

## Analysis of the STEM-Based Blended Project Based Learning Model to Improve Students' Science Literacy

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### Abstract

The purpose of the study was to analyze the application of the STEM-based Blended Project Based Learning model in improving scientific literacy skills and student learning activities. This research is a Research and Development (R&D), the product developed is a STEM-based blended project based learning model contained in the Syllabus, Learning Implementation Plan, evaluation tools, and Student Worksheets. The research design used One group pretest-posttest design. Data were collected using test and non-test methods, to measure aspects of scientific literacy skills and student activities in learning. The research subject is grade of VII SMP 1 Mejobo Kudus. The data analysis technique was carried out by descriptive analysis and inferential statistics (N-gain test). The results of the validation of the STEM-Based Blended Project Based Learning model for environmental pollution materials developed obtained valid criteria for use in learning. Characteristics STEM-based blended project-based learning model developed based on six main pillars, namely curriculum centered, contextual, real problem-based, constructive investigation, realistic projects and student autonomy. Application STEM-based blended project-based learning model meet the eligibility criteria. This is indicated by the average result of the classical science literacy test is 70.11 and the proportion of classical learning completeness meets 75 out of 105 complete KKM 70, and the average N-gain achievement is 0.40 in the medium category. The results of the analysis of the observation of student learning activities obtained the highest score or percentage, namely 71.90% in the good category. Student response to implementation STEM-based blended project-based learning model received a positive response from students with a mean score of 72.30 with the criteria of "agree".

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## INTRODUCTION

Scientific literacy skills in science learning which are one of the life skills that must be possessed by students in the 21st century during a pandemic are growing by integrating information and communication technology that is also developing. Scientific literacy is very important to prepare the provision of skills that must be possessed by students from elementary school to university levels which include critical thinking, creative, collaborative and communication skills.(Atta et al., 2020).Ariyatun et al., (2020) and Fives et al., (2014)states that scientific literacy is very important to be mastered by students in relation to how they view the environment, health, economy, and the problems of modern society more dependent on technology and the progress and development of science.

In terms of scientific literacy, the results obtained by students in Indonesia are still far from expectations. The results of the PISA (Program for International Student Assessment) survey conducted by the OECD (Organization for Economic Cooperation and Development) in 2006, the scientific literacy ability of Indonesian students was ranked 50th out of 57 countries, then in 2009 decreased, which was in the order of 60th out of 65 countries (Balitbang, 2011). In 2012 it declined to rank 64th out of 65 countries, in 2015 Indonesian students ranked 69th out of 79 countries, and the latest PISA results in 2018 published in March 2019 position Indonesia at 74th out of 79 countries. This data shows that the scientific literacy ability of Indonesian students is in the low category.(Yuliati, 2017), and students understand science is only limited to theory, students have not been able to apply science concepts in everyday life (Engel et al., 2019; Xiaomin & Auld, 2020).

The results of observations at SMP 1 Mejobo Kudus in the 2021/2022 school year, the end of the COVID-19 pandemic, show that learning about environmental pollution has not produced satisfactory results. Learning is carried out only in theory without relating it to real phenomena that occur in the surrounding environment. Student learning outcomes tooshows that students' scientific literacy is still low on environmental pollution material, namely 1) Students have difficulty in manalyze the factors causing water, air and soil pollution; 2) Students have difficulty analyzing the

impact of water, air and soil pollution; 3) Students find it difficult to analyze various solutions to water, air and soil pollution prevention. Students are also not active in learning environmental pollution materials such as in mcreate written ideas about solutions to problem solving on water, air and soil pollution, as well as students difficulties in designing tools to overcome soil pollution in the form of organic waste

Based on interviews with science teachers at SMP 1 Mejobo Kudus, learning in schools during the pandemic uses various methods. When Kudus Regency was in the COVID-19 red zone, the learning method used was the full online learning/distance learning (PJJ) method. In PJJ learning, teachers use WA (WhatsApp) media, Google Classroom, Google Forms, Zoom meetings and teachers' personal blogs in learning, to send materials and assignments that must be done by students. The variety of online/online PJJ applications is not very effective, especially for students and teachers. These conditions require improvements in the delivery of PJJ learning, especially science learning that is more effective so that in the process more emphasis is placed on the achievement of products, processes,

The solution to the problems mentioned above is to apply a digital-based learning model, one of which is the blended learning model.*Blended learning*is a combination of online-based learning with face-to-face learning in the classroom. The effect of the blended learning model has been investigated by several education practitioners including: Blended learning can increase the effectiveness of learning(Muñoz et al., 2020; Tamim, 2018; Wang et al., 2004), Blended learning can increase learning independence and attractiveness in learning(Kristanto et al., 2017). Web-based Blended Learning can improve student learning outcomes and motivation (Kundu, 2018).

