THE INFLUENCE OF PROJECT BASED LEARNING MODELS ON SCIENCE TECHNOLOGY, ENGINEERING AND MATHEMATICS APPROACH TO COLLABORATIVE SKILLS AND LEARNING RESULTS OF STUDENT

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Abstract

The main problem in learning science which until now has not yet been completely solved is by the assumption in students that this lesson is difficult to understand and understand. The main factor of this reality seems to be due to the lack of connection in learning science with everyday life.The Project Based Learning model with the STEM approach (Science, Technology, Engineering, and Mathematics) is very suitable to overcome these problems because in the learning process involves students working collaboratively by combining two or more disciplines. This research is a quasi-experimental which aims to determine the effect of the Project Based Learning learning model with the STEM approach to collaborative skills and student learning outcomes. Assessment of students' collaborative skills is obtained when students work on assignments in groups with the guidelines for collaborative skills rubric. Student learning outcomes are obtained from pre-test and post-test scores.

Keywords: *STEM Approach, Project Based Learning, Learning Outcomes*

PRELIMINARY

The most important aspect in developing a country is education. Education is a process of activities that are typically carried out by humans. Education is a product of human culture. Educational activities carried out in an effort to maintain and continue human life. In addition, education is philosophically intended in the context of human development. The presence of the 2013 curriculum is an attempt by the government to develop education in Indonesia, bearing in mind the competition in the 21st century that demands competent human resources in science, technology, engineering design and mathematics so that education is expected to integrate the four disciplines (Milaturrahmah, 2017 in Utami , 2018).

The main problem in learning science which until now has not yet been completely solved is by the assumption in students that this lesson is difficult to understand and understand. The main factor of this reality seems to be due to the lack of connection in learning science with everyday life. The emphasis on understanding the basic concepts and basic understanding of science is not associated with matters relating to everyday life.The challenge of an educator is to provide an education system that creates opportunities for students to connect knowledge and skills so that they become familiar to each student. Opportunities will not be created if knowledge and skills are separated in a learning process.

One learning approach that is consistent with the 2013 curriculum is the STEM approach (Gustiani, 2017). 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 the skills to learn and innovate which includes critical thinking, creative, innovative, and able to communicate and collaborate (Winarni, 2016).

Science learning in accordance with the STEM approach can be done with the PjBL (Project Based Learning) learning model. The PjBL learning model emphasizes contextual learning through complex activities such as giving students freedom to explore, plan learning activities, carry out collaborative projects, and ultimately produce a product (Rais, 2010). Departing from these conditions, it is time for students as student learning centers in schools to be encouraged to have collaborative skills.

The process of the PjBL learning model involves students in making a product. The activity is carried out in groups, so we need a collaborative skill that encourages students to work well together. Collaborative skills have 5 aspects, namely contribution (Contributions), time management (Time management), problem solving (Working problem solving), working with

others (Working with others), and investigation techniques (Research techniques). Aspects of collaborative skills are needed so students can carry out PjBL learning activities.

The success of the STEM learning approach in improving learning outcomes has been investigated by Jauhariyyah (2017). These basics are needed new learning approaches and models in biology learning in class XI MIPA SMAN Pakusari that can affect collaborative skills and learning outcomes, namely by applying the STEM approach and Project Based Learning learning models.

METHODS

This type of research is a quasi-experimental study using two classes, one experimental class and one control class. The design of this study used a pre-test post-test control group design. This study uses two class samples, namely one class using a project based learning model with the approach of science, technology, engineering and mathematics and one control class using conventional learning with a scientific approach.

Table 1. Research design pre-test post-test control group

E	O1	X1	O2
K	O3	X2	O4

(Source: Sukardi, 2014: 66)

Information :

E : experimental class
K : control class
O1 : results *pre-test* experimental class
O2 : results *post-test* experimental class
O3 : results *pre-test* control class
O4 : results *post-test* control class
X1 :learning with the approach of Science, Technology, Engineering and Mathematics with problem based learning learning models
X2: learning withscientific approach to discovery learning models.

The learning outcomes of the cognitive domain were analyzed using analysis of covariance (anakova) with the student's initial ability (pretest) as a covariate, while the final ability was measured by the posttest results.

RESULTS AND DISCUSSION

a. Results

Sampling was taken from the study population namely class XI MIPA 1, XI MIPA 2, XI MIPA 3, XI MIPA 4 and XI MIPA 5. Determination of sampling is done using data on the value of even semester semester test (UTS). After obtaining the UTS Biology grades even semester.

Based on recommendations from biology subject teachers, 2 class samples were selected namely Class XI MIPA 1 and XI MIPA 3. Based on the data from the normality test analysis results, it can be seen that the significance level> 0.05 so that it can be concluded that the data are normally distributed. Next, the homogeneity test was performed using the Levene test to determine the level of uniformity in each class. Homogeneity test is performed to determine whether the data taken has been homogeneous or not. Based on the results of the homogeneity test the magnitude of the Levene Statistical Test is 0.446 with a significance level of 0.507. Therefore the significance level> 0.05 then H0 is accepted and H1 is rejected with the assumption that the two classes are homogeneous.

