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Students' Critical Thinking Skills in Learning Science at Subject Structure and Function of Plant Networks using The Project-Based Learning Model in Class VIII MTs Muhammadiyah 02 Pekanbaru

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ABSTRACT

This study aimed to see how students' critical thinking skills were applied after the Project-Based Learning model was applied. This research is experimental research with Two-Group Pretest-Posttest Design. The population of this research was of 216 students. The sampling technique used was a simple random sampling technique, 36 students for the experimental class and 36 for the control class. The instrument used is a test. The hypothesis testing using a t-test found that the tcount was higher than ttable (2,399>1,688). From the results of the analysis, it was found that there were significant differences in students' critical thinking skills with the Project-Based Learning model compared to the conventional model.

Keterampilan Berpikir Kritis Siswa Dalam Pembelajaran IPA Pada Mata Pelajaran Struktur Dan Fungsi Jaringan Tumbuhan Dengan Model Pembelajaran Berbasis Proyek Di Kelas VIII MTs Muhammadiyah 02 Pekanbaru

ABSTRAK: *Penelitian ini bertujuan untuk melihat bagaimana kemampuan berpikir kritis siswa diterapkan setelah model Pembelajaran Berbasis Proyek diterapkan. Penelitian ini merupakan penelitian eksperimen dengan Two-Group Pretest-Posttest Design. Populasi penelitian ini sebanyak 216 siswa. Teknik pengambilan sampel yang digunakan adalah teknik simple random sampling, 36 siswa untuk kelas eksperimen dan 36 siswa untuk kelas kontrol. Instrumen yang digunakan adalah tes. Pengujian hipotesis dengan menggunakan uji-t diketahui bahwa thitung lebih besar dari ttabel (2,399>1,688). Dari hasil analisis diketahui bahwa terdapat perbedaan yang signifikan kemampuan berpikir kritis siswa dengan model Pembelajaran Berbasis Proyek dibandingkan dengan model konvensional.*

INTRODUCTION

Education is an effort to educate students to be better at human civilization. According to the National Education System Law Number 20 of 2003 Chapter II article 3, national education functions to develop and shape the character of the nation (Purwanto, et al, 2020);(Saputro & Rayahub, 2020). Education is a continuous process and never ends (never-ending process). This is done to provide direction for Indonesian education

Rani Safitri[1], Neng Sholihat[2], Hadi Purwanto[3]

for the future (Widya et al, 2019);(Ulil et al., 2021).

In education, the prioritizes understanding, skills, attitude, and character education (Listiagfiroh & Ellianawati, 2019);(Putri et al., 2020). The 2013 curriculum requires a future-ready generation (Rezeki et al, 2015). The 2013 curriculum has three aspects of assessment: knowledge, skills, attitudes, and behavior. Science learning is oriented toward developing strategies and problem-solving solutions in everyday life (Nugraha et al, 2017).

The curriculum development for the education unit also has a central position in developing students' abilities or skills because they are no longer teacher-centered (Rezeki et al, 2015). The relationship between the 2006 KTSP and the 2013 Curriculum are subject units, lesson hours, learning implementation, learning strategies, and assessing graduation competency standards. One of the 2006 KTSP skills is critical thinking skills. Critical thinking skills are analytical thinking that can produce different solutions (Yazar, 2015);(Suwarma & Kumano, 2019).

Critical thinking skills are indispensable in facing life's challenges (Nuryanti et al, 2018);(Rati et al., 2017b). Nugraha et al, (2017) and Ardiyanti (2016) claim that students' critical thinking skills have increased by applying the PjBL (Project-based Learning) model because science skills affect critical thinking skills, and high learning motivation affects high critical thinking skills. To achieve learning objectives, teachers must apply learning models that can foster student motivation (Ardiyanti, 2016);(Anggiani, 2020). Critical thinking skills are an important aspect of education. In Indonesia, critical thinking skills are seen to be weak from the results of PISA (Program for International Student Assessment) and TIMSS (Trens International Mathematics and Science Study) where Indonesia is ranked 40th out of 42 countries. And for PISA 2012 Indonesia is ranked 64th

out of 65 countries (Lismayani & Mahanal, 2017);(Suardana et al., 2018);(Saputri et al., 2019).

