Tadris: Jurnal Keguruan dan Ilmu Tarbiyah 3 (1): 47-53 (2018)
DOI: 10.24042/tadris.v3i1.2535

TADRIS: JURNAL KEGURUAN DAN ILMU TARBIYAH
(Tadris: Journal of Education and Teacher Training)
P-ISSN: 2301-7562 | E-ISSN: 2579-7964
ejournal.radenintan.ac.id/index.php/tadris/index

Project Based Learning (PjBL) Model on the Mathematical Representation Ability

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Article History:
Received: March 24th, 2018
Revised: April 24th, 2018
Accepted: May 30th, 2018
Published: June 29th, 2018

Keywords:
Conventional model,
Mathematical representation ability,
Project Based Learning (PjBL).

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Abstract: This study aims to determine the comparison of students 'mathematical representation ability through the Project Based Learning (PjBL) Model and the students' mathematical representation ability through the conventional model. The PjBL model is a student-centered, innovative, project-based learning model and positioned teachers as effective facilitators in the contextual learning related to real life situation. This research employed quasi-experimental design. The research applied the posttest only non-equivalent control group design through randomized cluster sampling. The data collection technique used was tested. The instrument used to collect the data was the essay test. Data analysis was conducted using independent sample t-test. The result of the data calculation through the Independent-Sample T-Test test obtained the significance level of 0.913 means that the students' mathematical representation ability was better after the learning through Project Based Learning (PjBL) model was conducted compared to the students' mathematical representation ability through a conventional model. This means that the PjBL model is more influential on students' mathematical representation ability.

INTRODUCTION

Mathematics is a branch of science that plays an important role in education (Supriyani, Mastur, & Sugiman, 2015). Mathematics as a tool to develop students' thinking ability is important to bring impacts or change for students in the learning process (Mujib & Mardiyah, 2017; Oktaria, Marini, Akhmad Khairil Alam, 2016; Syazali, 2015). One of the mathematical thinking abilities that must be owned by students is the mathematical representation ability (Armadan, Somakin, 2017; Hanifah, 2015). The representation ability is a mathematical ability to disclose mathematical ideas that refers to the configuration of characters, drawings or diagrams, real-life situations, spoken language, and written symbols which serve as a tool for finding solutions from the interpretation of students' thinking to the existence of a problem (Fardillah, 2017; Jitendra, Asha K., 2016b; Marwan, Sulastri, 2017; Syafri, 2017; Yusnita, Irda, R.Masykur, 2016). One of the factors influencing students' mathematical representation is the innovation in the learning model (Astuti, 2017). The learning model that can be selected is the Project Based Learning (PjBL) Model.

The PjBL model is a student-centered, innovative, project-based learning model and positioned teachers as

effective facilitators in the contextual learning related to real life situation (Aydin, Elif, 2015; Khan, Zeashan H, 2017; Kokotsaki, Dimitra, Victoria Menzies, 2016; Lestari, D.P, Ach. Fatchan, 2016). Previous research has been conducted regarding the use of PjBL as learning model, among others: PjBL influences; mathematical communication skills, critical-thinking skills, learning outcomes, process skills, problem-solving, creative thinking, and understanding of concepts (Ambarwati, R., Dwijanto, 2015; Duke, Halvorsen, & Strachan, 2016; Fernandes, 2016; LeBoeful, Richard L, 2018; Lestari, D.P, Ach. Fatchan, 2016; Muslim, 2017; Noviyana, 2017; Tobias, Evan S., Mark Robin Campbell, 2015; Wulandari, 2016).

Based on pre-existing research, this research also applied the same PjBL model. Based on pre-existing research, this research also applied the same PjBL model. The novelty of this research compared to the previous one is the objective which is to compare the ability of mathematical representation through the Project Based Learning (PjBL) model and the ability of mathematical representation through a conventional model.

METHOD

The research method applied was experimental research. The type of research used was quasi-experimental design. The research design used was posttest only, non-equivalent control group design. The sample was taken using cluster random sampling technique. The data collection used was tested. The instrument used for data collection was essayed test. The hypothetical test was done using independent sample t-test. The procedure of the study is presented in Table 1.

