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Implementation of Project-Based Learning (PjBL) in Collaboration Skills and Communication Skills of Students

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Abstract-This study aims to (1) determine an increase in collaboration and communication skills through project-based learning, (2) determine the relationship of collaboration skills and communication skills through project-based learning. The population of this research is six classes XI MIA and a sample of this research are two classes, an experiment class with project-based learning and a control class with conventional. The instrument of collaboration and communication skills are the observation sheet and questionnaire. Improved collaboration and communication skills were analyzed using normalized gain (N-gain). A collaborative relationship with communication using the correlation test. N-gain results show that project-based learning can improve student's collaboration and communication skills, each in the medium category. The relationship between collaboration and communication skills shows a positive direction, which means that the more the collaboration skills increase, the better the student's communication skills.

Keywords: Project-Based Learning, collaboration skills, communication skills

I. INTRODUCTION

The 21st century people are facing an industrial revolution 4.0 that shows the role of technology that is fast paced and automatic [1]. The existence of the industrial revolution 4.0 challenges humans to have the skills to be able to compete with the progress of the times. Collaboration and communication are skills that must be possessed in order to be able to face the industrial revolution 4.0 [1] [2] [3].

Collaboration is a skill that trains students to work together in order to find solutions to a problem [19]. Roekel defines collaboration as an effort to demonstrate the ability to work effectively and respectfully with diverse teams to achieve shared goals with shared responsibilities [18]. This research focuses on the understanding of collaboration according to Roekel (2011). Collaboration can be trained when producing a work in teaching and learning activities. The exercise will make students work together and effectively so that the expected goals can be realized [4]. These skills need to be trained so that students are able to accept differences and respect each other early and do not prioritize personal interests.

Communication is the art and process of creating and sharing ideas [20]. Roekel also defines communication as an ability to communicate clearly, articulate thoughts and ideas effectively using verbal, written, and nonverbal communication skills in various forms and contexts, listen effectively to decipher meanings, including knowledge, values, attitudes, and effectively in diverse environments including multilingual and multicultural [18].

Learning physics is part of learning science. This study adapted communication from Roekel with Spektor-levy et al to fit the learning of science [5] [18]. In fact in the field the results of students' scientific communication skills are still low. Students have a level of reading results that are still low, have not been able to retrieve information from reliable reference sources, and have not been able to display illustrations through graphics or pictures.

One learning model that can practice collaboration and communication skills is the project based learning (PjBL) model [6]. This is because the stages of learning that will occur require students to collaborate to solve problems and achieve desired goals. During the process of finding these solutions, students will also communicate, both when searching for sources, deciding on the right solution, to presenting the results of discussions that have occurred. This is also supported by the results of previous studies [7] [8] [9] [10].

II. THEORY

A. Project Based Learning (PjBL) Model

The PjBL model is a learning model that starts from project planning and development by producing a work in the form of products that can be presented and published [11]. The steps of the PjBL model in this study are based on [11] which consists of five steps, namely: (1) Finding ideas, (2) Designing projects, (3) Arranging project arrangements, (4) Implementing projects, and (5) Assess the product produced.

This model also has advantages, namely (1) increasing motivation [8], (2) increasing learning outcomes [12], (3)

increasing collaborative abilities [7], (4) improving communication skills [7], (5) increasing skills to manage learning resources [13], (6) make learning fun [14], (7) improve student ethics [13], (8) increase student creativity [15], (9) reduce the level of anxiety / fear during learning activities teaching [16], (10) improving problem solving skills [17], (11) improving resource management skills [17].

B. Collaboration Skills

Collaboration skills are an effort to demonstrate the ability to work effectively and respectfully with diverse teams to achieve shared goals with shared responsibilities.

Students who are skilled at collaborating will be able to accept differences by respecting one another and prioritizing shared interests to achieve common goals. The success of collaboration skills can be known by fulfilling the indicators created in the rubric used, while the collaboration assessment indicators are adapted from Buck Institute for Education [18]. The reason for selecting this indicator is because it provides a concise and clear breakdown and the availability of an assessment rubric.

Indicators of collaboration are: (1) taking responsibility for oneself, (2) helping groups, (3) respecting others, (4) making and following agreements, (5) organizing work, and (6) working as a whole group.

C. Communication Skills

Communication skills are as an ability to communicate clearly, articulate thoughts and ideas effectively using verbal, written, and nonverbal communication skills in various forms and contexts, listen effectively to describe meaning, including knowledge, values, attitudes, and effectively in the environment diverse including multilingual and multicultural [18]. Physics is a science learning, so the communication referred to in this study is scientific communication. Good scientific communication must be able to measure communication skills in learning science. Indicators of scientific communication skills according to [5], as in Table 1.

