Effects of Brain-Based Learning on Students' Understanding of Newton's Law Concept

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Effects of Brain-Based Learning on Students' Understanding of Newton's Law Concept

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ABSTRACT
This research aims to determine the effect of brain-based learning on grade ten students' understanding of Newton's law concept. The research method used was the pre-post test experimental design. The research was conducted in the 2019/2020 academic year in one state senior high school in Palembang. Data collected using the Force Concept Inventory (FCI). The research result reveals that there was a significant difference in students' understanding before and after the insturction.

Keywords: *Brain-based learning, concept understanding, Newton's Law.*

1. INTRODUCTION

Physics is a branch of natural science (IPA) that studies natural phenomena related to activities in everyday life. Therefore physics is a science that has an important role in the effort to master science and technology. So that students in schools are expected to be able to study physics well. Based on the facts in the field, many students rely on memorizing formulas in working on physics problems without understanding the meaning and concepts of the formula. This can lead to low student learning outcomes. One possibility that occurs is how to teach teachers that do not involve students in learning. So that students only receive information from the teacher and can only remember what he said.

The learning method which tends to be monotonous which is less involves students in finding a concept and does not provide opportunities for them to propose ideas, creates ignorance of students about the concepts of physics obtained. So that a change is needed in the process of teaching and learning activities from passive students to student-centered learning. Therefore, in order to realize more effective physics learning, students must be more active in processing knowledge by understanding concepts independently.

Physics learning can be said to be successful if students are active and involved in the learning process. Students active in the learning process can build their own knowledge so that they can gain a deep understanding, direct students to carry out scientific activities and be able to find and understand physics concepts. A way that can be done to improve student learning outcomes requires improvements in the application of learning methods. However, in an meffort to move away from conventional teaching methods and to identify pedagogical strategies suitable for teaching physics so as to improve conceptual understanding in students, there are many conceptual patterns and method (learner-centered approaches) such as cooperative learning method, problem-based learning, guided inquiry, brain-based learning, and other learner-centered learning method. The teacher has the responsibility to organize, direct, and create an atmosphere that encourages students to carry out various activities in the learning process.

The brain-based learning (BBL) method is a way to optimally empower students' brain potential (Kumala, 2016). By balancing the use of students' right brain and left brain. The use of this learning method can develop students' brain abilities and optimize their potential. In addition, the use of this brain-based learning method tends to be student-centered where learning more will make students active and learning will be meaningful because students discover the concept of the material being studied by themselves (Sholihat, et al, 2017). Al-Balushi & Al-Balushi (2018) found that brain-based learning had a more lasting impact on student retention than conventional teaching techniques. Based on these findings, physics teachers can use a brain-based learning method that has just been developed in the classroom (Saleh & Subramaniam, 2018).

The human brain consists of two parts, namely the right brain and left brain. Although physics subjects are dominant in the left brain, to make students creative and communicative requires maximum right brain work. Teachers who teach physics subjects often only convey something that only reaches the students' left brain, so that students only know and understand but have a little difficulty in the field of practice. Even though the right brain is a source of creativity, so it is unfortunate if the teacher never involves it in the learning process. A person who uses the two hemispheres of the brain which tends to be balanced will be able to maximize the potential of their brain. So, this is where brain-based learning is needed as a prerequisite that can empower both hemispheres (Faidi, 2013).

2. METHOD

The research method used in this research is mixed methods. The combination research method used is the concurrent embedded model (a mixture of reinforcement/second method strengthens the first method). Quantitative methods are the main data and qualitative methods are reinforcing/supporting methods. The main data were taken from the results of student tests, namely tests before being treated and after being given treatment. Supporting data is taken from the results of observations of student activities during the learning process carried out by the observer. The design of this research is experimental. Only one class of experimental research was used as the research sample. Students are given a pre-test to determine the initial state before being given treatment then given a post-test to determine the final state after being treated with a brain-based learning method to determine the learning outcomes of students.

