning that there is no difference in cognitive learning outcomes by applying STEAM Ecobrick Project-based learning to students at SMP Muhammadiyah 1 Jember with students at SMP Muhammadiyah 6 Wuluhan. The average value of cognitive learning outcomes for students of SMP Muhammadiyah 1 Jember is 82.88 and students of SMP Muhammadiyah 6 Wuluhan are 79.81, the difference between the two is 3.07. By implementing STEAM Ecobrick Project-based learning it can improve students' cognitive learning outcomes. STEAM in this research, the Science aspect the material Analyzing the occurrence of Environmental Pollution and its Impact on Ecosystems. The Technology aspect by utilizing the internet to find material looking for material related to plastic waste management and creating eobrick. The Engineering aspect by which is related to waste management, namely using Ecobrick. The Art aspect is related to the creativity of students in making various forms of ecobrick, for example chairs, tables, flower vases will be formed. The Mathematic aspect is the mathematical aspect is demonstrated by calculating the need for plastic waste materials to become ecobrick raw materials and determining the type of ecobrick space so that it can support the Art aspect.

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