TABLE I. COMMUNICATION INDICATORS AND SUB-INDICATORS

Indicators of Communication	Sub Indicator (Example)
Search information	Taking information in a computer database, instructions in the library, using catalogs, interviewing experts
Read scientifically	Read scientific articles, get to know the reference books used, read research reports or news.
Listening and observing	Resources that can be used are teachers, videos, debates, demonstrations.
Write scientifically	Posts can be contained in the form of articles, reports, abstracts, scientific essays.
Presenting information	Information can be presented again in the form of schemes, graphs, tables,

Indicators of Communication	Sub Indicator (Example)
	pictures or illustrations, using multimedia, panelists, and scientific posters.

III. METHOD

This study uses one class subject with no control class. The subjects of this study were treated and observed to see improvement in collaboration and communication skills.

The population in this study were all students of class XI Science (MIA) Senior High School State 12 Medan (SMA Negeri 12 Medan) E.Y. 2019/2020, this research took place in the first semester of E.Y. 2019/2020. This research sample is a class XI Science (MIA). The research instrument used was the observation sheet and questionnaire. Data is collected based on observers' results using the rubric provided (observation sheet) and filled out by students (questionnaire sheet). Analysis of the data used respectively is the normalized gain (N-gain) to see improvements in collaboration and communication skills and correlations to see the effect of the collaboration relationship on communication.

IV. RESULT AND DISCUSSION

Data collection conducted in this study was to use an observation sheet that was observed by observers and questionnaires filled out by students.

6.1. Collaboration Results

6.1.1. Observation sheet

The average and overall improvement in the results of student collaboration observation sheet and each indicator can be seen in Table 2.

TABLE II. AVERAGE AND IMPROVEMENT OF COLLABORATION OBSERVATION SHEET RESULTS

No	Indicators of collaboration	Meetings			
		I	II	III	IV
1	taking responsibility for oneself	10	13	17	20
	N-gain	21%	36%	43%	
2	helping groups	8	11	14	18
	N-gain	19%	23%	40%	
3	respecting others	9	13	16	19
	N-gain	27%	27%	38%	
4	making and following agreements	8	12	16	19
	N-gain	25%	33%	38%	
5	organizing work	10	13	16	19
	N-gain	21%	27%	38%	
6	working as a whole group	9	14	17	20
	N-gain	33%	30%	43%	
Mean		9	13	16	19.2
N-gain		24%	29%	40%	

The data above is obtained by using the N-gain equation by comparing the average of the meeting after the previous and

then divided by the difference between the maximum number of observations with the results of the previous meeting. The maximum number of scores on this observation sheet is 24. Mathematically to obtain an N-gain of 21% on the first

$$\text{indicator is: } N - \text{gain} = \frac{13 - 10}{24 - 10} * 100\% = 21\%$$

Likewise for further results. Based on the data, the average collaboration skills in Table 2 show an increase in the collaboration skills of students who are taught using the PjBL model, where the results indicate a medium category.

6.1.2. Questionnaire

The average collaboration and improvement questionnaire overall and each indicator are categorized in Table 3.

TABLE III. AVERAGE AND IMPROVEMENT OF COLLABORATION QUESTIONNAIRE SHEET RESULTS

No	Indicators of collaboration	Pertemuan			
		I	II	III	IV
1	taking responsibility for oneself	53	75	95	115
	N-gain	25%	31%	44%	
2	helping groups	39	60	79	102
	N-gain	21%	24%	38%	
3	respecting others	45	69	90	110
	N-gain	25%	30%	40%	
4	making and following agreements	44	69	88	105
	N-gain	26%	27%	33%	
5	organizing work	54	79	99	115
	N-gain	29%	33%	39%	
6	working as a whole group	40	60	87	111
	N-gain	20%	34%	45%	
Mean		46	69	90	110
N-gain		24%	29%	40%	

Based on the average value of the questionnaire on each indicator of collaboration skills in Table 3 which shows that the results of the observation sheet are in line with the results of the questionnaire filled out by students.

6.2. Communication Skills Results

6.2.1. Observation sheet

Average and overall improvement in the results of student communication observation sheets and each indicator can be seen in Table 4.