Understanding the concepts measured in this study on the cognitive aspects by giving tests (pre-test and post-test). The research instrument in the form of multiple-choice test questions for the Force Concept Inventory compiled by Hestenes et al. (1992) was revised by Hallouni et al (1995) and translated by Syuhendri (2012). After obtaining the pre-test and post-test data, a prerequisite test was carried out, namely the normality test and the homogeneity test. Furthermore, the dependent t test is carried out to determine If the results of statistical analysis show that the post-test is greater than the pre-test, then there is an effect of the brain-based learning on students' conceptual understanding.

3. RESULT AND DISCUSSION

3.1 Results

3.1. Description of Learning Implementation

Concept understanding is seen from student learning outcomes through the learning process using a brain-based learning. This research was conducted in 5 meetings, the first meeting was conducted a pretest, Three times the learning process was treated with a brain based learning and the last was a posttest. Learning at school with an allocation of 3 x 45 minutes in one week, is carried out three times the learning process or 9 learning hours. Before being given the treatment, students were given a pre-test to find out the students' initial understanding. After being given a pre-test, the class that was the research sample was treated with a brain-based learning method. At the first meeting students learn the concepts in the material of law I, II, III Newton through experiments by following student worksheets, then discuss and present the results in front of the class.. The second meeting studied the types of forces and the application of Newton's law to straight motion, at this meeting students are also asked to make observations, study literature and group discussions using student worksheets. At the last meeting students learn the application of Newton's law to circular motion, students are given problems for group discussions and given questions to challenge students' thinking skills. To arouse students' enthusiasm in giving opinions and answering teacher questions, students are given prizes. During the learning process students are allowed to drink water when they feel thirsty, this is to avoid dehydration in students while studying. Because when students are dehydrated it can reduce brain performance, students often feel lethargic, tired, sleepy, and bored.

After being given treatment in the form of implementing learning in class, students who were the research samples were given a post-test. Given the post-test aims to determine the extent to which students understand the concept after being given treatment. To be able to create a pleasant learning atmosphere, researchers invite students to be involved in learning activities, especially researchers as teachers must make students comfortable with the presence of teachers in the classroom, with students who accept the presence of the teacher in class, the teacher can easily manage the class. When students feel uncomfortable with the existence of teaching in class, students are not interested in learning and being in the classroom. Therefore, researchers introduced and approached students or touched students 'hearts first before touching students' brains.

3.2. Data Description of the Pre-test and Post-test Results

The test data results obtained from the pre-test and post-test can be described in Table 1 below.

Table 1. Results of pre-test and post-test data

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Pre-test	34	13	43	26.53	8.411
Post-test	34	60	90	71.00	8.202

Table 1 shows the results of the pre-test or initial test before being treated, the average value is 26.53 and a standard deviation of 8.411 with the lowest value of 13 and the highest value of 43. After being given treatment the results of the post-test or final test obtained an average value of 71.00 and a standard deviation of 8.202 with the lowest value of 60 and the highest value of 90.

3.3 Results

Analysis of the data obtained through the research process carried out the prerequisite test, namely the normality test and the homogeneity test. After the two prerequisite tests were carried out the results obtained from the two data were normally distributed and homogeneous. Then the data is done with a statistical test, namely the t-test. All data analyzes were processed using the SPSS Version 22.0 for Windows application.

3.3.1 Normality test

In this study, the pre-test and post-test data normality test was carried out using the Shapiro-Wilk test on the SPSS version 22.0 for Windows statistical application. With the criteria for a significance value of more than 0.05, the data obtained is normally distributed and if the significance value is less than 0.05 the data are not normally distributed. The results of the pre-test and post-test data normality test are described in Table 2.

