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The Effect of STEM Integrated PBL Model to Practice Students' Scientific Communication Skills

Ayu Islamiyah, *Fitria Eka Wulandari
Science Education Study Program, Faculty of Psychology and Education, Sidoarjo Muhammadiyah University, Jl. Mojopahit No. 666B, Sidowayah, Sidoarjo, East Java, Indonesia. Postal code: 61215
*Corresponding Author e-mail: fitriaekawulandari@umsida.ac.id

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Abstract

This study aims to determine the effect of the STEM integrated PBL model to practice students' scientific communication skills. The population of this study were students from the eighth grade of Junior High School of 1 Candi. The sample used is 30 students selected from the population using simple random sampling technique. This research method is Pre-Experimental Design. The design in this study is a one-shot case study. Data from the observation results of the assessment of students' scientific communication skills were analyzed using quantitative descriptive methods, by finding the mean and finding the percentage of indicators of scientific communication skills. The results showed that the application of the STEM-integrated PBL model in science learning material additives was able to improve students' scientific communication skills in a good category, with the average result of students' scientific communication being 2.7.

Keywords: STEM, PBL, Scientific Communication.

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INTRODUCTION

The 21st century is the main foundation for various aspects of modern human life, this is marked by the rapid use of information and communication technology in everyday life. With the dependence of all aspects of life on today's science and technology, it causes changes in qualifications that are increasingly competitive (Mukarromah, 2018). One aspect that is affected by the 21st century is the aspect of education. Students who live in this era are required to have 21st century skills in order to compete. 21st century skills include problem solving, critical thinking, creativity, collaboration, and communication skills (Ramdani et al., 2019).

Communication is a process of giving or receiving information to others (Haryanti & Suwarma, 2018). Communication can be done orally or in writing. Communication is the basis of all aspects of life, where there is an interactive process that is very important in delivering messages (Aristianti, E., Susanto, H., Marwoto, 2018). In learning, communication is a tool used to measure the level of student understanding, because when students are able to communicate the results of their learning, it means that students understand the material presented (Wulandari et al., 2019). Likewise in science learning which in its approach uses a scientific approach such as observing, asking questions, collecting data, and communicating results. Therefore, considering the importance of communication, scientific communication skills are very important in science learning to be able to improve learning (Ika, 2018). Communication is the main principle of a learning process. When students have a high

understanding of knowledge but cannot convey their ideas orally or in writing, it will hinder the process of learning and communicating scientifically.

Scientific communication skills become a problem that needs to be considered where students' scientific communication becomes the main problem. In line with research conducted by Haryanti & Suwarma, 2018 about scientific communication in one of the junior high schools in Bandung, that only 7 students have good communication skills or 43,75%. Then 9 students are included in the category of low communication or 56,25%. The same results can also be seen from the research of Hendriana & Kadarisma (2019) which states that students have low communication skills. 60% of students can state events in language and symbols, 42% of students can reflect on pictures and diagrams, 29% of students can make models in the form of pictures, tables, and graphs. From several explanations of problems in scientific communication, this can also happen at Junior High School of 1 Candi class 8 which is still very low.

This is evidenced by the observation that students are not taught how to solve problems. Additionally, students are not taught how to create graphs or tables. The ability to describe tables, pictures, and diagrams in the form of verbal information is 53%, and the ability to make conclusions based on the data presented is 56%.

Based on observations that have been made by researchers, students' scientific communication is low in science learning, where the teacher gives student worksheets (LKS) to do practicum. Students are only asked to fill out LKS and not to make a report on the results of the practicum. Students are only directed to fill in the table of experimental results, answer the analysis, and write conclusions on the worksheets provided by the teacher. The learning method used by the teacher adjusts to the situation, because students do hybrid learning. At Junior High School of 1 Candi, one hour of lessons is only twenty minutes because it is still in the pandemic period. Therefore, the best learning model to train students' scientific communication skills is to apply the PBL (Problem Based Learning) model. This model can train students to find concepts independently based on real problems from life with research abilities, so that the model has the highest level (C. D. Putri et al., 2020). This was also stated by Shofiyah & Wulandari, (2018) that in learning the PBL model, students play an active role in obtaining concepts from problem solving found by students. Abdullah & Faijah Kurniati, (2020) stated that PBL is able to improve the scientific communication skills of student learning outcomes compared to conventional models. The weakness of the PBL learning model is that students have difficulty in the problem solving process (Anindya Fajarini, 2018). PBL has the potential to burden students, because students do not have much time for independent study (Anindya Fajarini, 2018).

From the weakness of the PBL model, a suitable learning approach to be applied to complement the PBL model is the STEM (Science, Technology, Engineering, Mathematical) approach. This is because in learning with the STEM approach students are not only taught theoretically, but students also practice in the form of projects. So that students are directly and actively involved in the learning process. This is in accordance with the nature of science learning (Septiani, 2014). In the STEM approach, students can be encouraged to design, develop, and utilize technology, hone understanding, and apply knowledge (Ishak, 2021). By exposing students to a problem by integrating science, technology, engineering, and mathematics in solving real problems, it can improve students' ability to communicate scientifically. When students are trained to communicate scientifically, students will be accustomed to communicating orally (presenting practice results) and able to communicate in writing (writing practice results correctly according to the systematics) (Mufidah, 2019). Based on this background, the purpose of this study was to find out how the influence of the STEM integrated PBL model on training students' scientific communication skills in additive material science learning.