TABLE IV. AVERAGE AND IMPROVEMENT OF COMMUNICATION OBSERVATION SHEET RESULTS

No	Communication indicator	Meetings			
		I	II	III	IV
1	Search information	5	8	11	15
	N-gain	20%	25%	44%	
2	Read scientifically	6	9	12	15
	N-gain	21%	27%	38%	
3	Listening and observing	5	9	13	16
	N-gain	27%	36%	43%	
4	Write scientifically	7	10	13	15
	N-gain	23%	30%	29%	
5	Presenting information	8	12	15	17
	N-gain				

No	Communication indicator	Meetings			
		I	II	III	IV
	N-gain	33%	38%	40%	
Mean		6	10	13	16
N-gain		25%	31%	39%	

Same with collaboration skills, this data is obtained by using the N-gain equation by comparing the average of the meeting after the previous and then divided by the difference between the maximum number of observations with the results of the previous meeting. The maximum number of scores on this observation sheet is 20. Mathematically to obtain an N-gain of 20% on the first indicator is:

$$N - \text{gain} = \frac{8 - 5}{20 - 5} * 100\% = 20\%$$

The average communication skills in Table 4 show an increase in students' communication skills taught using the PjBL model, where the results indicate a medium category.

6.2.2. Questionnaire

The overall communication and improvement questionnaire overall and each indicator are categorized in Table 5.

TABLE V. AVERAGE AND IMPROVEMENT IN COMMUNICATION QUESTIONNAIRE RESULTS

No	Communication indicator	Meetings			
		I	II	III	IV
1	Search information	45	63	77	88
	N-gain	31%	34%	41%	
2	Read scientifically	49	67	80	89
	N-gain	33%	35%	38%	
3	Listening and observing	51	69	82	92
	N-gain	34%	37%	45%	
4	Write scientifically	35	56	71	82
	N-gain	30%	31%	33%	
5	Presenting information	50	65	78	88
	N-gain	28%	33%	38%	
Mean		46	64	78	88
N-gain		31%	34%	39%	

Based on the average value of the questionnaire on each indicator of communication skills in Table 5 which shows that the results of the observation sheet are in line with the results of the questionnaire filled out by students.

6.3. Discussion

The PjBL model in this study uses the syntax of Patton (2012), which consists of five phases, namely (1) Finding ideas, (2) Designing projects, (3) Arranging project settings, (4) Implementing projects, and (5) Assessing products that generated. Learning on the topic of temperature and heat starts with the phase of finding ideas. Finding ideas means students are given a contextual problem, related to the topic of temperature and heat to be solved together. Students will be challenged to think. Scientific communication activities that occur in this phase are students communicating to retrieve information related to the topic given, both from books, the internet, and reference sources provided by the teacher. In line with communication activities, students also collaborate by

working together to get the information needed from each student so that the group has a strong basis for solving problems. The first meeting, students are not used to it and there are still many who are confused, but at the next meeting students begin to get used to reading each source, then compare and agree on ideas to be made.

The project design phase requires students to arrange work timelines, manage projects to be created, and the division of tasks of each group member where this is in line with collaborative activities. Students will collaborate to reach mutual agreement in determining the organization and division of tasks of the group. The teacher also communicates the indicators to be assessed, so students are more directed and focused on completing the task. The scientific communication activities that occur in this phase are listening and observing sources provided by the teacher, videos, and demonstrations.

The phase of constructing a project means that the student will prepare a model of the project being worked on. Respect for others will be seen in this phase, where advice is needed from group members to provide an overview of the project model to be agreed upon. Initially there was each group, there were 1-2 people who did not want to be involved, even though they knew something was wrong. Encouragement from the teacher is needed at this stage in order to maximize the workings of each group member. The teacher also emphasizes the results of this group are not for themselves, but rather a shared responsibility. Typical writing activities also occur in this phase.

The project implementation phase allows students to implement project models that have been mutually agreed upon. The teacher can observe the activities of mutual respect, complete cooperation, helping each other in groups. The project is designed to be completed at each meeting, so good collaboration and communication is needed at this phase. Several times students have difficulty at this stage, but with good cooperation the project can be completed. The first meeting there is one group that is not ready to complete the project, but the next meeting of each project can be completed properly.

The final phase in this PjBL model is assessing the product. The product is assessed through group presentations in front of the class. A good group in communicating is proven by providing clear discussion results, in accordance with the actual situation and can present illustrations through graphs, tables, or pictures. Collaborative activities such as respecting others can also occur at this stage. This is because during the discussion (questions, criticisms / suggestions) from other groups to the group presenting. Full cooperation is also demanded to occur in the group presenting.

The results of the collaboration and communication assessment on each indicator can be seen in tables 1 and 2.

Based on the table produced, communication results of each indicator showed an increase in the medium category. The results of the collaboration of each indicator also show in the

medium category. Based on the results obtained, it can be seen that student collaboration skills are comparable to student communication. This is also supported by the results of previous researchers [6] [7] [8] [9] [10] [21].

V. CONCLUSION

Based on the results and discussion of research shows that project-based learning can improve student collaboration and communication skills, each in the medium category. The relationship between collaboration and communication skills shows a positive direction, which means that the more the collaboration skills increase, the better the students' communication skills.

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