In the implementation of blended learning, an integrated online learning processing system is needed (Dziuban et al., 2018). Munir (2010) revealed that the learning process using e-learning design requires a learning management system (LMS). LMS is the management of interaction in a technology-based learning process through the website. One of the LMS that is often used in learning isMicrosoft Office 365 orMs. Teams. STEM (Science, Technology, Engineering and

Mathematics) is one of the learning approaches that are suitable for science learning. The learning model that is in accordance with the STEM approach is Project Based Learning (PjBL). Blended learning using the PjBL model combined with the STEM approach is expected to improve several learning objectives.

**METHOD**

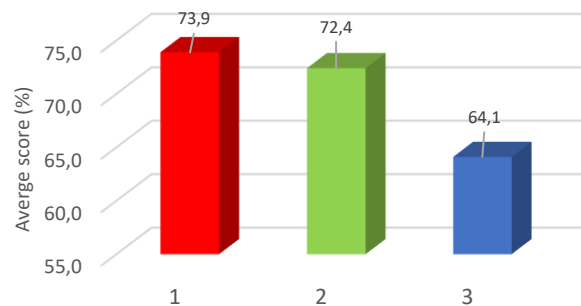
This research was conducted in SMP 1 Mejubo Kudus for the academic year 2021/2022 totals 105 students. In this study, the subjects were given treatment in the form of blended project based learning based on STEM. After being given treatment, the subjects were given a written test related to scientific literacy questions. The research instruments developed include written tests, observations, interviews and documentation. The data collection technique in this study was through a multiple-choice type test technique which was declared valid by 2 material experts and had a reliability of 0.72. The data analysis was done by calculating pretest-posttest scores, t-test and N-gain and then quantitative descriptive.

Students' scientific literacy ability is measured based on scientific literacy indicators. Then, the analysis of students' scientific literacy was carried out by calculating the score of each indicator of scientific literacy ability from the answers to the test questions. The criteria for achieving student scientific literacy for each indicator are 84 < % 100 very good categories, 68 < % 84 good categories, 52 < % 68 good enough categories, 36 < % 52 poor categories and % 36 with categories very less. Meanwhile, to strengthen the results found in the open test, the researchers conducted interviews with respondents.

The problem of the low scientific literacy ability in Indonesia which is still low is expected to be able to be upgraded with various applications of appropriate learning models. This study aims to analyze students' scientific literacy skills through Blended-PjBL-STEM learning. The scientific literacy ability of students in this study was measured using a scientific literacy test for environmental pollution materials that had been validated by experts and tested for validity and reliability. Scientific literacy skills measured in this study include the ability to explain scientific phenomena, the ability to evaluate and design scientific investigations and interpret scientific data and evidence. The scientific literacy test was carried out in grade of VII SMP 1 Mejubo Kudus, totaly 105 students. Based on the analysis of the homogeneity test on the value of the first semester report card, the value of sig.0.285 is obtained,

The scientific literacy ability test consists of 20 multiple choice questions covering three aspects of scientific literacy ability. Each aspect of scientific literacy ability has different indicators. The overall achievement of scientific literacy skills was obtained by calculating the average percentage of students who answered correctly on each item. Obtaining research data related to scientific literacy ability in each indicator of scientific literacy ability is obtained by calculating the percentage of achievement of test results for each indicator then comparing the scores obtained by each student with the maximum value and finding the average value of the achievement of scientific literacy abilities for each indicator. The results of the scientific literacy test were then analyzed in every aspect of scientific literacy. The results of the analysis of the average scientific literacy ability of students in each aspect of ability are briefly summarized and presented in the picture 1 below.

**RESULTS AND DISCUSION**



**Figure 1.** Scientific literacy skills of students after the learning process

Information:

- 1: Explaining scientific phenomena
- 2: Evaluating and designing scientific investigations
- 3: Interpret scientific data and evidence

The highest average score of the scientific literacy ability test shown in the figure shows that the largest percentage of ability lies in the aspect of explaining scientific phenomena, which is 73.69%, the second is in the aspect of evaluating and designing scientific investigations, which is 72.4% and the third is in the aspect of interpreting data and scientific evidence by 64.1%. Based on the category of scientific literacy ability, students' ability to explain scientific phenomena is in the high category, the ability to evaluate and design scientific research is in the high category and the ability to interpret scientific data and evidence is in the medium category. Meanwhile, the distribution of the level of scientific literacy ability is briefly presented in the table 1 below.

