THE EFFECT OF A STEM APPROACH WITH THE PROBLEM BASED LEARNING MODEL ON COMMUNICATIVE SKILLS AND STUDENT LEARNING OUTCOMES

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Abstract

Teaching and learning process can be combined with the existence of skills. There are 4 types of skills that can be needed in the 21st century era. One such skill is the Communicative skill. Communicative skills are learning that emphasizes aspects of communication, interaction, and developing linguistic competencies, as well as language skills (listening, reading, writing, speaking) as a goal to recognize that there is a connection with communication activities in daily life. The learning process can also use a learning approach that is relevant for students so that students can improve student learning outcomes at school. One learning approach that fits the 2013 curriculum is the STEM approach. The STEM approach is a learning approach that combines two or more fields of science contained in STEM, namely science, technology, engineering or engineering, and mathematics. Through the STEM approach students are expected to have 2 skills of learning and innovation which include critical thinking, creative, innovative, and able to communicate and collaborate. Thus, learning must be embedded in basic concepts to the development of science and thinking skills.

Keyword: *Communicative, STEM*

1. INTRODUCTION

The world of education in Indonesia is currently growing, with various kinds of curriculum reforms, learning innovations, and the fulfillment of educational facilities and infrastructure. The implementation of the 2013 Curriculum will be able to improve the learning process. The 2013 curriculum is one of the government's efforts to develop education in Indonesia which requires education based on science, technology, engineering design and mathematics so that it is hoped that it can help better education. The 2013 curriculum is a competency-based curriculum designed for the competence needs of the 21st century. The 2013 curriculum aims to develop the potential and character of students to have a curious, honest, responsible, logical, critical, analytical and creative attitude [1].

The current problem in learning is the lack of self-confidence in students in listening, speaking and writing with various media. The main factor that affects students is the lack of self-confidence in themselves, which causes these students to lack in expressing opinions. If students have shown courage, it is expected that their speaking skills will increase [2]. According to (Nuraeni, 2002) that speaking is the process of delivering information from the speaker to the listener with the aim of changing knowledge, attitudes, and listening skills as a result of the information received so that students can grow their self-confidence in front of many people [3].

The teaching and learning process can also be combined with skills. There are 4 types of skills that can be needed in the 21st century era. One of these skills is communicative skills (Rabawati, 2013). Communicative skills are an approach based on the idea that the ability to use oral communication is a goal that must be achieved in the learning process (Mamonto, 2018) [4]. Communicative skills are used in student learning to get as many opportunities as possible in terms of communicating orally and in writing (Utami, 2007). By mastering speaking skills, students will be able to express their thoughts and feelings intelligently according to the context and situation when speaking. Speaking skills form a creative future generation so that they are able to produce communicative speech or utterances (Mamonto, 2018) [5].

The learning process is also integrated with an approach. One of the learning approaches that are in accordance with the 2013 curriculum is the STEM approach (Gustiani, 2017). The STEM approach is a learning approach that combines two or more fields of science contained in STEM, namely science, technology, engineering or engineering, and mathematics (Ismayani, 2016). Through the STEM approach, students are expected to have 2 learning and innovation skills which include critical thinking, creative, innovative, and able to communicate and collaborate (Winarni, 2016). The STEM approach has been a topic of international discussion during the last decade. This is due to changes in the global economy and labor needs which indicate there will be a shortage of workers and educators around the world who have STEM insights (Kennedy, 2014). According to the National Science Foundation, in the next 10 years as many as 80% of jobs will require competencies in science, technology, engineering and mathematics (Nurdiansyah, 2016) [6].

Problem based learning (PBL) is a learning model based on the principle of using problems as a starting point for the acquisition and integration of new knowledge (Cahyo, 2013). According to Mawaddah (2017) by applying the Problem Based Learning learning model, it can encourage student knowledge of the relationship between principles, concepts and skills, besides that it can also arouse student curiosity and student speaking skills and develop students' abilities to apply their knowledge. PBL teaches students to develop various points of view, carry out deep, active and meaningful learning and train students' communication and critical feelings (Celik, et al .., 2011). Based on the above problems, the authors conducted a study entitled The Effect of the Science, Technology, Engineering and Mathematics Approach with the Problem Based Learning Learning Model on Communicative Ability and Student Learning Outcomes [7].

