Quadrilateral Learning Based on Brain Potencies of 7th Grade in Karanganyar Regency, Indonesia

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ABSTRACT

The aim of the current study is to compare two learning models in quadrilateral learning. The models are Whole Brain Teaching (WBT) and Brain-Based Learning (BBL). This research is quasi-experimental research with a 2x3 factorial design. The population of this research was the 7th grade of junior high school in Karanganyar Regency with 181 students as the sample, 91 students taught with WBT and 90 students taught with BBL. Data analysis using a two-way ANOVA test with different cells. In this research indicating that learning models and the students' learning style have a significant impact on the quadrilateral learning achievement. The result showed that Fa(9.79)> Ftable (3.89) it means (1) the students who were taught by WBT model had better achievement with student who was taught by BBL model, (2) Fb(25.05)>Ftable(3.05) it means auditory learners have better achievement than visual and kinesthetic , visual learners have achievement than kinesthetic learners, and (3) Fab (0.0197) < Ftable (3.05) it means there is no interaction between the learning model and learning style.

INTRODUCTION

Mathematics is one of the most important subjects in Indonesia's education system. It is learned in elementary school up to university (Tanujaya, Prahmana, & Mumu, 2017). The reason is that mathematics is a branch of knowledge needed by students to support the success of their future learning (Niess, 2005). Due to the importance of mathematics, both in the formation of attitudes and its uses, a score enhancement of mathematics at each level of education must have serious attention (Schott, 2014). Mathematics score has an important role in determining the requirements of postgraduate students in Indonesia because mathematics is one of the compulsory subjects which determines national examination graduation (Prahmana & Kusumah, 2016).

Based on the National Examination Report 2018 (Ministry of Education and Culture Indonesia, 2018), the average score of mathematics subjects in the national examination for junior high school students in Karanganyar Regency is 49.42. Geometry is one of the materials which have low achievement. One indicator of geometry in the national exam of junior high school year 2018 was to find the area and perimeter of a quadrilateral. In this indicator, less than 47% of the total students who took national examinations in Karanganyar Regency are able to answer the problem correctly. There are some factors, both outside and inside the school, which influence the quality of academic achievement (Slameto, 2010) and the low achievement of students' in learning mathematics. Teaching method affects the responses of students and determines whether the students are interested, motivated and involved in the lesson in such a way as to engage in good learning and that what constitutes good teaching and learning of school subjects is the use of appropriate methods of teaching (Ahmed & Iliyasu, 2017). Instructional strategies adopted by teachers influence the students' low achievement in a quadrilateral. Learning by the active, innovative, creative method can also motivate the students to learn and improve their learning outcomes (Priyono, 2018), (Astri, Gunarhadi, & Riyadi, 2018).

The teacher must possess various professional competencies and skills (Simsek, 2017) and also they have a responsibility to ensure these competencies are already possessed by students(Purwanti, Gunarhadi, & Musadad, 2019). A teacher, to maximize learning process, should be able to provide learning process which can optimize brain function of all students, and learn based on the natural work of the brain (Winarso &

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Karimah, 2017). The research showed that a change in our experience will also change our brain. In other words, our brain is involved in our activities and our experience has the ability to change our brain. Therefore, it is important for a school to give a positive experience to the students, in a matter of study, in order to make the students be effective in studying (Jensen, 2008). Brain-based learning is able to make connections between brain research and teaching practices (Willis, 2007).

Brain-Based Learning (BBL) is a learning model which is based on the brain. This model was developed by Eric Jensen (2008), he stated that basically every student has a similar ability, yet due to several factors, it leads different development abilities for each student. Furthermore, *Whole Brain Teaching* (WBT) is another learning model based on brain ability. It is developed for the first time in 1983 by Chris Biffle who collaborated with his two students, Jay Vanderfin and Chris Rekstad, they work to develop a strategy in improving learning in the class (Kharsati & G.S, 2017). Brain-Based Learning claims that learning should be adapted to the way the brain processes information that is receiving, storing, and retrieving information in a fun way, while the Whole Brain Teaching claims that the way of learning which allows students to recall information is by activating every part of the brain through coding and repetition (Handayani & Corebima, 2017). WBT and BBL have a syntax of stretching or resting exercises to maximize the absorption of material that has been delivered to students (Emilda, 2015). Stretching and resting exercise can also reduce stress in the learning process (Kaur, 2013).

