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The Effect Of Project Based Learning Model On Student's Learning Results In Cognitive Domain and Creative Thinking Ability On Material Of Temperature and Calorie

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Abstract

The aimed of this study were: 1) to determine the significant difference between the effect of project-based learning and direct learning model on students' result of learning in cognitive domain, and 2) to find out the significant difference between the effect of project-based learning and direct learning model on students' creative thinking ability before and after learning. Population of the study included all students of class VII at SMP Negeri 02 Rumbia. who enrolled in second semester of 2020/2021 academic year. Samples of the study were class VII.2 consisting of 25 students, as a control class, and class VII.5 consisting of 23 students as an eVIIperimental group. The result showed that: 1) there was a significant difference between the project-based learning model and the direct learning model in their effect on students' results of learning in cognitive domain; and 2) there was a significant difference between the project-based learning model and the direct learning model in their effect on students' creative thinking ability before and after learning. Thereby, project based learning had significant effect on students' result of learning in cognitive domain and creative thinking ability before and after learning of temperature and calorie.

Keywords: project based learning model, learning model, results of learning in cognitive domain, creative thinking ability.

Introduction

The project-based learning model can be viewed as a model for creating a learning environment that can encourage students to construct knowledge and skills individually through group activities. In this learning model students experience stages consisting of the stages of questioning, planning, data collection, doing projects, assessing and evaluating.

Sastrika (2013), found that the project learning model has a very significant influence on students' conceptual understanding and critical thinking skills in the teaching and learning process. Meanwhile, Yance (2013) also concluded that there was a significant influence on students' physics learning outcomes in the cognitive, affective, and psychomotor domains. Lindawati (2013), explained that implementing Physics learning through project-based learning can increase student

creativity. The use of a project-based learning approach can significantly improve the learning outcomes of students' cognitive, affective and psychomotor aspects (Gangga, 2012). Rahmawati (2011), found that the project learning model has a very significant effect on improving learning outcomes and student engagement in the teaching and learning process.

Project-based learning is a comprehensive approach to classroom teaching and learning designed to engage students in authentic problem investigation. Having a project can also illustrate how technology can support students and teachers in working on projects, so that motivation and thinking can be maintained (Phyllis C. Blumenfeld, et al, 2012)

Middle School Neg. 02 Rumbia is one of the junior high schools in Bombana Regency which has an interesting phenomenon that deserves scientific study. Preliminary studies conducted from July to November 2020 while teaching science subjects, show that the project-based learning model has not been applied in learning physics. Materials on temperature and heat that are learned to achieve basic competencies in analyzing temperature changes in objects can be taught using a project-based learning model.

Although research on project-based learning models has been conducted before, there are still differences between the results of these studies. Therefore, the authors conducted research on the effect of project-based learning models on learning outcomes in the cognitive domain and creative thinking skills of students on temperature and heat in class VII students of SMP Neg. 02 Rumbia

Literary Review

Project-based learning (PBL) is a learning model that uses problems as the first step in collecting and integrating new knowledge based on experience in real activities. PBL is designed to be used on complex problems that require lessons to be investigated and understood. The definition of PBL according to some experts, is stated as follows; 1) Thomas Mergendoller and Michaelson say PBL is a systematic teaching method that incorporates lessons into learning complex knowledge and skills, authentic questions and designing products and assignments, 2) Baron B. says PBL is a constructive way of learning approach to deepen learning by a research-based approach to problems and questions that are weighty, real and relevant to their lives (Grant 2010).

This project model is constructivist, that is, students are also multiple intelligences, because students use various intelligences in carrying out projects carried out such as logical-mathematical intelligence, visual space, kinesthetic, interpersonal, linguistics, environment and others (Yamin, 2004).

Project-based learning is based on the theory presented by several experts which are summarized as follows.

a. John Dewey

The project method comes from John Dewey's idea of the concept of "Learning by doing", namely the process of obtaining learning outcomes by carrying out certain actions according to their goals, especially the process of mastering the child about how to do a goal. John Dewey describes a view of education in which schools are supposed to reflect the larger society and the classroom is a laboratory for solving real-life problems. Dewey encourages teachers to encourage students to engage in problem-oriented projects or assignments and help them investigate intellectual and social issues (Grant, 2010).

b. Piaget, Vygotsky and Constructivism

Jean Piaget and Lee Vygotsky are figures in the development of the concept of constructivism. It is on this concept that the foundation of project-based learning is laid. Piaget suggested that students of all ages are actively involved in

acquiring information and constructing their own knowledge. Knowledge is not static but continuously grows and changes as students face new experiences that force them to build on and modify their prior knowledge. Vygotsky, like Piaget, believed that intellectual development occurs when individuals are faced with new and challenging experiences, when they try to solve problems raised by these experiences.