METHOD

Research Design

This study uses a descriptive quantitative approach because the results of observations are converted into numbers which are analyzed using statistics with the aim of knowing the effect of the STEM integrated PBL model on the scientific communication skills of junior high school students. The research method used is a pre-experimental design method with a one-shot case study design. The one-shot case study aims to determine the effect of the treatment. In this study, all classes were given treatment in which each meeting was assessed using an observation sheet to measure students' scientific communication skills (Sugiyono, 2020). In general, research designs are presented with the following symbols:

X	**O**

(Indrawan.,Yaniawati., 2016)

Information:
X = Use of PBL STEM learning model
O = Results of scientific communication skills

Population and Samples

The population in this study was class eight of Junior High School of 1 Candi. The total of students is 210 in the 2021-2022 academic year. The sample of this study was 30 students of class VIII-G. The data collection technique used in this study was to select samples with *probability* techniques of *simple random sampling* type. The technique is carried out by random sampling without paying attention to anything in the population (Sugiyono, 2020). The location of this research was conducted at Junior High School of 1 Candi precisely on Mojopahit Street No. 7, Candi District, Sidoarjo Regency. The research was carried out from November 8, 2022 to December 16, 2022, according to the schedule for science subjects

Data Collection Technique

The data collection technique in this research is in the form of observation of scientific communication skills. The indicators of written scientific communication skills that were observed were in the form of indicators for making practicum reports. Aspects of report assessment include introduction, theoretical study, results and discussion (in the form of presenting data in tables and reading tables), and conclusions written in practicum reports by students after students follow the additive learning process using a STEM-based PBL model approach (Widayanti & Sukirno, 2018). The research instrument used is a scientific communication assessment validation sheet, which is valid and reliable where in determining the validity and reliability of the instrument the researcher uses two expert validators who are competent in science learning. instrument, content suitability, and language and writing with an average score of 4,3 with conclusions on the criteria very valid. To see the reliability in this study using the Borich method known as the Percentage Agreement (PA) with a percentage value of 96.5%. According to Borich, 2015 the instrument is said to be reliable if the percentage value of the agreement is more than or equal to 75%.

Data Analysis Techniques

Observational data on the assessment of students' scientific communication skills were analyzed using descriptive quantitative by scoring. From these results, researchers observed to obtain data on students' scientific communication skills. Observational data on the assessment of students' scientific communication skills were analyzed using descriptive quantitative methods, by finding the mean, and finding the percentage of indicators for scientific communication skills. This data analysis is used to determine the level of scientific communication skills of students in the form of writing or practicum reports using written scientific communication indicators. Before analyzing the data, the researcher first looks for

the mean to calculate the average scientific communication skill indicator and looks for the percentage of each scientific communication skill indicator.

a. Finding for mean

Finding the mean or average scores can be calculated by adding up all the data and then dividing by the amount of data. The formula is as follows:

$$M = \frac{\sum x}{n}$$

(Rohmah et al., 2022)

With a description:
M = mean
∑x = sum of all data
N = sum of subjects

b. Finding the percentage

Finding the percentage of each indicators data of students' scientific communication skills using statistical analysis, with the formula:

$$P = \frac{\sum score\ obtained}{\sum maximum\ score} \times 100\%$$

(Safitri et al, 2018)

The percentage scores obtained is summed up in a descriptive sentence as follows:

Percentage	Category
0% - 25%	Less
26% - 50%	Enough
51% - 75%	Good
76% - 100%	Excellent

(Arikunto, 2010)

RESULTS AND DISCUSSION

The results of this study are presented in the form of an assessment of scientific communication skills and the achievement of an indicator of scientific communication indicators of eighth grade of Junior High School of 1 Candi in science learning material additives. An assessment of scientific communication ability can be seen in Chart 1.

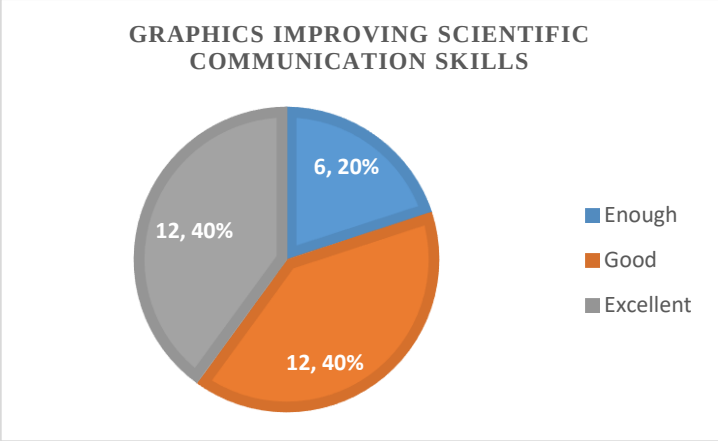

Chart 1. Improved Student Scientific Communication

Based on Graph 1 obtained from 30 VIII grade students, it can be seen that there are only 12 students with scientific communication skills in the category very “excellent” with a percentage range of 76% - 100%. Students who have the skilllessness of scientific communication in the category "Good" with a percentage range of 51% - 75% total 12