Besides learning model, the other factor which influences the low learning outcomes is the student itself or student internal factor (Crosnoe, Johnson, & Elder, 2004). Among many factors, learning style has an effect on students' learning outcomes (Putra, Kusmayadi, & Sujadi, 2014), (Ramlah, 2014), (Putri, Mardiyana, & Saputro, 2019). In line with Stenberg's research (Stenberg, 1997), it is stated that psychologist, teacher, and researcher will be helped in improving learning quality of the student if the learning style of the student can be figured out. Concept of organizational learning draws from theoretical assumptions that are complementary to each other and relies on learning styles (Gantasala & Gantasala, 2009). The students' learning style includes visual (tend to be interested in visualization), auditory (tend to be interested in listening), and kinesthetic (tend to be interested in physical activity) (DePorter & M Hernacki, 2013). There is different understanding in comprehending each learning style concept which can affect the learning outcome quality of the student in quadrilateral material (Pangadongan, 2015). There is a linkage between the Whole Brain Teaching model and student learning style in the implementation of the Whole Brain Teaching model. Chris and his colleague stated that the students will be more involved in the class activity when they are, emotionally, got involve in lessons which require them to see, speak, listen, and physically move (Kharsati & G.S, 2017). So, the implementation of whole brain teaching has relevance with visual learners, auditory learners, and kinaesthetic learners.

Aim of the Study

Aim of the present study is to compare whole brain teaching with brain-based learning model and discusses the achievement of mathematics score based on student's learning style. In this paper to find out (1) which one provides better learning achievement between the WBT model and the BLB model, (2) which learning achievement is better between visual learners, auditory learners, and kinesthetic learners, (3) are there interactions between learning models and learning styles.

METHOD

This research is a quasi-experimental research with a 2 x 3 factorial design. Free variable for this research is model learning and students learning style, while the dependent variable is achievement learning students in the subject of a quadrilateral. The population in this research is all students of 7th grade Junior High School in Karanganyar Regency 2018/2019 academic year. Sample of this research is 181 student taken from 3 schools. For each example has taken a class (91 Students) taught with *Whole Brain Teaching* (WBT), and the other class (90 students) taught with *Brain-Based Learning (BBL)*. The samples were taken use of *stratified cluster random sampling technique*. Grouping schools based on data results of a national examination in the academic year 2018-2019 with 3 category that is high, medium and low which are selected using

Stratified Cluster Random Technique Sampling. They are SMP N 1Tawangmangu, SMP N 1 Karangpandan, and SMP N 2 Ngargoyoso.

The stages of data collection methods used in this study consisted of methods of documentation, questionnaires, data retrieval, and data testing. The instrument used in this study was a test to obtain data on mathematical achievements in quadrilateral material and questionnaires to collect data about student learning styles. Test instruments with validity, reliability, different power tests and difficulty levels. Lilliefors formula normality test, variance homogeneity test with Bartlett test, and balance test with one-way ANOVA with different cells. Hypothesis testing of two-way ANOVA with different cells.

Data Analyses

The prerequisite test result will be shown below :

The test results on the previous knowledge requirements data and learning achievement concluded that all samples came from populations that were normally distributed. For this research, normally test used to Lilliefors. Here is the result of normally test with a significance level of 5%.

Table 1. The result of normality test data achievement learning mathematics

Group	L_{obs}	L_{table}	Conclusion
WBT	0,0918	0,0929	Normal
BBL	0,0915	0.0934	Normal
Auditory	0.1139	0.1217	Normal
Visual	0.0492	0.0944	Normal
kinesthetic	0.0595	0.1437	Normal

Based of Table 1 visible that L_{obs} for each sample less than L_{tab}, so H_0 is accepted. It means that each sample from population have a normal distribution.

The next is a homogeneity test. Homogeneity test used to knowing is data of samples have the same various. For testing, this homogeneity used Bartllet method with F-test. Here is the result of the homogeneity test significance level of 5%.

Table 2. Result of homogeneity data of achievement learning mathematics

Groups	K	X^2_{obs}	$X^2_{(0,05;k-1)}$	Decisions	Conclusion
Learning Model	2	1.3565	3.841	H_0 accepted	Various Homogeneity Population
Learning Style	3	3.9649	5.991	H_0 accepted	Various Homogeneity Population

Based on Table 2, $X^2_{obs} < X^2_{table}$ its mean that all students have the same variety or the samples are homogenous.

Based on the balance test results using the T-test, it can be concluded that the sample learning model of the population group in Karanganyar Regency is: balanced. Next, two-way ANOVA test with different cells in the learning achievement data (Budiyono, 2009).

FINDINGS

Next, two-way ANOVA test with different cells in the learning achievement data (Budiyono, 2009). A summary of two-way ANOVA with different cells is presented in Table 3.

