The Effect Of Project-Based Learning On Collaboration Skills Of High School Students

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Article history	Abstract
	The purpose of this study was to determine students' collaborative skills in using project-based learning at SMAN 1 Tanjung pinang. This type of research is a quasi-experimental study with a pretest-posttest group design. The sample used was class XI MIPA 2 as the experimental and class XI MIPA 3 as the control group. A simple random sampling technique selected the sample. Data collection was carried out by distributing collaboration skills rubrics to students. The data analysis technique used the Man Whitney U test because the data were not normally distributed. The results showed that the sig value of the Mann-Whitney U Test was $0.045 < 0.05$, which means that the students' collaboration skills in the experimental group were better than the control group. So it can be said that there is an influence of project-based learning models on student collaboration skills.

1. INTRODUCTION

Education is an inventory of human resources that have a strategy for survival in the face of world civilization. Education is the relationship between teachers and students who put up communication for learning and un-separated. The educational curriculum is an education component to renew the quality of education carried out by the government. The education curriculum must be comprehensive and responsive to social changes and relevant to society and technological advances.

The development of technology and information demands an education system properly. The 2013 curriculum, as the last revised curriculum from the previous curriculum, was good to implement; in the 2013 curriculum, students were expected to have collaborative skills with peers. The implementation of learning includes preliminary activities, core activities, and closing activities. The learning activities are related to learning strategies, such as choosing the suitable learning model to achieve learning objectives. The success of a learning process involved several factors; are educational management, a component related to the overall management of the

learning process closely, including various innovative learning models. According to Soliman (2017), using effective learning strategies was very important for long-term learning outcomes and good academic achievement.

Project-based learning was inseparable from the constructivist process, and the process of the investigation carried out by a person based on their perspective and thinking (Jalinus et al., 2017). Project-based learning can improve critical thinking students, especially about fluency and flexibility (Chen et al., 2019). The implementation of the project-based learning model cannot be separated from students' skills in collaborating to achieve the planning made. Collaborative activities help students find out the critical thinking skills and motivation in the learning process (Hamidah & Kusuma, 2019). Collaborative learning consisting of three to nine students in one group makes classroom conditions and learning optimally (Rau et al., 2017).

Project-based learning is a learner-centered learning model to build and apply concepts from the resulting project by independently exploring and solving real-world problems. According to Ummah et al. (2019), project-based learning is a learning model suitable for learning with specific product outputs, such as making learning media. The result in learning is a product that is the result of group work.

The steps of the project-based learning model according to Ummah et al. (2019) as follows, 1) The essential questions were given at the beginning of learning; 2) the teacher must adjust the relevant topic and learn for students, at this stage, the teacher and students collaborate each other, where the teacher provides information on what students in completing projects can use topics and tools; 3) make a schedule such as creating a timeline, deadlines, innovations; 4) asking students to provide reasons for choosing the solutions they made; 5) monitoring the progress of students, at this stage the teacher provides monitoring to students during the completion of the project by facilitating and guiding students; 6) evaluation functions to help teachers see the achievement of standards, evaluate the progress of each student, as well as provide feedback to students and assist students in developing different strategies.

The advantages of the project-based learning model by Yulianto et al. (2017) are increasing the motivation of students, increasing the ability of elementary school science literacy (Afriana et al., 2016), increasing learning creativity and critical thinking of students (Anazifa & Djukri., 2017).

Collaboration is essential in facing the 21st century today facing the 4.0 revolution; creative skills are needed to become a competent human being (Naila et al., 2019). The collaboration process is also essential because it relates to student cognitive skills (Putri et al., 2018). Collaboration skills also have a positive impact on social and as a changed behavior during the learning process.