students. Then students who have the skilllessness of scientific communication in the category "Enough" with a percentage range of 26% - 50% total 6 students. It can be said that in the presence of an integrated PBL STEM model, namely in the syntactic presentation of the results of the discussion, according to the results of the study, it can be said that students' scientific communication skills are categorized as good with an average score of 2,7 and a percentage of 67,3%.

According to the results of the study, the final result was "Good". The same can be seen in the study by Agustina et al., (2020) which aims to increase the level of communication skills of students after the introduction of STEM education. There is a STEM approach, there are disciplines that are interconnected with each other. Science has math to process data, while technology and engineering are applications of science. This is also supported by a study by Afriana et al., (2016) which states that in STEM education, students are scientifically and technologically literate, as can be seen in reading, writing, observing, and doing science. Because in the process of science, students make observations, interpret, group, predict, communicate, for example, read graphs, charts or tables, make hypotheses, design experiments, apply concepts, ask questions, use tools and conduct experiments (A. N. Putri & Muhartati, 2019). This is also supported by the Astuti et al., 2019 study that STEM education is able to improve cognitive and psychomotor abilities because students move according to interests and problem-solving abilities through the integration of disciplines.

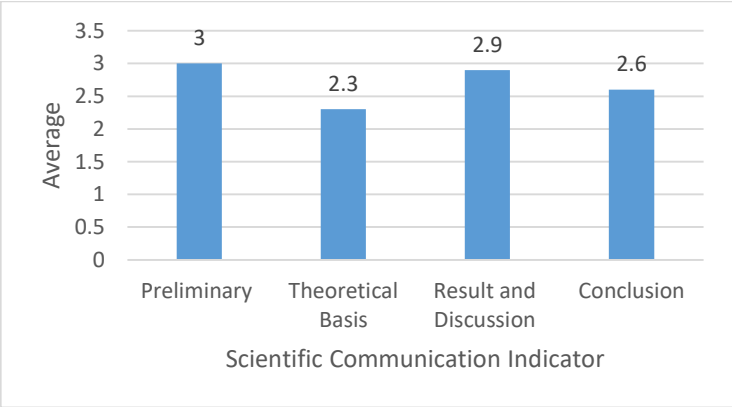

Chart 2. Achievement of Student Scientific Communication Indicators

Based on Chart 2, the average science communication score is 2,7 with a percentage range of 57% - 75% and good categories. According to the results of the study, the average value of the preliminary indicators was obtained, namely 3, the average value of the indicators of the theoretical basis was 2,3; the average value of the results of the discussion was 2,9; and the average value of the indicator findings was 2,6. Thus, it can be concluded that the highest average of the indicator is the introduction with a mean of 3, and the lowest mean of the indicator is the theoretical base with a mean of 2,3.

Students' scientific communication skills in writing are measured using a practice report. Indicators of scientific communication skills in writing consist of introduction, theoretical background, discussion results and conclusions. The mean and percentage of each indicator is obtained from the highest to the lowest mean, including introduction, results and discussions, conclusions, and theoretical background. Introduction has the highest GPA with a percentage of 74% (good), this is due to the fact that when teaching STEM, students must make observations and formulate solutions to a real problem in the real world (Ismayani, 2016). This is consistent with the statement of Khairani et al., (2018) which states that STEM is capable of improving learning skills, solving problems, discovering new things, understanding oneself, thinking logically, and adapting technology.

Then the discussion results and scores have the second highest average with a percentage of 73% (good). This is because in STEM education, students are taught to

represent data and read graphical tables or charts in the learning process with additional material (Astuti et al., 2019).

The conclusion indicator has the third highest average value with a percentage of 66% (good). This is because in the PBL STEM model students have been trained in relating results to existing theories and concepts. This is also proven by Yusdiana dan Hidayat (2018) that students can draw conclusions based on processes and concepts.

The theoretical foundation indicator has the lowest average with a percentage of 57% (good). This is due to the lack of literacy in finding solutions to the problems studied (Nurcahyono & Novarina, 2020).

CONCLUSION

Based on research data and data analysis, it can be concluded that learning using the STEM integrated PBL model can train students' scientific communication skills on Additive Substance material with good category. The results of the scientific skills research of students obtained a good category with a percentage of 67,3%. Among the achievements of the indicators, the theoretical foundation has the lowest value with a percentage of 57%.

REKOMENDATION

The use of learning with STEM-integrated PBL models requires a long period of time. So, the solution for learning to be implemented more effectively and efficiently, it is necessary to process the right time. So that the next research can be more optimal, the teacher should provide motivation and opportunities for students to get used to scientific communication in science learning.

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