2. RESEARCH METHOD

Types of research

This type of research is a quasi-experimental research, namely by using two classes, one experimental class and one control class.

Place and time of research

The place of research was carried out at SMA Negeri 1 Arjasa Jl. Sultan Agung No. 64, Krajan, Arjasa, Jember. The research was conducted in February in the even semester of the 2020/2021 academic year.

Population and Sample Research

The study population was all students of class X MIPA SMA Negeri 1 Arjasa in the academic year 2020/2021 which consisted of 5 classes, namely class X MIPA1, X MIPA2, X MIPA3, X MIPA 4, and X MIPA 5. Of the five classes two classes will be taken. based on the normality test and homogeneity test with the Laevene's Test Variance technique, in order to obtain the control class and the experimental class.

Sampling in this study was carried out by first testing the normality of the population, then doing the homogeneity test. The function of conducting the homogeneity test is carried out to determine whether all class X students of SMA Negeri 1 Arjasa have the same abilities or not.

Research variable

	Variable
Free	STEM approach Discovery Learning Learning Model
Bound	Communicative skills Student learning outcomes

Research

Research design

This research is a quasy experimental research, namely research using the Science, Technology, Engineering and Mathematics approach with the Problem Based Learning learning model in the experimental class and learning in general using the Discovery Learning learning model in the control class.

The design of this study used a pre-test post-test control group design.

Data collection technique

a. Observation

The observation method is used to observe student activities in learning. The observations are presented in the form of an observation sheet developed by the researcher and will be filled in by the observer at each meeting.

b. Interview

Interviews were conducted before and after conducting research to teachers and students. This activity is carried out to determine the difficulties experienced during the learning process.

c. Documentation

Documentation is done by collecting data in the form of writing, namely in the form of test scores at the end of the odd semester to determine the level of homogeneity of the population taken. In addition, documentation is carried out when interviewing teachers and students, lists of student names, pretest and posttest results, pretest and posttest evaluation tools assessment sheets and photos of the learning process in the Plantae chapter.

d. Test

The test is used to assess and measure student learning outcomes, especially cognitive learning outcomes or knowledge regarding the assignment of teaching materials in accordance with educational and teaching objectives. Tests were carried out before and after learning, namely in the form of pretest and postest. The pretest aims to measure the knowledge that students have before learning. The posttest aims to measure students' understanding of the subject matter after the application of the STEM approach.

Data Analysis Technique

a. Students' communicative abilities were measured using an instrument for assessing communicative abilities. To determine the effect of the STEM approach and integrative learning methods on students' communicative abilities during learning, the Independent Sample t-test analysis was used with the LKPD value as data.
b. Cognitive learning outcomes on the influence of science, technology, engineering and mathematics approaches with problem-based learning models on cognitive learning outcomes can be tested using the ANAKOVA statistical test using SPSS because cognitive learning outcomes have a reinforcing variable (covariate), namely the pre-test value.
c. Learning outcomes in the psychomotor domain in the test carried out on the influence of science, technology, engineering and mathematics with a problem-based learning model on psychomotor learning outcomes is the Independent Sample t-test on psychomotor learning outcomes based on the aspects of assessing student skills or skills which include preparation tools, skillful in using tools, and performing work procedures.

3. RESULT AND DISCUSSION

Data Analysis of Learning Outcomes in the Cognitive Domain

The results of students' cognitive learning in the study were obtained through the test method, namely pre-test before the approach and model was applied and post-test after the approach and model was applied. The test covers the plantae material which consists of 15 multiple choice questions and 5 questions. Data on the results of students' pre-test and post-test scores.

Table 3. Students' pre-test and post-test scores

Class	The number of students	Average ± SD		Difference
		Pretest	Posttest	
Experiment	35	53,37 ± 6,77	75,65 ± 6,31	22,28
Control	35	47,78 ± 8,16	57,09 ± 7,82	9,31

Based on the table of pre-test and post-test values, it can be seen that the mean pre-test value of the experimental class is 53.37 (± 6.77) and the post-test value is 75.65 (± 6.31), while the pre-test mean value is 75.65 (± 6.31). the control class test was 47.78 (± 8.16) and the post-test score was 57.09 (± 7.82) and the mean difference of the experimental class was 22.28, while the control class was 9.31. It can be concluded that the increase in cognitive learning outcomes in the experimental class is higher than the control class.