Table 3. Two-way ANOVA with different cell

Source	JK	Dk	RK	F_{obs}	F_{table}	Conclusion
A	1132.2355	1	1132.2355	9.7879	3.8951	H_{0A} rejected
B	5796.2170	2	2898.1085	25.0535	3.0476	H_{0B} rejected
A*B	4.5570	2	2.2785	0.0197	3.0476	H_{0AB} approved
Error	20243.4415	175	115.6768			
Total	27176.4510	180				

Based on the result of a two-way analysis of variance in Table 3:

- $F_{table} < F_{obs}$, so H_{OA} analysis of variance rejected, it means that learning model influence on mathematics achievement students
- $F_{table} < F_{obs}$, so H_{OB} analysis of variance rejected, it means that students learning style influence on mathematics achievement students
- $F_{table} > F_{obs}$ then H_{OAB} analysis of variance approved, it means that there is no interaction between learning model with students learning style

Further research hypothesis test. Table 4 below shows on average each cell and the mean marginal shown in.

Table 4. Average of students' score and marginal average

Learning model	Learning Style			Marginal average
	A (b1)	V (b2)	K (b3)	
Whole Brain Teaching (a1)	65.5714	58.7027	51.6923	58.8132
Brain-Based Learning (a2)	60.9032	53.2632	46.4762	54.3111
Marginal average	63.1186	55.9467	49.3617	

Based on Table 4, a marginal average of *Whole Brain Teaching* model is higher than a marginal average of *Brain-Based Learning* model, in the other word *Whole Brain Teaching* models give better achievement than *Brain-Based Learning* model.

The result of comparing two different cells between column shown in Table 3 below:

Table 5. Comparison of two different cells between column

Source	$(x_i - x_j)^2$	$\frac{1}{n_i} + \frac{1}{n_j}$	RKG	F_{obs}	F_{table}	Conclusion
$b_1 - b_2$	51.4373	0.0303	115.6768	14.6839	6.0952	H_{0A} rejected
$b_1 - b_3$	189.2535	0.0382	115.6768	42.7998	6.0952	H_{0B} rejected
$b_2 - b_3$	42.4648	0.0346	115.6768	10.6067	6.0952	H_{0AB} rejected

Based on Table 5, for $b_1 - b_2$ and $b_1 - b_3$ $F_{obs} > F_{table}$, so mathematics achievement of auditory learners is better than the mathematics achievement of visual learners and mathematics achievement of auditory learners is better than the mathematics achievement of kinesthetic learners. The result for $b_2 - b_3$, $F_{obs} >$

F_{table} , so mathematics achievement of visual learners is better than the mathematics achievement of kinesthetic learners.

RESULT, DISCUSSION, AND SUGGESTIONS

Based on the results of hypothesis testing in the previous section, can be concluded that learning model influence on mathematics learning achievement student. On quadrilateral learning, the student that is given *Whole Brain Teaching* have mathematics learning achievement better than students who are given *Brain-Based Learning* model. The student learning style gives effect on mathematics achievement students especially on quadrilateral material, that is an achievement of auditory learners is better than the achievement of visual learners, the achievement of auditory learners is better than the achievement of kinesthetic learners, and achievement of visual learners is better than the achievement of kinesthetic learners. There is no interaction between learning models and student learning style.

From the results of the study, the WBT model can be used as a reference for teachers to improve the quality of learning, especially mathematics. The positive interaction between teachers and students makes the classroom atmosphere more lively and meaningful. WBT helps teachers to be more active and able to explore their abilities when learning mathematics. Learning styles turned out to also influence students' mathematics learning achievement on quadrilateral material. Although the results of this study indicate no interaction between the WBT learning model and BBL with student learning styles, there needs to be further research on the application of the WBT, BBL model based on other independent variables. Or conversely, examine other interactive learning models that are tailored to students' learning styles.

REFERENCES

Ahmed, M., & Iliyasu, M. B. (2017). Effect of laboratory activity based method on performance in geometry among junior secondary school students in kastina state, Nigeria. *Abacus,The Journal of The Mathematical Association of Nriaige*, *42*(2), 55–60.

Budiyono. (2009). *Statistika untuk penelitian*. surakarta: Uns Press.

Crosnoe, R., Johnson, M. K., & Elder, G. H. (2004). School size and the interpersonal side of education: An examination of race/ethnicity and organizational context. *Social Science Quarterly*, *85*(5), 1259–1274.

DePorter, B., & M Hernacki. (2013). *Quantum learning: Membiasakan belajar nyaman dan menyenangkan*. Bandung: Kaifa Learning.