Table 1. Study Design

Class	Treatment	Ability	Analysis
X_1	O_1	Y_1	Y_1 vs Y_2
X_2	O_2	Y_2	

Description:
X_1: Experimental group
X_2: Control Group
O_1: Treatment using PjBL
O_2: Treatment using conventional model
Y_1: Experimental group's mathematical representation ability through the Project-Based Learning model
Y_2: Control group's mathematical representation ability through conventional model

RESULT AND DISCUSSION

The results of the test on mathematical representation ability through Project Based Learning (PjBL) model and Conventional model are presented in Table 2.

Table 2. Descriptive Data on Mathematical Representation Ability

Representation Ability	Mean	Median	Variance	Std. Deviation	Min	Max	Range
PjBL Model	61.8750	60.0000	88.306	9.39715	45.00	85.00	40.00
Conventional Model	62.1429	65.0000	87.831	9.37180	40.00	75.00	35.00

Table 2 shows the descriptive data of experimental and control classes. Descriptive data contain the value of the mean, median, variance, std. Deviation, minimum, maximum, and range. The mean of PjBL model was 61.8750 while the mean of the conventional model was 62.1429. The median of PjBL model was 60.0000 while the conventional model was 65.0000. The score of the variance of the PjBL model was 88.306 while the Conventional model was 87.831. The std. Deviation of PjBl model was 9.39715 while the conventional models were 9.37180. The minimum score of PjBL model was 45.00 while the conventional

model was 40.00. The maximum score of the PjBL model was 85.00 while the conventional model was 75.00. The range on the PjBL model was 40.00 and the conventional model was 35.00. Based on the descriptive data above, the score of variance, std. Deviation, minimum maximum, and range of PjBL model are greater than the Conventional model. While on the mean and median score of Conventional model is greater than the PjBL model.

Before performing the parametric test, the assumption test was done, namely: normality and homogeneity tests. Normality test was to find out whether the data were normally distributed or not and homogeneity test was to determine the variance of two data distribution. The results of the normality test data can be seen in Table 3.

Table 3. Normality Test Results on the Mathematical Representation Ability

Model	Kolmogorov-Smirnov		
	Statistic	Sig	Conclusion
PjBL	0.142	0.102	Normal
Conventional	0.160	0.066	Normal

Table 3 shows the results of the normality test of the mathematical representation ability on the PjBL and Conventional model with the level of significance $\alpha = 0.05$. The output of the normality test on the PjBL model using the Kolmogorov-Smirnov Statistic was 0.142 and *Asymp. Sig* was 0.102. While the Conventional model, the obtained Statistic was 0.160 and *Asymp. Sig 0.066*. With the tested hypothesis:

H_0 : Normally distributed data
H_1 : Data not normally distributed

Data distribution is said to be normal if the value of *Asymp. Sig* > α, then H_0 is accepted. The probability output of the Kolmogorov-Smirnov for the PjBL model was 0.102 and the Conventional model was 0.066, whereas $\alpha = 0.05$. The value of PjBL model was *Asymp. Sig* > $\alpha = 0.102 > 0.05$ and on the conventional model was Asymp. *Sig* > $\alpha = 0.066 > 0.05$. This means that the data was normally distributed.

After it was known that the data were normally distributed, the homogeneity assumption test was done to determine the homogeneity of the two data. The variance of two data is said to be homogeneous if *Asymp. Sig* > α, then H_0 is accepted. With the hypothesis tested are:

H_0 : Data distribution is homogeneous
H_1 : Data distribution is not homogeneous

The homogeneity test of the mathematical representation ability through PjBL model and Conventional model with the significance level of $\alpha = 0.05$, based on the descriptive data it was obtained the *sig = 0.959*. *Asymp. Sig* > $\alpha = 0.959 > 0.05$. This means that the data was homogeneous. Based on the result of normality and homogeneity tests it was known that the data were normally distributed and homogeneous.

The condition for parametric statistic test in the form of Independent Sample T-test was fulfilled based on the result of normality and homogeneity. The test was performed to test the hypothesis that compares the mathematical representation ability representation ability through PjBL model and Conventional model. The comparison of the samples was independent based on the descriptive data in the Independent-Sample T-test. With the hypothesis being tested:

$H_0 : \mu_1 \leq \mu_2$
$H_1 : \mu_1 > \mu_2$
μ_1 : The mathematical representation ability through PjBl Model
μ_2: The mathematical representation ability through conventional Model

The hypothetical test using Independent-Sample T-test was

conducted with the level of significance of $\alpha = 0.05$, as can be seen in Table 4.