The student's cognitive learning outcomes were then analyzed using the covariance analysis test (ANAKOVA), but before the covariance analysis test (ANAKOVA) was carried out, the normality and homogeneity test had to be carried out. After the data is normally distributed and homogeneous, it can be continued with covariance analysis (ANAKOVA) which aims to determine whether there is an effect of differences in treatment using the STEM approach with the Problem Based Learning learning model on student learning outcomes in the cognitive domain in the experimental class and the control class.

Table 4. ANOVA Test Results Pre-test and Post-test values

Source	Sum of type III squares	Df	Mean square	F	Sig.
Corrected model	6216,158[a]	2	3108,079	77,95	,000
Intersept	2544,528	1	2544,528	63,853	,000
Pretest	703,095	1	703,095	17,644	,000
Class	3604,484	1	3604,484	90,452	,000
Error	2430,842	61	39,850		
Total	290608,000	64			
Total corrected	8647,000	63			

a. R squared = .719 (R squared adjusted = .710)

Based on the results of the ANAKOVA test analysis, the pre-test and post-test values in the table can be concluded that there is a significant difference between the cognitive learning outcomes of the control class and the experimental class students, namely with a significance value of 0.000 ($p < 0.05$) which means between the value of the experimental class and the control class has a significant difference in the value of learning outcomes in the cognitive domain. It can be concluded that there is a significant effect of the STEM approach with the Problem Based Learning learning model on student cognitive learning outcomes.

Analysis of Psychomotor Domain Learning Outcomes

The students' psychomotor learning outcomes in this study were obtained from the observation sheet made by the researcher. The observation sheet consists of three indicators, including being skilled at preparing tools, skilled at using tools, and performing work procedures appropriately.

Table 5. Average Value of Student Psychomotor Learning Outcomes

Indicator	Experiment	Control
	Average ± SD	Average ± SD
Skilled in preparing tools	77,34 ± 7,40	78,90 ± 11,02
Skilled in using tools	80,46 ± 10,50	80,46 ± 10,33
Perform work procedures	81,25 ± 10,99	72,65 ± 7,28
Average	80,46 ± 10,16	75,97 ± 10,56
Category	Good	Enough

Based on Table 5. in the experimental class, the students' psychomotor scores were 80.46 (± 4.95) and the psychomotor scores in the control class were 75.97 (± 5.20). It can be concluded that the increase in learning outcomes in the psychomotor domain of the experimental class is higher than the control class, so that there is a significant difference in scores between the experimental class and the control class. The distribution of data on student psychomotor learning outcomes in the experimental class and the control class has different values in each of the aspects that have been measured, including the skillful aspects of preparing tools, skillful use of tools, and performing work procedures. The average result of these three aspects in the experimental class has a higher value than the control class.

The learning outcomes of the psychomotor domain were then analyzed using the Independent Sample t-test, but before conducting the Independent Sample t-test, first carried out a normality test and a homogeneity test. The normality test is carried out to determine whether the data obtained is normally distributed or not. Based on the results of the normality test, the average value of learning outcomes in the psychomotor domain of the control and experimental classes stated that the data were normally distributed.

Table 6. Results of the independent samples t-test in the psychomotor domain

T test for differences in means				
		T	Df	Sig.
Communicative skills	Assumption of the same variant	3,78	62	0,000
	Assumption of unequal variants	3,78	61,48	0,000

Based on the results of the t-test analysis in the table, it can be concluded that there is a significant difference between the student learning outcomes in the psychomotor domain in the control class and the experimental class, with a significance value of 0.000. This can be interpreted as p <0.005, which means that H0 is rejected and H1 is accepted, which means that the value of the experimental class and the control class has a significant difference or it can be interpreted that there is an effect of the STEM approach with the Problem Based Learning learning model on student learning outcomes in the psychomotor domain.