Students' low critical thinking skills can be caused by learning models that teach critical thinking skills that are not used properly in every lesson in class (Ilaah & Yonata, 2015). According to Sugiarti & Bija (2012), the quality of education can be obtained by developing students' critical thinking skills so that teachers can choose the right learning model to be applied in the teaching and learning process. The learning model that is suitable for training students' critical thinking skills is the PjBL Model (Zahroh, 2020).

PjBL (Project-Based Learning) is a learning model that needs to be applied because it is relevant to learning activities in the classroom (Suciani et al, 2018). PjBL focuses on a problem and its solution, decision-making, finding sources, and working in groups to produce the final product (Rati et al, 2017).

Based on the research results Rezeki et al, (2015), applying the PjBL model is very effective because it can increase student learning activities. The PjBL model requires students to complete a project, and students are required to understand what they produce. In addition, the PjBL learning model can also increase the sense of responsibility in students. In addition, PjBL can also support the growth of critical and responsible thinking skills because the PjBL model encourages students to be more active, initiative, independent, and think critically and analytically (Astuti, 2015). PjBL can make students more active and creative in learning, and PjBL can produce a project at the end (Erisa, 2021).

Based on the observations that have been made, it is known that students' science learning outcomes are still low. It can be seen from the results of the daily assessment of the eighth-grade students of MTs Muhammadiyah 02 Pekanbaru. A lot of students still scored below the KKM (criteria of minimum mastery) for science, 76 (39%).

Rani Safitri[1], Neng Sholihat[2], Hadi Purwanto[3]

This low score was caused by the learning process that was carried out ineffectively or inefficiently. The learning models used were also monotonous and unvarying. It is necessary to innovate in the teaching and learning process to overcome these problems. One way that can be done to improve student learning outcomes is to choose the right learning model for each subject. Science learning emphasizes providing experiences to develop and understand the natural environment (Purwanto et al, 2020).

There are several kinds of learning models that can be applied, one of which is a project-based learning model. Project-based Learning can foster a disciplined, active, and creative attitude in students (Nurfitriyanti, 2016). The Project-based Learning model has the potential to create a very large and interesting experience for students, with the final result in the form of a product (Erisa, 2021).

METHOD

This research is experimental. According to Sugiyono (2015), the experimental method can be interpreted as a desired research method to find the effect of treatment on others through controlled and controlled conditions.

The research design uses a Two-Group Pretest-Posttest Design, where the pretest (initial test) is carried out before the treatment (treatment). At the end of the learning, there is a posttest (final test) (William & Hita, 2019).

Eksperimental	O	X	O
Control	O	C	O
	Pretest	*Treatment*	*Posttest*

Figure 1. The Design of the Two-Group-Pretest-Posttest

This research was conducted for the eighth-grade students in the odd semester of the 2022/2023 academic year, located at MTs Muhammadiyah 02 Pekanbaru. The population in this study were all eight-grade classes, which consisted of 6 classes. The sampling technique used in this study was simple random sampling. The samples were taken randomly from six classes of VIII MTs Muhammadiyah 02 Pekanbaru, and two classes were taken.

The experimental and control classes' determination was based on two homogeneous daily average scores from six classes. The highest-class average value became the experimental class, while the second-highest average was the control class.

RESULTS AND DISCUSSION

This research aims to determine whether the project-based learning model significantly influences the critical thinking skills of the eighth-grade students of MTs Muhammadiyah 02 Pekanbaru in the 2022/2023 academic year. The data obtained in this study were in the form of pretest and posttest scores for the experimental and control classes.

This research was conducted in two classes, namely class VIII-3 as the experimental class and VIII-4 as the control class. Each student in the experimental and control classes who became the research sample consisted of 36 students.