Table 4. Test Result of t-test on Mathematical Representation Ability

	Levene's Test for Equality of Variances		T-test for Equality of Means	
Mathematical Representation Ability of PjBL and Conventional Model	F	Sig	*t*	Sig. (2-tailed)
	0.003	0.959	-110	0.913
			-110	0.913

Table 4 shows the result of independent sample T-test on the mathematical representation ability through PjBL model and the conventional model. The significance level obtained was 0.913 > 0.05. This means that the average mathematical representation ability through PjBL model is better than the mathematical representation ability through the conventional model, so it can be concluded that the PjBL model has more influence on students' mathematical representation ability.

Lesh, Landau, and Hamilton find that there are five forms of representation used to understand mathematics namely (a). Real life experience, (b). Manipulative model, (c). Drawings or diagrams, (d). Uttering words, and (e). Written symbol (Miftah, Ramdani, 2016). The mathematical representation ability refers to the configuration of characters, images or diagrams, real-life situations, spoken language, and written symbols that require interpretation of students' thinking to find a solution to the existence of a problem (Jitendra, Asha K., 2016a). The ability of mathematical representation is needed to present various ideas or mathematical ideas received by the students (Hernawati, 2016).

In addition to the abstract mathematical concepts, objects in mathematics are objects that can only be accessed through their representation and mathematical thinking that requires the use of various representations (Widiati, 2015). The statement indicates that learning mathematics requires the ability to interpret and construct a representational ability. It proves that there is an influence of PjBL model on students' mathematical representation ability.

The PjBL model is a student-centered learning model and integrated with real-world problems, where students are active while teachers are only a facilitator in learning (Duke et al., 2016; Tobias, Evan S., Mark Robin Campbell, 2015). The average student's mathematical representation ability is dependent on the applied learning model. Each stage of learning process requires the existence of a learning model that is able to encourage students to develop thinking processes in an effort to improve student ideas. This is not solely the teacher's role in monitoring and assessing student participation, so the teacher must choose the right learning model (Yusnita, Irda, R.Masykur, 2016).

The activity of the steps of the PjBL model can provide stimulus to students to improve positive attitudes in learning so that it can affect the students' mathematical representation ability (Pratama, Hendrik, 2016). The learning process of Project Based Learning (PjBL) Model is generally expressed by The Ministry of Education are as follows: (1) determining the project, (2) designing steps to complete the project, (3) preparing the implementation schedule, (4) completing the project with the facilitation and monitoring from the the teachers, (5) preparing the reports and presentation/publication of project outcomes, and (6) evaluating the project's processes and outcomes (Ambarwati, R., Dwijanto, 2015).

Unlike the Conventional model which is still often used by teachers in teaching and learning process. The conventional model is a model that is always used by the teacher, but its use it depends on the teacher's ability in giving explanations which are not easy acquired by all teachers (Mardianto, 2014). Basically, every model is not better than the other, because each model has its own advantages and disadvantages. However, the model that is closely related with mathematical representation ability is PjBL. This model gives more influence. An equivalent or similar learning model with PjBL is more effective than the application of conventional learning methods (Imawan, 2015). Despite the facts in the field that there are still many teachers who apply the conventional model (Yuniawatika, 2016).

Based on the theory, in line with the results of the data analysis of the research, the students' mathematical representation ability through Project Based Learning (PjBL) model is better than the students' mathematical representation ability through the conventional model. This means that the PjBL model is more influential on students' mathematical representation ability.

CONCLUSION

Based on the results of data analysis and processing supported by the theoretical basis and referring to the objectives of the study, it can be concluded that: the students' mathematical representation ability through Project Based Learning (PjBL) is better than the student's mathematical representation ability through the Conventional model. This means that the PjBL model is more influential on students' mathematical representation ability.

Based on the conclusion, there are some suggestions proposed by the researcher, namely: further research can be focused on another learning model that has more influence on students' mathematical representation ability and also to use the same model or other learning models focused on the students' other effective ability. Hopefully, this research can be useful and become a source of reference for further research.

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