Data Analysis for Communicative Skills

Data on the results of students' communicative skills were obtained from the results of student discussions during class individually for 2 meetings. Each student has five criteria in the ability of communicative skills.

Table 7. Average value of communicative ability

Class	Average ± SD	Lowest score	highest score
Experiment Class	76,92 ± 4,42	63,67	93,33
Control Class	68,90 ± 5,27	60,00	66,67
Difference	8,02083		

Based on the table above, it can be seen that the average score of students' communicative ability in the experimental class was higher, namely 76.92 when compared to the average value of critical thinking skills in the control class, namely

68.90. So, the average difference in critical thinking skills between the experimental class and the control class is 8.02083. The table above also shows that the highest score obtained by the experimental class is 93.33 and the lowest value is 66.67. The control class has the highest value of 76.67 and the lowest value of 60.00.

Table 8. Classification of Students' Communicative Ability Values Based on Indicators

Indikator	Experiment	Control
	Average ± SD	Average ± SD
Oral communication	74,68 ± 6,21	69,57 ± 10,45
Understand the aims and objectives	71,87 ± 7,37	68,12 ± 7,80
Using communication strategies	70,00 ± 7,62	66,87 ± 7,80
Presentation skills	75,31 ± 10,15	70,62 ± 11,24
Receptive communication	84,06 ± 7,97	68,12 ± 8,92
Average	76,92 ± 7,66	68,93 ± 9,02
Category	High	Enough

Based on the table above, it was found that the mean value of the communicative ability of the experimental class students had a high value of 76.92. none of the indicators of communicative skills in the experimental class fall into the low criteria. The indicator with the highest score in the experimental class is the indicator to make and determine the conclusion of 85.62 ± 6.69 which is included in the very high criteria. The table is also known that there are three indicators that have high criteria, including aspects of oral communication, presentation skills and receptive communication.

The data on the ability of students 'communicative skills in the control class based on the table above shows that the average value of students' critical thinking skills in the experimental class has a high value of 68.93. The indicator with the highest score in the control class is the indicator identifying assumptions of 70.62 ± 11.24 and the indicator making and determining the conclusion of 70.31 ± 7.94 which is included in the high criteria. The table also shows that there are two indicators that have sufficient criteria, including in the aspect of understanding the aims and objectives and using communication strategies.

The results of the students' communicative abilities are then analyzed using the Independent Sample t-test, but before the Independent Sample t-test is carried out, they must first carry out the normality and homogeneity test. The test results show that the data is normally distributed, so that it can be continued with the homogeneity test using Levene's Statistic Test before testing the Independent Samplet t-test.

Table 9. T-test results on the value of communicative skills

T test for differences in means				
		T	Df	Sig.
Critical thinking skills	Assumption of the same variant	8,130	62	0,000
	Assumption of unequal variants	8,130	58,193	0,000

Based on the results of the T-test analysis in the table, it can be concluded that there is a significant difference between the critical thinking skills of the control class and the experimental class students with a significance value of 0.000. This can be interpreted as p <0.005 which means that between the experimental class and control class scores have a significant difference in the value of communicative abilities or it can be interpreted that there is an effect of the STEM approach with the Problem Based Learning learning model on the value of communicative abilities.

Learning Implementation

The implementation of the approach with the learning model applied in the learning process is measured when the learning process takes place by 4 observers, namely 4 biology education students.

Table 10. Implementation of learning

Class	Implementation of learning %
Experiment Class	100
Control Class	100

Based on the table above, it shows that the implementation of learning in the experimental and control classes is in accordance with the learning plan, namely the experimental class using the STEM approach with the Problem Based Learning learning model while the control class uses a scientific approach with the discovery model.

Discussion

The effect of the STEM approach with the Problem Based Learning learning model on learning outcomes in the cognitive domain

The ANAKOVA test results in table 4.7 show that the significance value is 0,000, where p <0.005, which means H1 is accepted and H0 is rejected. It can be interpreted that there is an effect of different treatment approaches and learning models on students' cognitive learning outcomes, so it can be concluded that there is an effect of applying the STEM approach to the Problem Based Learning learning model on student cognitive learning outcomes. This is because STEM with the Problem Based Learning model can encourage understanding of the relationship between student principles, concepts and skills, so that it can increase curiosity and stimulate students 'creative imagination and can develop students' abilities to apply their knowledge, so that students can improve their learning outcomes. (Mawadah, 2017).

