International Journal of Elementary Education
Volume 6, Number 2, Tahun 2022, pp. 297-304
P-ISSN: 2579-7158 E-ISSN: 2549-6050
Open Access: https://doi.org/10.23887/ijee.v6i2.46651

The Impact of Brain Based Learning Strategy on Mathematical Communication Ability of Grade V Elementary School Students

Winda Amelia[1*], Venni Herli Sundi[2], Asep Supena[3], Yufiarti[4]

[1,]Pendidikan Guru Sekolah Dasar, Universitas Trilogi, Jakarta, Indonesia,
[2]Pendidikan Guru Sekolah Dasar, Universitas Muhammadiyah Jakarta, Jakarta, Indonesia,
[3,4]Pascasarjana Program Studi Pendidikan Dasar, Universitas Negeri Jakarta, Jakarta, Indonesia

ARTICLE INFO

Article history:
Received January 22, 2022
Accepted April 16, 2022
Available online May 25, 2022

Kata Kunci:
Strategi Pembelajaran, Brain Based Learning, Kemampuan Komunikasi Matematis

Keywords:
Learning Strategy, Brain Based Learning, Mathematical Communication Ability

ABSTRAK

Sebagian besar siswa beranggapan matematika sebagai mata pelajaran yang rumit dan memberatkan, sehingga cenderung kurangnya minat mempelajari mata pelajaran matematika, kemampuan komunikasi matematis menjadi salah satu hal penting dalam pembelajaran. Oleh karena itu, agar pembelajaran matematika disukai, perlu dilakukan upaya untuk mengadopsi strategi pembelajaran yang dapat meningkatkan kemampuan komunikasi matematis siswa Sekolah Dasar. Penelitian ini bertujuan untuk mengetahui perbedaan strategi pembelajaran manakah yang menghasilkan kemampuan komunikasi matematis yang lebih tinggi antara Brain Based Learning dengan strategi pembelajaran konvensional. Penelitian ini merupakan jenis penelitian quasi experiment (eksperimen semu). Pengambilan sampel dengan teknik cluster random sampling. Teknik analisis data menggunakan uji normalitas, homogenitas, pengujian hipotesis dan hipotesis statistik. Kesimpulan dari penelitian ini adalah sebagai berikut: 1). Peningkatan nilai rata-rata sebesar 58,15 dialami kelas eksperimen dengan strategi Brain Based Learning lebih tinggi jika dibandingkan nilai rata-rata kelas kontrol sebesar 14,9. Sehingga kemampuan komunikasi matematis siswa di kelas eksperimen pada pelajaran matematika mengalami peningkatan yang signifikan dibanding kelas kontrol; 2). Hasil perhitungan statistik diperolehan t hitung yaitu 8,25 dan nilai t tabel didapatkan angka 1,99 lebih kecil dari nilai t hitung, sehingga strategi Brain Based Learning membawa dampak positif terhadap kemampuan komunikasi matematis kelas V dalam pembelajaran matematika.

ABSTRACT

Most students think of mathematics as a complicated and burdensome subject, so there tends to be a lack of interest in studying mathematics. Mathematical communication skills become one of the important things in learning. Therefore, so that math learning like, need made an effort to adopt learning strategies that can improve. Mathematical communication skills of elementary school students. This study aims to determine the differences in which learning strategies result in higher mathematical communication skills between students and students Brain Based Learning with conventional learning strategies. This research is a type of quasi-experimental research (quasi-experimental). Sampling with cluster random sampling technique. The data analysis technique used normality, homogeneity, hypothesis testing and statistical hypotheses. The conclusions of this study are as follows: 1). An increase in the average value of 58.15 experienced by the experimental class with Brain Based Learning strategy higher than the average value of the control class of 14.9. So that the mathematical communication skills of students in the experimental class in mathematics experienced a significant increase compared to the control group; 2). The results of statistical calculations obtained t count is 8.25 and the value of t table is 1.99 which is smaller than the value of t count, so Brain Based Learning strategy has a positive impact on the mathematical communication skills of class V in mathematics learning.

