

Differences in Mathematical Understanding between Brain-based and Montessori Learning Viewed From Self-Regulated Learning

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Abstract

This study aims to know: (1) the difference in students' mathematical understanding (SMU) between Brain Based Learning (BBL) and Montessori learning; (2) the difference in students' Self-Regulated Learning (SRL) between Brain Based Learning (BBL) and Montessori learning; and (3) the difference in SMU between BBL and Montessori learning in each category of SRL. This quasi-experimental research applies a quantitative approach with a posttest only control group design. The selection of research samples was carried out using purpose sampling. The results of this study are: (1) there is no difference in understanding of mathematics between students who are taught with the BBL model or with the Montessori method; (2) there are no differences in SRL between learning classes; (3) there is no significant difference in SRL between categories in BBL and Montessori classes.

Keyword: Brain-based learning, Mathematical understanding, Montessori, Self-regulated learning.

1 INTRODUCTION

Education is a process that is needed by each individual to obtain balance and improve the quality of individuals and society. Education plays an important role in improving the quality of human resources. This confirms that education has the ability to improve personality, develop skills, target students and expand knowledge and skills that apply to life. The activities that take place in the educational process cannot be separated from mathematics as a basic science which is the basis for the development of other sciences. Mathematics learning will help students form a high level of understanding as well as the ability to think critically and logically in knowledge (Fallo, Son, & Maifa, 2022). However, in fact, mathematics learning that takes place only focuses on memorizing formulas so that students tend to have difficulty in dealing with problem solving problems.

SMU is a basic ability that students should have in the learning process (Hikmah, Rezeki, & Tama, 2023). Students who have SRL will be trained to understand a problem. In the process of increasing SMU, educators play an important role in understanding and explaining the material that has been taught.

The knowledge provided by educators to students is conveyed through real experience and involves students in forming their own understanding. However, in reality, the implementation of this paradigm still experiences various obstacles and problems which then have an impact on the low quality of education itself. Based on the results of the 2018 Program for International Student Assessment (PISA) for the mathematics category, Indonesia is ranked 73rd out of 79 countries with an average score of 379 with an OECD average score of 487 (Tohir, 2019). There are factors that influence the achievement of this ranking, such as: the high enthusiasm of teachers in Indonesia, however, some educators still do not understand the needs of each student (Kemendikbud, 2019). Learning activities in class students tend to listen and educators

play a dominant role, learning only focuses on values which should be oriented towards steps in SMU, the learning method used by teachers is the conventional method with lectures so that it provides less experience for students in constructing knowledge. owned (Mufidah & Luk, 2014).

Learning has an impact on students' development in the cognitive, psychomotor and affective aspects of the learning process. Fun learning activities because there is collaboration between students can increase the self-regulated learning of students and trigger students' understanding of mathematics in learning. However, based on the results of observations carried out at Al-Husna High School, Tangerang City, the learning model applied by educators is still a teacher center or only an educator as an information center in the ongoing learning process. This is also reviewed based on the results of students' national exams in the indicator of understanding of mathematics subjects in algebra material in 2018 achieved an average score of 55.97% while in 2019 achieved an average score of 56.21% (Kemdikbud, 2019).

Learning prepared by educators also influences the success of the learning process. Learning is a procedure focused on achieving goals. Sulha (2020) stated that the Montessori method is a learning method that is able to strengthen students' interactions with the environment as a learning resource.

The aims of the study were to know: 1) the difference in SMU between BBL and Montessori learning, 2) the difference in SRL between BBL and Montessori learning, and 3) the difference in SMU between BBL and Montessori learning in each category of SRL (high, medium, low).

2 RESEARCH METHODS

This research was conducted on grade X students of SMA Al Husna Kota Tangerang. The sample used in this study amounted to 41 students, namely class X science which amounted to 2 students and class X social studies which amounted to 19 students. This research method is quantitative research with the research design used is Quasi Experimental Design. This form involves two groups, the BBL group and the Montessori group. This design does not begin with a pretest. To determine the effect of the two groups simply by being given different treatments, both groups were given posttests. Posttest results are used to find out which one is more effective.