The positive impact on the cognitive aspect is marked by an increase in science learning outcomes, which shows that the cognitive value of science tends to be positive when students receive learning with the STEM approach (Bicer & Capraro, 2019). Various schools abroad are changing the basis of classroom learning with STEM. Students in schools that use the STEM approach are compared with schools that do not apply this approach (Non-STEM) to see that there are differences in grades between the two (Gonzalez, 2012). The STEM approach is also considered effective to be applied in learning science and mathematics in Indonesia, which combines this approach with various learning models, such as Problem Based Learning (PBL), which is a learning model to solve a problem and then reveals the existing problems that have been given before then students look for know for yourself how these problems can be resolved properly (Hapizoh, 2019). The STEM approach can be combined with various learning models and strategies to obtain optimal results.

The research results from Afolabi stated that there were significant changes in student learning outcomes using the Problem Based Learning (PBL) learning model compared to the conventional model. In addition, the statement from Albanese and Mitchel strengthens that compared to conventional learning models, it is better to use problem-based learning models that are able to construct concepts and develop process skills such as communicative and collaborative skills in students.

The expansion of the use of STEM education arises because after being implemented in learning, it turns out that this approach is able to increase knowledge mastery and apply knowledge to solve problems (Anggraini, 2017). Thus, all achievements in learning facilitated by science-based subjects can be realized through the implementation of the PBL-STEM learning process. The learning achievement can be said to be able to improve the scientific literacy skills of students.

STEM can also be juxtaposed with other learning models, such as Lestari's research (2018) which applies Science, Technology, Engineering and Mathematics-Problem Based Learning (STEM-PBL) to

improve scientific literacy, collaboration skills, communicative skills, motivation, understanding of material, creative thinking skills, effectiveness, meaningful learning, and support for future careers.

The effect of the STEM approach with the Problem Based Learning learning model on learning outcomes in the psychomotor domain

The first indicator that is measured in the psychomotor domain is skill in preparing tools which are student activities in preparing tools when carrying out practicum activities. In this activity, students will get a high assessment if they prepare the tools completely and vice versa the assessment will be low if students do not bring the tools that have been determined. According to Saputri et al (2013) the success of an experiment depends on the ability to choose and use tools appropriately. In this indicator, there are differences in behavior in the experimental and control classes, namely that the experimental class has a high average score compared to the control class. The mean value in the experimental class on the indicator of skill in preparing tools and materials was 79.34, while in the control class it had a value of 78.90.

The second indicator measured in the psychomotor realm is skill in using tools, which are students' activities in using tools when carrying out practicum activities. According to Saputri et al (2013) the success of an experiment depends on the ability to choose and use tools appropriately. In this activity, students will get a high assessment if they use the tools according to the procedure and vice versa the assessment will be low if students use the tools not according to the procedure. In this indicator, there are differences in behavior in the experimental and control classes, namely that the experimental class has a high average score compared to the control class. The mean value in the experimental class on the indicator of skill in preparing tools and materials was 81.56, while in the control class it had a value of 80.46.

The third indicator that is measured in the psychomotor domain is carrying out work procedures appropriately when carrying out practicum activities. In this activity, students will get a high assessment if students do practicum in accordance with work procedures and vice versa the assessment will be low if students do practicum not in accordance with work procedures. In this indicator, there are differences in behavior in the experimental and control classes, namely that the experimental class has a high average score compared to the control class. The average value in the experimental class on the indicators of performing work procedures was 81.25, while the control class had a value of 72.65. According to Sudjana (2006), the Problem Based Learning (PBL) learning model can also increase the cooperation and cohesiveness of students and train leadership in a group and the ability to move or manipulate will be controlled by the psychological maturity of the students themselves. So that students 'psychomotor skills can be trained properly and can support students' creativity. In addition, the existence of a good approach also strongly supports students' psychomotor results.