**Table 1.** Criteria for the Level of Students' Scientific Literacy Skills

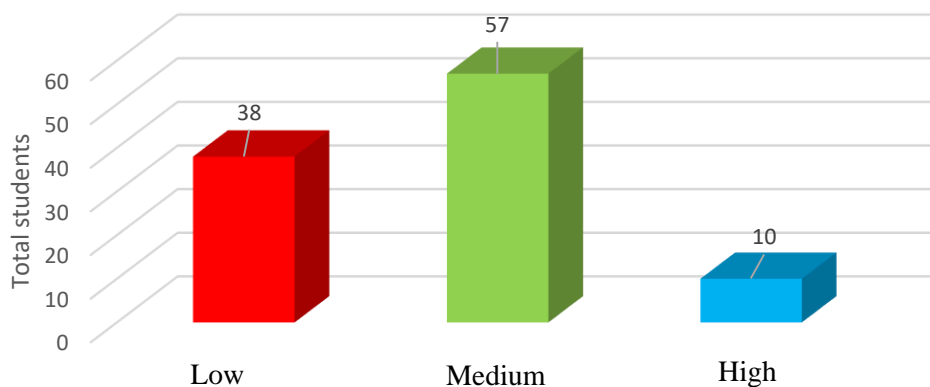
No	Competency Level	interval	Number of Students
1	Tall	$66.6 < p < 100$	69
2	Currently	$33.3 < p < 66.6$	32
3	Low	$< p < 33.3$	4

The table above shows the scientific literacy ability of class VII students of SMP 1 Mejobo Kudus

at a high level there are 69 students, at a medium level there are 32 students while at a low level there are 4 students. Overall, the average scientific literacy ability score of seventh grade students of SMP 1 Mejobo Kudus got 70.1% in the high category.

This study refers to the cognitive level that can be achieved by students. The description of the assessment is as follows: 1) Low level, if students can only solve problems by carrying out a one-step procedure, for example remembering facts, principle terms, or concepts determining one point of information from graphs or tables; 2) Medium level, moderate if students can only solve problems related to using and applying conceptual knowledge to describe or explain phenomena, choosing appropriate procedures that involve two or more steps in solving problems, organizing data, interpreting or using data; and 3) High level, if students can answer chemical literacy questions to the stage of analyzing complex information or data,

The magnitude of the increase in students' scientific literacy skills is obtained from the calculation of the N-gain (g) formula, namely by comparing the pretest and posttest scores. From the calculation results shown in the Appendix, the average value of the pretest results is 50.14 and the average posttest results is 70.10 so it has a  $g = 0.40$  value in the medium category.



**Picture 2.** Total students based on N-gain's category

Picture 2 shows that there are 10 students who have increased their scientific literacy skills in the high category. In the medium category there were 57 students and in the low category there were 38 students who experienced an increase in scientific literacy skills on environmental pollution material. Average score of scientific literacy ability the pretest result is 55.5 and the average posttest result is 71.17 so it has a value of  $g = 0.40$  in the medium category. The results of this moderate increase are influenced by internal factors of students who are not used to doing test scientific literacy skills so that students need more time in understanding science contextually. This shows that the Blended-PjBL-STEM learning model can facilitate students in project activities so that students not only cognitively understandable but can relate knowledge to everyday life values and product manufacturing projects (Harto et al., 2019). Innovative science learning can be an alternative to improve scientific literacy skills, therefore researchers carry out learning innovations using STEM-based PjBL models (Sumarni et al., 2020; Ariyatun & Octavianelis, 2020).

## CONCLUSION

Application of STEM-based blended project-based learning model meets the eligibility criteria. This is indicated by the average result of the classical science literacy test is 70.11 and the proportion of classical learning completeness meets 75 out of 105 complete KKM 70, and the average N-gain achievement is 0.40 in the medium category. The results of the t test output obtained that the value of sig has a value of  $-19,680 < -1,98326$  so that there are differences in the results of the scientific literacy test between before and after the application of Blended-PjBL-STEM learning. These results indicate that Blended-PjBL-STEM is effective in improving science literacy skills of junior high school students.

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