1. Pretest and Posttest Results of Experiment and Control Class

The results of the calculation of the average pretest and posttest of the experimental and control classes before and after being given treatment are as follows:
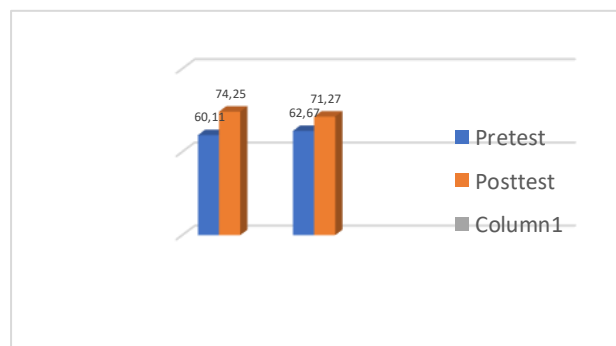

Figure 2. The Pretest and Posttest Results of the Experimental and Control Classes

Based on the research with the model described above, the results of calculating the mean or average of the control class pretest questions are higher than the experimental class. The control class got an average pretest score of 62.67 and the experimental class got an average pretest score of 60.11. The low pretest score was due to the lack of students' initial understanding of the structure and function of plant issues.

However, after the experimental class was treated with a project-based learning model, the posttest average of the experimental class was higher than the control class. The experimental class got an average posttest result of 74.25, and the control class got an average posttest score of 71.27. The posttest value of the experimental class is higher than the control class because the experimental class uses the PjBL model in which students are directed to create a project about learning materials that can make it easier for students to understand the material. This study's results align with research (Itsna, 2022), where the PjBL model based on scientific literacy has a fairly effective effect on increasing student learning outcomes at the SMP/MTs level, with an increase of 58%.

2. Data on the value of critical thinking skills of experimental class students per indicator

Of the 12 indicators proposed by Ennis, the following are the results of the analysis of the six indicators studied, namely focusing questions, analyzing questions, considering whether sources are reliable or not, observing and considering observation reports, inducing and considering results, and making and determining the results of considerations. The average value data can be seen in the following graph:
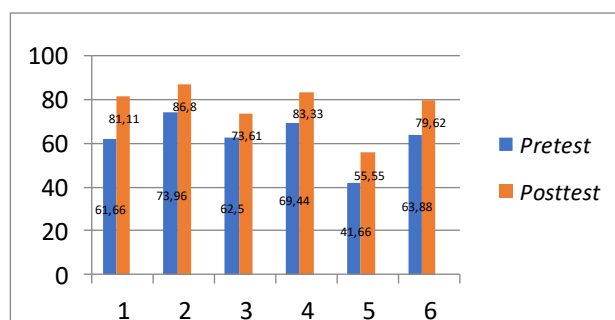

Figure 3. Students' Critical Thinking Skills Scores in the Experimental Class per Indicator

Based on Figure 2, a comparison chart of the pretest and posttest scores for the experimental and control classes per indicator, the value of focusing on the questions has an average pretest score of 61.66 and an average posttest score of 81.11. the mean value for analyzing the questions of the pretest was 73.96, and the average value of the posttest was 86.80. Considering whether the source is reliable, the mean pretest score is 62.50, and the posttest means is 73.61. Observing and considering the observation report got an average pretest score of 69.44 and the posttest score of 83.33. Induce and consider the results of the average pretest value of 41.66 and the posttest average value of 55.55. Make and determine the results by considering the average value of the pretest 63.88 and the average value of the posttest 79.62.

From the data above, it can be seen that indicator number 2, namely analyzing questions, got an average pretest score of 73.96 and a posttest of 86.80, which was the highest score. This is because students can analyze the questions and answers given by the teacher. And the lowest indicator is to induce and consider the results with an average pretest value of 41.66 and an average posttest value of 55.55.

The low result of the average value of this indicator can be caused by students' difficulty in putting forward hypotheses. In addition, students' desire/encouragement and interest in learning can also affect student learning outcomes (Nabillah & Abadi, 2019).