Data on the results of students' pretest and posttest values can be seen in table 3. below.

Table 2. Student Pretest and Postest Value

Class	Total students	SD average		Difference	Percentage of Increase
		Pre test	Post test		
Control	31	22.45	39.03	16.58	16.58%
Experiment	31	22	46.84	24.84	24.84%

Based on the table it can be seen that the mean of the pre-test control class is 22.45 while in the experimental class 22. Both of these averages are obtained from the average value of students' pre-test daily tests on the subject of the Reproductive System. The pre-test values obtained in the control and experimental class are not too different because based on the homogeneity test that has been carried out on the abilities possessed by the two classes are classified as the same. After being given treatment, students are given a post-test to find out the student's final learning outcomes. The post-test scores obtained between the control and experimental classes were quite different at 39.03 in the control class and for 46.84 in the experimental class. The experimental class

showed a higher increase in learning outcomes in the post-test results obtained from the initial value (pre-test) compared to the control class. The following are the results of an anakova test of student cognitive learning outcomes.

Table 3. Anakova Test Student Learning Outcomes

Tests of Between-Subjects Effects

Dependent Variable: posttest

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1061,765a	2	530,883	29,954	000	504
Intercept	7945,570	1	7945,570	448,314	,000	, 884
Pretest	357,233	1	357,233	20,156	,000	, 255
Class	735,117	1	735,117	41,478	,000	, 413
Error	1045,670	59	17,723			
Total	119253,000	62				
Corrected Total	2107,435	61				

Based on the results of the analysis using the Anakova test on cognitive learning outcomes of students shows that by using the learning model STEM-PjBL (Science, Technology, Engineering, and Mathematic-Project Based Learning) the significance level of 0,000 <0.05 with the meaning that there is an influence of learning models STEM-PjBL (Science, Technology, Engineering, and Mathematic-Project Based Learning) on student learning outcomes.

Data on the results of collaborative skills can be seen in table 4. below.

Table 4. Average Value of Students' Collaborative Skills

Class	Total students	SD average		Difference	Percentage of Increase
		Initial value	Final score		
Control	31	39.84	50.17	10,33	10.33%
Experiment	31	40.48	65.17	24.69	24.69%

Based on the Table it can be seen that the mean initial value of the control class is 39.84 while in the experimental class 40.48. Both of these averages are obtained from the average value of students' collaborative skills on the subject of the Reproductive System. The initial values obtained in the control class and experiment are not too different because based on homogeneity tests that have been carried out on the abilities possessed by the two classes are classified as the same. After being given treatment, students are re-assessed their collaborative skills to find out the final results of students' collaborative skills. The final value obtained between the control and experimental class is quite different, amounting to 50.17 in the control class and for 65.17 in the experimental class. The experimental class showed an increase in collaborative skills higher at 24.69% in the results obtained from the difference between the initial and final grades. Whereas the control class showed an increase of 10.33%.

Data analysis results of anacova test that has been done on students' collaborative skills can be seen in Table 5.

Table 5. Anakova Test of Collaborative Skills

Tests of Between-Subjects Effects

Dependent Variable: posttest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3531,626a	2	1765,813	115,213	,000	, 796
Intercept	1301,450	1	1301,450	84,915	,000	, 590
Early Value	44,126	1	44,126	2,879	,000	, 047
Class	3396,524	1	3396,524	221,612	,000	, 790
Error	904,261	59	15,326			
Total	210575,000	62				
Corrected Total	4435,887	61				

Based on Table 4.2 it can be seen that the significance level of 0,000 <0.05 so that it can be interpreted that there is an influence of the STEM-PjBL (Science, Technology, Engineering, and Mathematic-Project Based Learning) learning model on students' collaborative skills.

Effects of Learning Models STEM-PjBL (Science, Technology, Engineering, and Mathematic-Project Based Learning) on Students' Collaborative Skills

Test the analysis of the effect of STEM-PjBL (Science, Technology, Engineering, and Mathematic-Project Based Learning) learning models on students 'collaborative skills was analyzed using an anakova test by comparing the difference in the value of students' collaborative skills in the control class using conventional methods namely 10.33 with experimental class 24.69 that uses the STEM-PjBL (Science, Technology, Engineering, and Mathematic-Project Based Learning) learning model. This means that the increase in collaborative skills in the experimental class is higher than in the control class. The significance value also shows 0,000 <0.05 so that it can be interpreted that there is an influence of the STEM-PjBL (Science, Technology, Engineering, and Mathematic-Project Based Learning) learning model on students' collaborative skills. Huang (2010), collaboration skills that involve students in the dealing or agreement process to establish a decision is crucial to the success of the project.