Table 2. Results of the Pre-test and Post-test Data Normality Test

Tests of Normality			
	Shapiro-Wilk		
	Statistic	df	Sig.
Pre-test	0.948	34	.103
Post-test	0.940	34	.060

Based on the results of the normality test in Table 2, the pre-test data normality test obtained a significant value of 0.103. The normality test of the data obtained is more than 0.05, the data is normally distributed. The normality test on the post-test data obtained a significant value of 0.060. The normality test of the posttest data obtained is more than the significance value of 0.05, the data is normally distributed.

3.3.2 Homogeneity Test

Table 3. Results of the Pre-test and Post-test Homogeneity Test

Test of Homogeneity of Variances			
Levene Statistic	df1	df2	Sig.
0.013	1	66	.910

Based on Table 3, the results of the homogeneity test using the Levene Statistic test at the pretest and posttest show a significant value of 0.910, with the significance criteria of more than 0.05, the data obtained is homogeneous and if the significance value is less than 0.05, the data is not homogeneous. The significant value obtained is more than 0.05, so the data can be said to be homogeneous.

3.3.3 Hypothesis Testing

After conducting the prerequisite test, namely the pretest and posttest normality and homogeneity tests, the hypothesis testing is carried out. The pretest and posttest data were normally distributed and homogeneous. Then the hypothesis test is carried out with the dependent t-test, with the criterion if the significance value is more than 0.05 then H_0 is accepted and H_a is rejected and if the significance is less than 0.05 then H_0 is rejected H_a is accepted. Table 4 illustrates the results of the calculation of the dependent t-test data.

Table 4. Results of the dependent pre-test and post-test t-test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest – Posttest	-44.471	9.083	1.558	-47.640	-41.301	-28.549	33	.000

Based on the results of the dependent t-test in Table 4, the average difference between pretest and posttest is -44.471 and a standard deviation of the difference between pretest and posttest 9.083. The result of the t-test is -28.549. The significant value of the pre-test and post-test hypothesis test results in the study sample was obtained 0.000. The significant value is obtained smaller than 0.05 which means that H_0 is rejected dan H_a is accepted. So it can be concluded that there is a significant difference between students' understanding of concepts and measurements before and after treatment.

3.4 Discussion

In this study, the brain-based learning method is a way to optimally empower students' brain potential. By balancing the use of students' right and left brain. Optimal use of the brain apart from being able to make students focus on the process of receiving learning, students can also be creative in learning. In addition, the brain-based learning method is student-centered learning so that students can be active in building knowledge and understanding concepts independently.

In this study, data collection was taken from test and non-test techniques. The test result data based on Table 1 shows the average result of the pre-test value of 26.53 with a standard deviation of 8.411and The average value of the post-test value is 71.00 with a standard deviation of 8.202. This shows that there is an increase in students' conceptual understanding of Newton's law material after being given treatment. The pretest and posttest data on the student's cognitive learning outcomes were then analyzed statistically, starting from the prerequisite test, namely the normality test and the homogeneity test, Furthermore, hypothesis testing is carried out to determine the significant difference between students' understanding before and after being treated.

The normality test was carried out using the SPSS Version 22.0 for Windows application, based on the results of the calculation of Shapiro Wilk in Table 2 the pretest gets a significant value of 0.103. When compared with the criteria normally distributed 0.103 > 0.05, then the data can be said to be normally distributed. The posttest got a significant value of 0.060. This significant value is obtained greater than the 0.05 significance criteria, so the data is normally distributed. Then the data homogeneity test was then carried out using the SPSS Version 22.0 for Windows application. Based on the Levene Statistic test in Table 3, the pretest and posttest get a significant value of 0.910. A significant value is obtained greater than the 0.05 significance criteria, so the data is homogeneous.