3. Normality Test

Table 1. Teast of Normality

	Class	Shapiro-Wilk		
		Statistics	df	Sig.
Results	Pretest Experiment Class	.973	36	.513
	Posttest Experiment Class	.949	36	.097
	Pretest Control Class	.968	36	.366
	Posttest Control Class	.958	36	.190

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Based on the table above, it can be seen that the pretest value of the experimental class is 0.513, and the posttest value of the experimental class is 0.097. The pretest value of the control class is 0.366, and the posttest value of the control class is 0.190. Based on the decision, if the value of sig is more than 0.05, then the data is normally distributed, and if the value of sig is less than 0.05, then the data is not normally distributed. Based on this decision, it can be concluded that the pretest and posttest scores of the experimental and control classes were normally distributed.

4. Normalized Gain Test (N-Gain)

Table 2. Normalized N-Gain

Information	Class	
	Experiment	Control
Gain	14.14	8.6
N-Gain	0.35 (35%)	0.23 (23%)
Criteria	Currently	Low

Based on the results of the output Gain table 4.4 above, it is known that the average Gain for the experimental class gets a value of 14.14 and N-Gain is 0.35 or 35%, and the Gain value for the control class is 8.6 and N-Gain is 0, 23 or 23%.

This shows that using the project-based learning model, the experimental class group gets an average Gain value for the experimental class, which is higher than the average Gain in the control class. The n-Gain test is used to see improvement in critical thinking skills(Zulmi et al., 2020)

5. Hypothesis Test

Based on the decision in the T-test, it is known that if the value of sig < 0.05 and the value of $t_{count} > t_{table}$, then H1 is accepted, and H0 is rejected. Based on the test results above, it is known that sig gets a value of 0.000 <0.05 and tcount gets a value of 2,399 > ttable value of 1,688. Based on these calculations, it can be seen that H1 is accepted and H0 is rejected. It can be concluded that Project-based Learning significantly influences students' critical thinking skills at MTs Muhammadiyah 02 Pekanbaru.

The results obtained in this study follow research conducted by Nurfitriyanti (2016), with the title project-based learning model of mathematical problem-solving ability. The study found that there was an effect of applying the project-based learning model on mathematical problem-solving abilities.

The same results were obtained by the research conducted (Rezeki et al., 2015)with the title of research: The application of project-based learning (PjBL) methods accompanied by concept maps to improve student achievement and learning activities in redox material for class X-3 SMA Negeri Kebakkramat in the 2013/2014 academic year. This research shows that the application of project-based learning methods accompanied by concept maps can improve student learning activities. It can be seen from the percentage of achievement of student learning activities in the first cycle of 77.78% increased to 83.33% in the second cycle.

This study's results align with research (Anggiani, 2020) who researched the effect of project-based learning on the accounting learning outcomes of class X students at YWKA Private Vocational School in Medan for the 2019/2020 school year. The study's results showed the influence of the PjBL model on student learning outcomes by 74%.

CONCLUSIONS AND SUGGESTIONS

Based on the results of research that have been carried out regarding students' critical thinking skills in science learning material on the structure and function of plant tissue using a project-based learning model in class VIII MTs Muhammadiyah 02 Pekanbaru, it can be concluded that:

1. Applying a project-based learning model on the structure and function of plant tissue in class VIII MTs Muhammadiyah 02 Pekanbaru significantly influences students' critical thinking skills. This can be proven by the value of sig getting a value of 0.000 <0.05 and tcount getting a value of 2.399 > ttable value of 1.688. This study was declared successful because H1 was accepted and H0 was rejected.
2. The improvement of students' critical thinking skills using a project-based learning model can be seen from the N-Gain value, where the experimental class gets 35% with moderate criteria. In comparison, the control class gets 23% with low criteria.

From the conclusions above, the researcher has several suggestions, namely:

1. Project-based learning models can be used to improve students' critical thinking skills.
2. Teachers can use project-based learning models as one of the variations of learning models in schools that can be used in teaching and learning

3. Further researchers who use project-based learning models can better master the syntax of this model and can be more creative in determining the projects that will be given to students so that the results obtained are more optimal.
4. Due to the limited time in compiling instruments and the instrument validation process, the researchers only validated the material without looking at indicators of critical thinking skills, so the results did not describe students' cognitive learning outcomes. For this reason, it is recommended for further researchers to further maximize the process of preparing and validating critical thinking skills instruments.

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