Chemistry is a topic taught in high schools and vocational schools. Chemistry studies substances and reaction products that cannot be separated from everyday life. Among the chemical topics taught in senior high schools are buffer solutions. Based on the results of research conducted by Prasetyowati & Suyanto (2016) that the buffer solution topic is one of the class XI chemical topic considered difficult by students (40%), and based on the results of interviews they have conducted with chemistry teachers that many students do not complete (60%) in studying the buffer solution topic so remedial must be done. In line with research from Mentari et al. (2017) that students still experience misconceptions about the buffer solution material. Based on several theories that have been described, this study aims to determine the effect of project-based learning models on student collaboration skills.

2. METHOD

This research was conducted at SMA Negeri 1 Tanjungpinang from February till March 2019. The population of this study was students of class XI MIPA consist of 240 students. The sample of this study was taken by simple random sampling technique so that there were as many as 40 students from class XI MIPA 2 as the experimental group and 39 students from class XI MIPA 3

as the control group. The research of this study was quantitative in quasi-experiment, with a pretest-posttest design. The data collection used observation, test, and non-test techniques.

The observation technique was carried out by observing the needs in the learning process and knowing the characteristics of each student. The test technique is carried out by distributing LKPD to students at the end of each lesson. At the same time, the non-test technique was carried out by distributing collaboration skills rubrics at the end of each lesson. Implementation of learning begun with giving pre-test questions then continued using a project-based learning model. Students were given LKPD as learning media which contains a problem. The learning process was carried out following the stages of the project-based learning model used in each learning process.

At the end of the implementation of learning, students were given the same post-test questions to see the increase in students' learning abilities. Collaboration skills data in this study were obtained from the results of assessment sheets by peers while carrying out learning activities. This assessment sheet consists of five indicators: reminding, working on, attending, being actively involved, solving problems, listening, and investigating.

As for the research design process that has been carried out, detailed information is in Figure 1.

Groups	Pre-test	Treatment	Post-test
Experimental	O_1	X	O_2
Control	O_3	-	O_4

Figure 1. Pre-test-post-test design

Information:
O_1 = Pre-test experimental group
O_2 = Post-test experimental group
X = Application of project-based learning model
O_1 = Pre-test control group
O_2 = Post-test control group

Table 1. Criteria for Achievement of Collaboration Skills

NO	Score Range	Category
1	81.28% - 100%	Very High
2	62.52% – 81.27%	High
3	43.76% - 62.51%	Medium
4	25% - 43.75%	Low

The indicators contained in the argumentation skills rubric are described in table 2.

Table 2. Indicators Collaboration Skills of Students

No	Indicators
1	Positive interdependence
2	Interaction activity
3	Individual responsibility
4	Interpersonal relationships
5	Group member interactions

Before data collection, firstly validated the research instrument. The validation was carried out by experts consisting of three chemistry education lecturers and one high school teacher. The expert of the judgment plays a role in theoretically validating the content, the construction, and the language of the collaborative competence questionnaire. The results showed that all indicators were declared valid and adequately used. After being declared valid, the research data from the collaboration skills rubric were analyzed using Mann-Whitney U Test.

3. RESULTS AND DISCUSSION

Based on the results of observations, it was found that the chemistry teacher used the discovery learning model frequently. The students' collaboration skills were visible, but they needed to be emphasized in terms of being proven by documentation of the group work carried out. Based on the observations obtained, the research to be continued. The data that had been collected from the pre-test and post-test results were analyzed using simple regression analysis.

The acquisition of the collaboration skills of students in the form of a percentage is shown in table 3:

Table 3. Collaboration Skills of Students

Indicator	Pre-Test	Pos-Test
1	94.27	91.87
2	93.10	95.00
3	94.27	94.37
4	92.00	95.25
5	89.17	93.12
6	92.12	92.75
7	95.70	93.57
Average	92.66	93.27
Category	Very High	Very High