Emilda. (2015). Teaching mathematics through ıntegrated brain gym in pair checks of cooperative learning. *IOSR Journal Of Humanities And Social Science Ver. III*, *20*(11), 27–31.

Gantasala, P. V., & Gantasala, S. B. (2009). Influence of learning styles. *International Journal of Learning*, *16*(9), 169–184.

Handayani, B. S., & Corebima, A. D. (2017). Model brain based learning (BBL) and whole brain teaching (WBT) in learning. *International Journal of Science and Applied Science: Conference Series*, *1*(2), 153.

Jensen, E. (2008). *Brain based learning : The new paradigm of teaching second-edition* (2nd ed.). usa: crowin press.

Kaur, J. (2013). Effectiveness of brain based learning strategies on enhancement of life skills among primary school students with internal and external locus of control. *International Journal of Advancements in Research & Technology*, *2*(6), 128–143.

Kharsati, M. P. D., & G.S, D. P. (2017). Whole brain teaching. *IOSR Journal of Humanities and Social Science*, *22*(06), 76–83.

Ministry of Education and Culture Indonesia. (2018). National examination report. Retrieved from hasilun.puspendik.kemendikbud.go.id

Niess, M. L. (2005). Preparing teachers to teach science and mathematics with technology: developing a technologypedagogical content knowledge. *Teaching and Teacher Educ*, *5*(21), 509–523.

Pangadongan, F. V. (2015). *Konsepsi Siswa SMP Pada Materi Segiempat Ditinjau dari Gaya Belajar*. 1001–1008.

Pradhita Yudhi Astri, T., Gunarhadi, G., & Riyadi, R. (2018). Numbered-board quiz with tgt to ımprove students' science achievement based on learning motivation. *International Journal of Educational Research Review*, *3*(4), 68–76.

Prahmana, R. C. I., & Kusumah, Y. S. (2016). The hypothetical learning trajectory on research in mathematics education using research-based learning. *Pedagogika*, *123*(3), 42–54.

Priyono. (2018). The implementation of PAIKEM (Active, innovative, creative, effective, and exiting learning) and conventional learning method to improve student learning results. *Journal of Social Studies Education Research*, *9*(2), 124–137.

Purwanti, D., Gunarhadi., & Musadad, A. A. (2019). The effect of local-based 2013 curriculum implementation on students' environmental awareness. *International Journal of Educational Research Review*, *4*(1), 65–75.

Putra, F., Kusmayadi, A., & Sujadi, I. (2014). Eksperimentasi Model Pembelajaran Kooperatif Tipe TGT Berbantuan Software CABRI 3D Ditinjau Dari Gaya Belajar Siswa. *Jurnal Elektronik Pembelajaran Matematika*, *2*(8), 816–827.

Putri, M. E., Mardiyana., & Saputro, D. R. S. (2019). The effect of application of react learning strategies on mathematics learning achievements: empirical analysis on learning styles of junior high school students. *International Journal of Educational Research Review*, 231–237.

Ramlah, F. D. (2014). Pengaruh Gaya Belajar dan Keaktifan Siswa Terhadap Prestasi Belajar Matematika (Survey Pada SMP Negeri di Kecamatan Klari Kabupaten Karawang). Jurnal Ilmiah Solusi. *Jurnal Ilmiah Solusi*, *1*(3), 68–75.

Schott, D. (2014). Context-dependent statements and consequences for the mathematical education of engineeringstudents. *World Trans. on Engng. and Technol. Educ*, *12*(3), 437–442.

Simsek, Y. (2017). The evaluation of the application of transported education by teachers. *International Journal of Educational Research Review*, *2*(1), 41–48.

Slameto. (2010). *Belajar dan Faktor-Faktor yang Mempengaruhinya* (5th ed.). Jakarta: PT. Rineka Cipta.

Stenberg, R. (1997). *Thinking Styles*. cambridge: Cambridge University Press.

Tanujaya, B., Prahmana, R. C. I., & Mumu, J. (2017). Mathematics instruction, problems, challenges and opportunities: A case study in Manokwari Regency, Indonesia. *World Transactions on Engineering and Technology Education*, *15*(3), 287–291.

Willis, J. (2007). Brain-based teaching strategies for ımproving students' memory, learning, and test-taking success. *Childhood Education*, *83*(5), 310.

Winarso, W., & Karimah, S. A. (2017). The influence of implementation brain-friendly learning through the whole brain teaching to students' response and creative character in learning mathematics. *Ssrn*, (October).