In an effort to gain understanding, individuals associate new knowledge. However, it is different from Piaget regarding the intellectual development of each individual regardless of social context. Vygostsky believed that social interaction with other people spurred the formation of new ideas and enriched students' intellectual development (Wrigley, 2012).

Project-based learning has five characteristics which are characteristics that can distinguish project-based learning from other learning models as follows: (a) centrality, the project as the center or center; (b) driving questions, Project-Based Learning focused on questions or problems that trigger students to solve problems with appropriate concepts, principles and knowledge; (c) constructive investigation, the project must be adapted to the abilities of the students and the projects carried out must provide new skills or knowledge for students; (d) autonomy, student activity is very important, students are decision makers and act as problem solvers; and (e) realism, student activities are focused on work that is similar to actual situations or the real world (Thomas, 2007)

According to Anderson and Krathwohl (2010) the cognitive process dimension consists of several levels, namely: 1) remembering, 2) understanding, 3) applying, 4) analyzing, 5) evaluating, and 6) creating. The cognitive process that is based on transferability which is emphasized in schools and universities is understanding. Understanding is constructing the meaning of learning material, including what is said, written, and drawn by the teacher. Students are said to understand if they can construct the meaning of learning messages, both verbal, written and graphic delivered through learning, books, and computer screens. Cognitive processes in the category of understanding include the ability to interpret, give examples, classify, summarize, conclude, compare, and explain the meaning of certain concepts.

Methodology

This research uses quasi-experimental methods and descriptive methods. The treatment given to the experimental group was in the form of implementing a project-based learning model. This research was conducted at State Middle School. 02 Rumbia in the even semester of the 2020/2021 academic year.

The population in this study were all students of class VII even semester of SMP Negeri. 02 Rumbia in the 2020/2021 Academic Year which is spread from class VII1 to class VII6 with a total of 225 students. The research sample is a class sample (cluster sampling). The class used as the experimental group was class VII.5 and the control group was class VII.3. Thus, the study sample amounted to 48 people.

The research variables consist of independent variables and dependent variables. The independent variables in question are project-based learning and direct learning. The dependent variable includes learning outcomes in the cognitive domain of students in terms of heat temperature and creative thinking skills. The instruments used to collect data consist of observation sheets on the application of project-based learning models, tests of cognitive learning outcomes, and tests of creative thinking skills.

To find out the difference between the project-based learning model and the direct learning model on learning outcomes in the cognitive domain and

students' creative thinking skills, it is analyzed using the normalized gain formula with reference to Hake (1999). Hypothesis testing uses the t-test for unpaired data with normal distribution and homogeneous variance with reference to Sudjana (2005).

Result and Discussion

Project-based learning is observed based on the observation sheet of the application of project-based learning models. The results of the observations showed that the aspects of the observations carried out at the first meeting were teacher and student activities in the starting phase with basic questions, designing project plans, and compiling schedules. The results of these observations indicate that the entire project-based learning phase has been carried out in three meetings. This is in accordance with the lesson plan that has been prepared.

Measurement of learning outcomes obtained by students in the experimental group in the control group was carried out through pretest and posttest. Pretest and posttest scores were analyzed to determine the increase in learning outcomes and creative thinking skills with normalized gain analysis.

Table 1. Description of the value of learning outcomes in the cognitive domain of students in the material Temperature and Kalor

Component	**Experiment Group**			**Control Group**		
	Pretest	*Posttest*	*Gain*	*Pretest*	*Posttest*	*Gain*
Number of Samples	23	23		25	25	
Min Value	20	48		12	72	
Maximum Value	60	84		44	40	
Average value	43,30	64,17	0,36	30,40	52,80	0,32
Standard Deviation	9,77	10,48		8,08	9,02	
Variance	95,49	109,79		65,33	81,33	

The effect of project-based learning models on learning outcomes in the cognitive domain can be seen from the differences in increased student learning outcomes in the experimental group and students in the control group. Based on the results of the pretest and posttest showed an increase in students' cognitive learning outcomes in both groups. This means that the learning outcomes in the cognitive domain of students have increased after learning activities by applying project-based learning models or without implementing project-based learning models.