The results obtained from the Independent Sample t-test in the psychomotor domain showed a significance value of $p = 0.000$ or $p < 0.05$, so the psychomotor scores in the experimental class differed significantly in the control class, which means that between the experimental class and the control class scores had differences. which is significant or can be interpreted that there is an effect of the STEM approach with the Problem Based Learning model on student learning outcomes in the psychomotor domain. This is in line with the opinion expressed by Asghar, et al., (2012) that the STEM approach with the Problem Based Learning learning model can help students understand and experience the process of scientific inquiry.

STEM learning is a learning approach that uses an interdisciplinary approach where its application is carried out by problem-based active learning. The STEM approach in learning can produce meaningful learning for students through the integration of knowledge, concepts, and skills, so that learning using STEM is

expected that students will be able to hone their skills especially in the current era of globalization and students can develop concepts related to solving complex problems. in everyday life related to the field of science (Sanjaya, 2009).

The psychomotor domain of students refers to when students do the practicum given by the teacher. Students are asked to bring various parts of the plant, including leaves, stems, flowers and fruit. Then, the students were asked to describe the scientific name and area name of the plants they brought using any application they could find in their respective Playstore applications. After this was done, there were 3 applications used by students in the experimental class, namely the PlanNet application, the Picture list application and the iNaturalist application. The three applications used by students have advantages and disadvantages. The PlanNet application is easier for students to apply directly because it does not need to log in or register first, but the disadvantage of the application is that it only has a scientific name, not the name of the region or the kingdom. Second, the Picture list application is also easier for students to apply without having to log in or register first, but the weakness of this application is that there are some plants that cannot be detected properly and many plants do not have a scientific name or area name. Third, the iNaturalist application, which is very complete and almost all plants can be detected, but the weakness of this application is that you have to log in first or register. According to students, an application that is easy to use in learning plantae is the PlanNet application because all plants can be detected even though only the scientific name appears.

According to (Abidin, 2014), students' psychomotor improvement is also due to the use of Technology Applications. Learning with this STEM approach, is able to train students to be able to have the ability to use various kinds of technology that can increase creativity and innovation so that students will be able to face global challenges. The relationship between students' psychomotor domains and current technology greatly affects the creativity of these students in solving problems.

According to (Dewi, 2017) states that the STEM Approach is useful for facilitating students to connect with the world through activities such as identifying problems, collecting data to solve problems, thinking of solutions, and considering the results in a multidisciplinary manner, especially in the psychomotor domain of students who can help students do practicum or matters relating to the application directly between each student and can foster a high sense of cohesiveness in a group to solve a given problem. In addition, it is also prepared based on the 2013 curriculum and includes cognitive, affective and psychomotor aspects so that learning objectives can be carried out properly.

The effect of the STEM approach with the Problem Based Learning learning model on students' communicative skills

Communicative skills are oriented to the learning process to teach language based on communication tasks and functions. The basic principle of communicative skills consists of language as a means of communication, emphasizing the teaching and learning process of non-fundamental discussions, and supporting students to communicate in the usual way (Hidayati, 2018). In the 2013 Curriculum, learning to write is seen in KI 4 (Core competencies), and its development is in competency standards and indicators. Thus, teachers are encouraged to emphasize writing learning on each topic. In accordance with the core competencies (KI 4) which is written as follows: reasoning, cultivating, and presenting in the realm of concrete and abstract relating to the development of the material they learn in school, either independently, in groups or classically with various methods according to the science being taught (Wediningsih, 2019).

The communicative abilities of students measured in this study used 5 aspects including oral communication, understanding the aims and objectives, using communication strategies, presentation skills and receptive communication. In the first indicator, namely oral communication,

it is known that there are differences in scores between the experimental class and the control class. The value in the experimental class was higher, namely 74.68 compared to the control class of 69.57. Oral communication is an activity to communicate or reformulate a problem so that it becomes simpler parts, which can make students better understand the concept of learning material well (Harrie, 2015). According to Leiccester (2010) students learn communicative gradually through habits that are trained in the form of formulating problems and answering questions that require explanation. According to Mulyani, in 2019 innovation is the most important key in the industrial era 4.0 which demands schools to form 21st century students who are able to think critically, creatively, collaboratively, and communicate.