After the prerequisite test, the pretest and posttest data were declared to be normally distributed and homogeneous, Then the two data were carried out by using the parametric dependent-sample t-test using the SPSS Version 22.0 for Windows application. Table 4 shows the results of the dependent t-test obtained at -28.549, which states that the difference in students' conceptual understanding between before and after being given treatment is accepted at the 95% significance level. The significant value of the pre-test and post-test hypothesis test results in the study sample was obtained 0.000. he significant value is obtained smaller than 0.05, which means that H_0 is rejected dan H_a is accepted. So it can be concluded that there is a significant difference between students' understanding of concepts and measurements before and after treatment. Through treatment with a brain-based learning method, students are actively involved in the learning process both individually and in groups and can understand scientific concepts. So that it has an impact on increasing student understanding. The experiences gained by students themselves can improve academic achievement and understanding of scientific knowledge (Ozden & Gultekin, 2008).

The results of this study indicate that the effect of the brain-based learning method can improve students' conceptual understanding in class X of Newton's law material. The results of this study are in line with research conducted Gladys, Stella dan Omobolanle (2018) which states that the brain-based learning method is a better learning strategy to increase student retention and understanding of concepts. Likewise with the results of research conducted by Sani, Rochintaniawati dan Winarno (2019) that brain-based learning can be an alternative tool to significantly improve students' mastery of concepts.

This study also uses non-test data which is supporting data to strengthen the research results, namely in the form of student activity observation sheets during the learning process. The observation sheet is made in accordance with the implementation of the teaching and learning process that has been designed in the lesson plan based on the stages of brain-based learning. Based on the results of observations made by observers during three meetings, students are actively

involved in the learning process. Students who are actively involved in the learning process can increase student activity in learning. So that students do not only receive information from the teacher, students can search and process information independently. In a study conducted by Solihat, et al (2017) also states that learning using a brain-based learning method can increase student activity. In implementing learning to optimize brain work, preferably more activities that must be done by students, invite students to do activities. Using new things to make the learning atmosphere always different, because students will easily remember a lesson at first experience and can be stored in long-term memory. Learn by doing experiments, discussing, and sharing information between groups, so that students don't just listen and sit quietly on the chair. With movement, students can think clearly rather than sitting. Because when students sit still for more than 20 minutes, the blood in the body collects on the buttocks and legs. By standing and moving can improve blood flow, in just one minute will have about 15% more blood in the brain, (Sousa David in Rakhmat, 2007:274). Cooperation and discussion can also build good communication relationships between students in the classroom.

Based on the results of observations made by observers when students are involved in the learning process, It can be concluded that students can think creatively, be enthusiastic, feel happy and comfortable in learning, so that learning does not feel boring and increases students' enthusiasm for learning. This is in line with research Nur (2016) that the creative thinking skills and independent learning of students who use the brain-based learning method are better than students who use conventional learning. In the learning process students can also make a mind map according to their respective creativity. Mind map making is important because the brain can easily remember information in the form of pictures, symbols, clues, and colors. The many colors can also inspire students' enthusiasm for learning. The benefits of a mind map are flexible, can focus attention, increase understanding and be fun (Deporter dan Hernacki, 1992). Based on the results of research conducted by Munfaridah, Yuliati & Diantoro (2015) *mind maps have a positive impact on the use of brain based learning*.

Students are also asked to take a short break while repeating the lesson by listening to classical music. In brain-based learning, music is one way to help optimize student brain function. DePorter (1992) says that relaxation accompanied by music keeps the mind ready and able to concentrate. From the creativity carried out by students, it can be said that students have empowered the optimal potential of the brain by involving the two hemispheres of the brain, namely the student's right brain and left brain.. So as to produce good learning outcomes. Based on the results of research that has been done and statements that are in line with other studies, it can be concluded in this study that brain-based learning method on students' understanding of concepts on newton law material can improve students' understanding before and after being given treatment.

4. CONCLUSION

Based on the results of the study, it can be concluded that there is a significant influence on students' understanding of concepts using the brain-based learning method. The effect of this brain-based learning method increases students' understanding of concepts before and after being treated.

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