Table 1. Reaserch Design			
Learning model group	Self-regulated learning category		
	High	Medium	Low
BBL (A)	A ₁ B ₁	A ₁ B ₂	A ₁ B ₃
Montessori (B)	A ₂ B ₁	A ₂ B ₂	A ₂ B ₃

Table 1 shows that the two groups were given the same test questions, the treatment given was different. The sampling technique used in this study is purpose sampling. In this study, researchers first made a test instrument in the form of 7 essay questions. The questions are then tested instruments to meet the requirements of a good test to be used as questions for research. The test requirements for good test questions are: validity test, reliability test. And make a test instrument with 30 statements then the statement is carried out instrument trials to meet the requirements of a good scale to be subsequently used as a questionnaire for research. The requirements for a good questionnaire test are: s validity test and reliability test.

After instrument trials are carried out to determine sufficient and good test questions and questionnaires, it is continued with a data analysis pre-incision test, namely a normality test to prove that the sample comes from a normally distributed population. The normality test used is a normality test with the Liilliefors method. After conducting the normality test, then perform a homogeneity test. The homogeneity test is used to

determine the similarity in each class or group. After the research data is known to be normally distributed and homogeneous, then a hypothesis test is carried out. The hypothesis used is Wallis's Kruskal test.

3 RESULT AND DISCUSSION

In the data on students' self-regulated learning between classes, learning is grouped into 3 categories, namely, high, medium, and low SRL groups. Students can fall into the high category if they get a score of more than 64, students who get a score of less than 64 and more than 54 fall into the medium category and, students who get a score of less than 54 will fall into the low category, the data will be presented in Table 2.

Table 2. Descriptive statistics

SRL Category	Learning Model group	N	Mean	S	S ²	X _{max}	X _{min}
High	BBL	8	70.5	4,78	22.86	79	65
	Montessori	7	71.1	4.3	18.29	79	65
Medium	BBL	6	58,5	2.95	8.7	62	54
	Montessori	7	58	8.49	72	63	54
Low	BBL	5	45.1	6.07	36.8	52	38
	Montessori	8	48	5.2	27.14	52	40

Based on Table 2, it can be seen that the average SRL of high category students in the BBL class is higher than the Montessori class, the average SRL of medium category students in the BBL class is higher than the Montessori class, while the average SRL of the low category in the Montessori class is higher than the BBL class students, then followed by calculating the normality of SRL data, The data obtained are presented in Table 3.

Table 3. Normality Test based on SRL Category

Learning Group	SRL Category	N	L ₀	L _{table}	Data distribution
BBL		19	0.077	0.195	Normal
	H	8	0.267	0.285	Normal
	M	6	0.133	0.319	Normal
	L	5	0.279	0.337	Normal
Montessori		22	0.088	0.173	Normal
	H	7	0.402	0.300	Unnormal
	M	7	0.281	0.300	Normal
	L	8	0.221	0.285	Normal

In Table 3, there are 7 groups with normal distribution and 1 group of independence groups with unnormal distribution were obtained, namely the high SRL group in the Montessori class. The normally distributed data is continued by conducting a homogeneity test which will be presented in Table 4.

Table 4. Homogeneity Test Summary

SRL category	K	F _{count}	F _{table}	Conclusion
Between learning group	2	1.174	2.112	Homogeneous
High	2			Unnormal of distribution data
Medium	2	8.28	2.151	Unhomogeneous
Low	2	1.36	2.112	Homogenous

Based on Table 4, the moderate self-reliance group does not come from an inhomogeneous population.

3.1 Mathematical Understanding

In the mathematical understanding data, students obtained on average in the BBL class better than the Montessori class, students with high SRL in the Montessori class have a better understanding than students with high SRL in the BBL class, and students with medium and low SRL in the BBL class have a better understanding of mathematics than students in the Montessori class, The data are presented in Table 5.