Based on data analysis results using anacova test and research that has been done with the initial value of collaborative skills between control classes39.84 and experimentation 40.48is the same, shown in the anakova test results that the significance of the initial value of collaborative skills is 0.095> 0.05. While the final value of collaborative skills between control classes50.17and 65,17 different experiments, shown in the results of the anacova test that the significance is 0,000> 0.05. The value of the collaborative skills of the experimental class is greater than the control class, meaning that the treatment is the application of the STEM-PjBL (Science, Technology, Engineering, and Mathematic-Project Based Learning) learning model to the experimental class significantly influencing students' collaborative skills. This was supported by Saenab, et al (2019), namely the PjBL (*Project Based*Learning) shows strengths in developing student collaboration skills. Because through the complex activities of the model such as working on project assignments and practicum, students are able to mutually agree and respect each other's different opinions to find solutions and achieve the main objectives of project implementation by utilizing various sources such as the internet or from certain resource persons.

Effects of Learning Models STEM-PjBL (Science, Technology, Engineering, and Mathematic-Project Based Learning) on Student Learning Outcomes

Cognitive domain student learning outcomes are measured from the scores after the test is given. Tests are given at the time before treatment (pretest) and after given treatment (posttest). The effect of STEM-PjBL (Science, Technology, Engineering, and Mathematic-Project Based Learning) learning models on student learning outcomes can be seen from the pretest and posttest values analyzed using anacova test with data prerequisites normally distributed, so that the normality test is done first by using One-Sample Kolmogorov Smirnov.

Based on the data obtained the average pretest score of students in the control class viz 22,45, and the experimental class is 22. The average post-test value of the experimental class is higher than the control class, which is equal to 46.84 in the experimental class and 39.03 in the control class.From the difference between the pretest and posttest scores of the control and experiment classes are also different. The experimental class shows a higher difference, i.e.24.84 compared to the control class viz 16.58. That means STEM-PjBL learning model (Science, Technology, Engineering, and Mathematic-Project Based Learning) can improve student learning outcomes. This is reinforced by anakova test results in the control class and experiment show the significance of 0,000 <0.05 means that it is significantly different, so it can be interpreted that there is an influence of STEM-PjBL (Science, Technology, Engineering, and Mathematic-Project-Based Learning) learning models on student learning outcomes student cognitive. This is consistent with research conducted by Furi, et al (2018) that learning using PjBLSTEM can improve learning outcomes of cognitive aspects, which is seen from the higher N-gain value compared to using the PjBL learning model.

STEM integrated PjBL can increase student interest in learning, learning becomes

more meaningful, helps students solve problems in real life, and supports future careers. In addition, STEM in PjBL provides challenges and motivates students because it trains students to think critically, analyze and improve higher-order thinking skills (Afriana et al, 2016). Improved learning outcomes in the experimental class are more significant than the control class. This is because when the learning process takes place, the learning model in the control class seems boring, students only listen to the teacher's explanation and work on the worksheet then discuss. Unlike the experimental class that is active during the learning processSTEM-PjBL (Science, Technology, Engineering, and Mathematic-Project Based Learning) involves students as a whole playing an active role so that the level of student focus in the experimental class is higher.

This can also occur because according to Ferdiansyah (2015) that the STEM integrated learning model of STEM can significantly improve the mastery of the concept of the subjects being taught. In addition, PjBL-STEM in PjBL provides challenges and motivates students because it trains students to think critically, analyze and improve higher-order thinking skills (Capraro et al., 2013). Through PjBLSTEM learning, students have scientific and technological literacy that appears from reading, writing, observing, and doing science so that it can be used as a provision for social life and solving problems encountered in daily life related to the field of science PjBL-STEM (Mayasari et al., 2014). Other than that,

There are obstacles when learning data collection results, namely the post-test scores in the control class and experiment are still low and do not reach the KKM value of 78. This is due to the very limited research time of only 3 meetings. Another obstacle is the reduced learning time caused by the pretest and posttest. So the material presented is still lacking in detail. Material Reproductive System has sub material that is difficult and also a lot so it allows students to understand the material as a whole. Apart from these possibilities it can also be caused by external and internal factors which cannot be predicted. This is reinforced by Slameto (2010: 54) argues that learning outcomes are influenced by several factors, both internal and external factors. Internal factors such as physical factors, psychological, and fatigue. While external factors such as family, school, and community factors. These factors either separately or together give a certain effect on learning outcomes achieved by students.

CONCLUSIONS

Based on the results of research and discussion that has been described, the following conclusions are obtained:

a. The PjBL (Project Based Learning) learning model with the STEM (Science, Technology, Engineering, and Mathematic) approach influences students' collaborative skills.
b. The PjBL (Project Based Learning) learning model with the STEM (Science, Technology, Engineering, and Mathematic) approach influences student learning outcomes.

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