The measured aspects consist of 4 indicators of creative thinking skills, namely: (a) fluency; (b) think flexibly (fleVIIibility); (c) original thinking (originality); and (d) detailed thinking (elaboration).

Table 2 Description of the value of creative thinking skills in the material Temperature and Heat

Component	**Experiment Group**			**Control Group**		
	Pretest	*Posttest*	*Gain*	*Pretest*	*Posttest*	*Gain*
Number of Samples	23	23		25	25	
Min Value	40	60		35	45	
Maximum Value	75	95		60	85	
Average value	62,83	81,74	0,49	45,40	71,20	0,47
Standard Deviation	9,51	9,37		6,28	10,34	
Variance	90,51	87,75		39,42	106,83	

The effect of the project-based learning model on the creative thinking skills of temperature and heat material can be seen from the difference in the increase in students' creative thinking skills in the experimental group with students in the control group. Based on the results of the pretest and posttest showed an increase in students' creative thinking skills in both groups. This means that students' creative thinking skills have increased after learning activities by applying project-based learning models or without implementing project-based learning models.

Data normality testing was carried out using the Kolmogorov-Smirnov (KS) statistical test. In this study used a significant level $\alpha = 0.05$. The results of the research data normality test are presented in Table 3.

Table 3 Data Normality Test using the Kolmogorov-Smirnov test

Variable	**Learning model**	**Significance**				**Decision**
		N	***Pretest***	***Posttest***	**Nilai α**	
Learning Outcomes in the Cognitive Domain	Project Based	23	0,39	0,46	0,05	Normal
	Direct	25	0,07	0,47	0,05	Normal
Creative Thinking Skills	Project Based	23	0,16	0,17	0,05	Normal
	Direct	25	0,24	0,13	0,05	Normal

The probability value for the learning outcomes variable in the cognitive domain and creative thinking skills taught using project-based learning models and direct learning has a value greater than alpha (α) 0.05. Thus it can be said that the data used in this study are normally distributed.

Testing the homogeneity of the data was carried out using the Levene test. The summary of the results of the data homogeneity test is presented in Table 4.

Table 4. Data homogeneity test results using the Levene test

Variable	**aspect**	**Significan**		**Decision**
		Probabilitas	**Alpha (α)**	
Learning Outcomes in the Cognitive Domain	*Pretest*	0,20	0,05	Homogen
	Posttest	0,58	0,05	Homogen
Creative Thinking Skills	*Pretest*	0,79	0,05	Homogen
	Posttest	0,62	0,05	Homogen

The probability value for learning outcomes in the cognitive domain and creative thinking skills has a value greater than alpha (α) 0.05. Thus it can be said that the data used in this study are homogeneous data.

After the normality test and homogeneity test are fulfilled, the hypothesis testing is carried out. The results of the t-test analysis regarding the differences in pretest and posttest learning outcomes in the cognitive domain taught using the project-based learning model and the direct learning model are presented in Table 5.

Table 5. The results of the hypothesis test on cognitive learning outcomes

Variable	Learning model	Significance	
		Probabilitaty	Alpha (α)
Learning Outcomes in the Cognitive Domain Variable	Project Based	0,378	0,05
	Direct	0,032	0,05

The pretest and posttest probability values for learning outcomes in the cognitive domain that were taught using the project-based learning model were 0.378 and those that were taught using the direct learning model were 0.032. Because the probability value is greater than alpha (α) 0.05, it can be said that there are differences in pretest and posttest learning outcomes in the cognitive domain taught using project-based learning models and direct learning.

Table 6. Results of the hypothesis test for creative thinking skills

Variable	Learning model	Significance	
		Probabilitaty	Alpha (α)
Creative Thinking Skills	Project Based	0,549	0,05
	Direct	0,848	0,05

The probability value for creative thinking skills taught using a project-based learning model is 0.549 and those taught using a direct learning model is 0.848. Because the probability value is greater than alpha (α) 0.05, it can be said that there are differences in the pretest and posttest results of creative thinking skills taught using the project-based learning model and the direct learning model.

Conclusion

The conclusions from this study are: 1) there is a significant difference between the project-based learning model and the direct learning model on the learning outcomes of students' cognitive domains, and 2) there is a significant difference between the project-based learning model and the direct learning model on the participants' creative thinking skills educate.

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