1. INTRODUCTION

Mathematics own very important role in human life, therefore Mathematics subject is always us see you a teach unit teaching. Thing this in accordance with the what which put forward in the Minister of Education and Culture, namely the subject of mathematics should give to all student starting from level school base on wards, to equip student with the ability to think logically, analytically, systematically, critically, innovative, and creative, as work ability same (Nenden., 2020; Setiani, 2018). Therefore, so that math learning process required and like, need made an effort to adopt the right learning strategy. The application of appropriate learning strategies can ideally strength then interest and motivation in the

*Corresponding author.
E-mail addresses: amelia009@gmail.com (Winda Amelia)

learning process so that teaching and learning activities can take place by optimally in accordance with educational goals (Adiansha & Sumantri, 2017; Mukhlis, 2016).

Likewise, with the goal Mathematics from the National Council of Teachers of Mathematics (NCTM) argues that the standard of mathematical competence required by students is problem solving skills, communication skills, connection skills, reasoning skills, and performance skills (Muslimahayati, 2019; NCTM., 2000). Skills Mathematical communication is an important skill that must be possessed by students. The development of communication skills can be done through various teaching units. Education units can be divided into three levels of education, namely basic education, junior secondary education, and higher education (Lestari et al., 2021). Mathematical communication skills become one of the important things in learning, especially when it comes to prerequisite material. Mathematical communication skills are needed so that students can recognize and use connections between interrelated mathematical ideas and create other ideas, as well as recognize and apply mathematics in contexts other than mathematics (Lestari et al., 2021; Oktaviani et al., 2019). However, the reality in the field of mathematical communication for elementary school students in learning mathematics is still very low.

The results of the fifth-grade mathematics assessment at SDN Pangadegan 07 Pagi, South Jakarta, are still relatively low. The problems raised explain that some students do not understand or have difficulty understanding the material taught in mathematics. One of the factors behind this problem is that students lack enthusiasm for learning, students tend to be less actively involved in learning activities and experience a decrease in mathematical communication skills. This can be seen from the average value of one semester is 70, as many as 30 students. 10 students who are able to achieve a value above the KKM and the rest of the students have not been able to get the value that has been set on the KKM. Skills mathematical communication will show understanding to concepts learned (Adiansha & Sumantri, 2017; Nilawati. et al., 2019). When something mathematical information concept is given to a student by a teacher, or when a student do it yourself through read, occur transition informal mathematics from the communicator to the communicator (Amalia & Saumi, 2018; Deswita & Kusumah, 2018). One of characteristic math is full with the term and symbol, so that the ability to communicate in mathematics is a condition special. Mathematical communication competence is ability disclose situations, pictures, diagrams in language, symbols, and ideas (Maulani et al., 2017; Saparudin & Effendi, 2019; Solihah et al., 2018).

At the international level, currently there are two main assessments that assess students' math and science abilities, namely TIMSS (Trend in International Mathematics and Science Study) and PISA (Program for International Student Assessment). PISA is a literacy competency for international study elementary school students that aims to measure students' reading, math, and science literacy achievement (Hadi & Novaliyosi., 2019; Musfiroh & Listyorini, 2016). This study was coordinated by the OECD (Organization for Economic Cooperation and Development) based in Paris, France. Indonesia is ranked 73 out of 79 participants with an average math score of 379. 5. Ability communicate directly mathematics is one field Cognitive that ideally must have student. Mathematical communication is Skills must-have students, as stated in Skill score curriculum 2013 (Muslimahayati, 2019; Wijayanto et al., 2018). These core competencies include: 1) Appreciate and practice the teachings of the religion he adheres to; 2) Be honest, disciplined, responsible, caring (mutual cooperation, cooperation, tolerance, peace, courtesy, responsive and proactive and interact effectively with the social and natural environment as well as world relations; 3) Understand, apply, analyze factual knowledge, conceptual, procedural based on his curiosity about science (Muslimahayati, 2019; Putrawan & Suharta, 2014).