The second communicative indicator is understanding the aims and objectives, it is known that there are differences in scores between the experimental class and the control class. The value in the experimental class was higher, namely 71.87 compared to the control class at 68.12. Understanding the aims and objectives included in the communicative realm. According to Johnson (2002), the communicative will make considerations to increase knowledge and gain understanding. In other words, the thinker will identify reasons and ask whether the reasons found fit the context and are based on reliable or relevant information.

The third communicative indicator is using a communication strategy, it is known that there are differences in values between the experimental class and the control class. The value in the experimental class was higher, namely 70.00 compared to the control class of 66.87. Using a communication strategy is included in the communicative domain of the strategy and tactic sub-skills, namely the ability of students to consider and communicate logically the reasons for a decision, assumption, to use an action or strategy in solving problems, so that they are able to make the right decisions in solving problems. Quality students are the output (output) of a good schooling system and are supported by problem-based and technology-based learning. In a multidisciplinary approach such as a combination of Science, Technology, Engineering, and Mathematics (STEM), it is very appropriate to raise environmental problems with the Problem Based Learning (PBL) approach. The integration of PBL in STEM makes it possible to actualize environmental literacy and students' abilities in the world of science (Farwati, 2015).

The fourth indicator of communicative ability is presentation skills, it is known that there are differences in scores between the experimental class and the control class. The value in the experimental class was higher at 75.31 compared to the control class at 70.62. Presentation skills are included in the communicative realm which means that they can prove the truth of the assumptions contained in a problem according to known knowledge (Kusmanto, 2014).

The fifth indicator of communicative ability is receptive communication, it is known that there are differences in values between the experimental class and the control class. The value in the experimental class was higher, amounting to 84.06 compared to the control class, which was 68.12. Considering the credibility of sources, including in the communicative domain, namely being able to select and sort out reliable sources or references that are used in solving a given problem. According to Irwan (2016), the communicative improvement of students in the experimental class is also due to the use of technology applications. Learning with this STEM approach is actually able to train students to be able to have communicative skills, collaborate, think critically and solve problems, as well as creativity and innovation so that students will be able to face global challenges.

The mean of each indicator in the experimental class is known to be higher than the control class. This proves that the STEM approach with the Problem Based Learning learning model can affect students' communicative abilities. This is closely related to the problem-based learning objectives conveyed by Nurhadi (2004),

namely to help students develop communicative abilities, solve problems, intellectual skills, learn about various adult roles through their involvement in real experiences or simulations, and become independent learning. In problem-based learning, in the teaching and learning process in the classroom, students are first asked to observe a phenomenon where in this study through the problems given by the teacher according to the material so as to provide stimulus to students to communicate more in solving an existing problem.

PBL-STEM can give a person's ability to understand science, communicate, and apply it in solving problems in ongoing learning. Based on the results of the PISA study, which is routinely carried out every 3 years, it was found that the scientific ability of Indonesian students was still very low, but with the development of PBL-STEM which was applied with communicative or collaborative skills, it could improve students' scientific abilities (Ritz, 2014).

Farwati's research results in 2015 stated that STEM is very likely to collaborate with problem-based learning. Thus, all learning achievements accommodated by science-based subjects are estimated to be realized through the implementation of PBL-STEM. In addition, if combined with a skill that can improve student application or ability to deal with a problem that occurs. One of the skills that can be applied is communicative skills in students where later students can develop their confidence to speak and interact in a group of people.

This is in accordance with the objectives of the 2013 curriculum which emphasizes the process of communicative skills, critical thinking, creatively, and innovatively on the aspects of essential abilities needed by all citizens to play a role in developing the country in the future. (Sari, 2017).

CONCLUSION

Based on the results of the research and discussion that has been described, the following conclusions can be drawn.

a. The STEM approach with the Problem Based Learning learning model has a significant effect on students' communicative skills. The average value of 76.92 in the experimental class and control class is 68.93.
b. The STEM approach with the Problem Based Learning learning model has a significant effect on student learning outcomes. The mean of psychomotor learning outcomes was 80.46 in the experimental class and 75.97 in the control class. Meanwhile, the difference in the value of learning outcomes in the cognitive domain was 22.28 in the experimental class and 9.31 in the control class.

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