Table 5. Statistics Mathematical Comprehension test results

Group	N	Mean	S	S ²	X _{max}	X _{min}
BBL	19	65.2	20.4	417.064	100	25
Montessori	22	58	25.69	659.905	88	13
BBL						
High	8	65.5	18.64	347.43	100	38
Medium	6	72.5	21.04	442.8	94	25
Low	5	63.6	18.62	346.8	81	25
Montessori						
High	7	74.5	14.97	224	88	38
Medium	7	58.5	21.91	480	88	13
Low	8	61.3	17.53	307.2	88	25

Based on Table 5, the average achievement of mathematical understanding of students in the BBL class is higher than students in the Montessori class, while the average achievement of mathematical understanding based on the SRL category is obtained the average achievement of mathematical understanding with high SRL in the Montessori class is higher than students in the BBL class, and the average achievement of mathematical understanding of students with medium and low SRL in the BBL class is higher than the participants Educate in a Montessori classroom.

In the normality test, mathematical understanding is obtained in the Montessori class is not normally distributed so that it is not continued with the calculation of the homogeneity test, the data is presented in Table 6.

Table 6. Learning Model Normality Test Summary

Group	N	L _{count}	L _{table}	Conclusion
BBL	19	0.0809	0.195	Normal
Montessori	22	0.2117	0.173	Unnormal

Because there are unnormal data distribution, this study conducted a hypothesis test with the Kruskal Wallis test whose results are presented in Table 7.

Table 7. Kruskal Wallis test

Data	Group	df	Z	χ^2	Sig.	Different?
SRL	BBL vs Montessori		-0.668		0.504	Not
SMU	BBL vs Montessori		-0.687		0.492	Not
SMU	in SRL Category (BBL vs Montessori)	5		35.805	0.000	Yes

Based on Table 7, Z value for SRL data of -0.668 with a significance of 0.504 was obtained which showed no difference between students in BBL and Montessori classes, a Z value for comprehension data of -0.687 with a significance of 0.492 which showed that there was no difference in SMU in BBL and Montessori classes, and for comprehension data reviewed from SRL, chi-square values were obtained of 35.805 with a significance of 0.000 which shows that there are differences in SMU in BBL and Montessori classes.

3.2 Findings of the research

Based on the results of data analysis, it shows that the average score of mathematical understanding in the BBL class is 65.2 and the average understanding of mathematics in the Montessori class is 58, the average understanding of mathematics of medium SRL is 72.5, and the average understanding of mathematics SRL is low of 63.5, while the average understanding of mathematics in the Montessori class is 58, with an average understanding of mathematics of high SRL of 74.5, The average mathematical understanding of moderate SRL is 58.5, and the average mathematical understanding of SRL is low at 61.3. In accordance with the results of the calculation of the Kruskal Wallis test and significant $\alpha=0.05$ obtained by 35.805 with a significance of 0.000 which shows that there are differences in SMU in BBL and Montessori classes.

This occurs allegedly caused by. some outside variables that influence dominantly. This study did not have results like previous studies conducted by: (1) Putri, Munzir, and Abidin (2019) reported that the application of the BBL model there was a significant difference between the experimental class and the control class. (2) Nurfadilah and Hakim (2019) said that students who are used to independent learning when facing problems tend to be calm when doing questions because they have high self-confidence so they are not easily influenced by other people's opinions. (3) Sulha (2020) said the success of the Montessori method depends on parental support, so it is very important to educate parents to support student learning activities.

4 CONCLUSION

Based on the results of the study and referring to the formulation of the problem, the conclusions drawn in this study are: (a) there is no difference in SMU between BBL and Montessori classes; (b) there is no difference in SRL between BBL and Montessori learning group; (c) students with high SRL in Montessori classes have a higher average achievement of understanding than students with high SRL in BBL classes, students with moderate SRL in BBL classes have a higher average achievement of mathematical understanding than students with moderate SRL in Montessori classes, and students with low SRL in BBL classes have a higher average achievement of understanding than students with low SRL in Montessori classes; (d) there are differences in students' understanding of mathematics between BBL and Montessori classes in terms of student SRL.

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