Based on table 3 most of collaboration skills indicator has increased. An explanation of each achievement of the criteria for collaboration skills is shown in Figure 2.
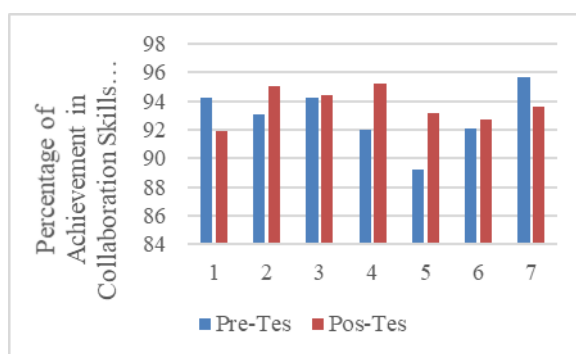

Figure 2. Graph of Percentage of Achievement in Collaboration Skills Indicator Points.

Based on table 2 and figure 2, it is known that each item indicator of students' collaboration skills has increased and also decreased. When analyzing the pre-test data for indicator one where 94.27% of students had the attitude of reminding friends if they have not done the task, then during the post-test, the attitude of reminding friends if they had not done the task decreased to 91.87%, this was due to several factors, namely students were not too ready to take part in learning and students do their busy assignments. The indicators of doing and attending group assignments have increased from 93.10% to 95.00%. Then the indicators provided opinions in the study group, were actively involved in the presentation of group results, participated in solving problems, listened to and accept other people's opinions, experienced consistency by students during the pre-test and the post-test that the improvement that occurs is not too significant. Then the indicator of participating in finding sources of information to solve the problem decreased from 95.70% to 93.57%; this was due to several factors, including students who had begun to show their respective busyness and did not show an attitude of responsibility in solving problems.

In the learning process, by applying the project-based learning model, the teacher gives assignments to students in the form of a project to produce a product, namely, mind mapping, which contains buffer solution topic where the teacher requires each group member to participate in solving the problem and each group member must write on cardboard given by the teacher. By

including the name of the participant. Students must collaborate by applying the indicator items of collaboration skills into study groups to get maximum results.

Making the product in mind mapping was found in the fifth step in the project-based learning model steps. Students were formed into 8 study groups, each group consisting of 5-6 students. Then students were asked to design the product to be made in advance. In the last meeting, students were asked to submit the resulting product in mind mapping. Some examples of product results from projects undertaken by students in mind mapping can be seen in Figure 3 and Figure 4.

Figure 3. Mind Mapping of Buffer Solution Topic..

Figure 4. Mind Mapping of Buffer Solution Topic.

Efforts to determine the effect of project-based learning on student collaboration skills can be seen in table 4.

Table 4. Mann-Whitney U Test

Test Statistics	
	results
Mann-Whitney U	577.000
Asymp. Sig. (2-tailed)	.043

Based on table 4, the significance value obtained was 0.043, more minor than the α value (0.05), which means that there was an influence from the project-based learning model on students' collaboration skills. Students are required to create projects that were carried out by collaborating with group members during the learning process. While the took place, students were asked to video the process being carried out. Each student was expected to participate during product creation. Therefore, it appeared that the project-based learning model has a good impact on the students' collaboration skills during the learning of chemical buffer solution material.

The research results obtained were corroborated by previous studies from Maghfiroh et al. (2016) and Safaruddin et al. (2020) that the project-based learning model can improve the science skills of students in the learning process. The findings also reinforce previous research that project-based learning is student-centered learning that provides a meaningful learning experience (Afriana et al., 2016) and effectively increases literacy for students (Eliana et al., 2016). Learning was implemented by project-based, students became actively involved in producing products (works). (Cörvers, 2016) and increase students' learning activities in the learning process (Rofiq et al., 2019).

4. **CONCLUSION**

Based on the research results, it was found that the student's skills in the experimental group were better than the control group. The project-based learning model has a positive influence on students who are actively involved in working on group assignments, giving opinions, being active in presenting the results obtained by the group, being actively involved in problems, and always accepting the opinions of other group members. Project-based learning positively influences students in honing their skills in doing projects to create mind maps from buffer solution topics.

ACKNOWLEDGMENT

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