Thus, realizing the importance of mathematical communication skills, as well as to create a pleasant mathematics learning atmosphere, teachers should pay attention to one important thing in the human body whose abilities are still not optimized, namely the ability of the brain (Setyoningrum. et al., 2020; Wigati., 2017). Therefore, it is necessary to have a learning strategy that optimizes the brain's thinking process and can improve mathematical communication skills in students' mathematics learning. So a suitable learning strategy to improve mathematical communication skills as expressed by Jensen is the Brain Based Learning strategy. Brain Based Learning is learning that is aligned with the way the brain is naturally designed to learn (Fauzia., 2021; Saputra et al., 2019). Brain Based Learning offers a concept to create learning oriented towards empowering the potential of students' brains (Deswita & Kusumah, 2018; Wigati., 2017). This allows a biological work system in the body to work to influence the structure and function of the brain in order to learn naturally. Basically, Brain Based Learning functions real experience in the learning process (Fauzia., 2021; Oktaviani et al., 2019; Saputra et al., 2019).

The planning stages of the Brain Based Learning strategy that Jensen revealed in his book are pre-exposure, preparation, initiation and acquisition, elaboration, incubation and memory entry, verification and belief checking, and the last stage is celebration and integration (Jensen, 2011; Solihat et al., 2017). Meanwhile, according to Sapa'at, there are three main strategies that can be developed in the implementation of BBL (Brain Based Learning), namely: 1) Creating a learning environment that challenges

thinking skills; 2) Creating a fun learning environment; 3) Creating an active and meaningful learning situation for students (Purnama, 2016). Thus, learning mathematics through Brain Based Learning strategies provides opportunities for students to hone mathematical communication skills. In addition, a challenging and fun learning environment will also motivate students to actively participate and have optimal activities in learning, because the growth of motivation can move students to learn or master the material being studied (Jensen, 2011; Purnama, 2016). Based on these problems, this study aims to determine the differences in mathematical communication skills between students who use Brain Based Learning strategies with conventional learning strategies.

2. METHOD

This research is a quasi-experimental type of research (quasi-experimental) with a pre-test and post-test control group design. In simple terms, the research design used can be described as in Table 1.

Table 1. Research Design Pre-test and Post-test Control Group Design

Pre-Test	Treatment Group	Post-Test
O_1	X_1	O_2
O_3	X_2	O_4

Information:
O_1 : experimental class pretest
O_2 : final test (post-test) experimental class
O_3 : control class pre-test
O_4 : final test (post-test) for control class
X_1 : treatment (Brain Based Learning strategy
X_2 : control class (multi-strategy)

The population in this study were all fifth-grade elementary school students in Pangadegan Village, South Jakarta with a total of 173 students. Then the sampling was carried out using cluster random sampling technique, so the sample in this study was 64 students consisting of students in class VA and VB at SDN Pangadegan 07 Pagi, South Jakarta. The instrument developed in this research is a test of mathematical communication skills equipped with an assessment rubric that is useful in scoring. While the data analysis technique used normality test, homogeneity, hypothesis testing and statistical hypothesis. The data from the students' mathematical communication ability test results are ordinal data, so first the data is converted in the form of interval data using MSI (Method Successive Interval) either manually or with the help of Microsoft Excel 2010. The data processed in this study is the result of pre-test data. and the results of post-test data obtained from the experimental class and the control class. Furthermore, the data was tested using the t-test at a significant level α =0,05.

3. RESULT AND DISCUSSION

Result

The results of the study were carried out at SDN Pangadegan 07 Pagi, South Jakarta by giving treatment to the two classes, namely class VA as the experimental class with a total of 32 students and class VB as a control class with a total of 32 students. Both classes will be given a pre-test and post-test. Based on the summary of the pre-test scores, it can be explained that of the 32 students there was the lowest score of 13 and the highest score of 98. In addition, descriptive statistical calculations showed the average gain of the experimental class was 44.25, the median was 44.5, the mode was 13, and standard deviation 23.12. So that the acquisition of the smallest and largest range of values in the experimental class is 85 and the length of the class is 15. There are 16 students (50%) of the 32 students in the experimental class who have scores below the average, while the group of students who have scores around the average and above the average are 16 students (50%).

Obtaining pre-test scores before getting treatment with Brain Based Learning strategy. Furthermore, the acquisition of pre-test score data was analysed to see an initial picture of the mathematical communication skills of control class students. Based on the summary of the pre-test scores, it can be explained that from 32 students the lowest score was 13 and the highest score was 110. In addition, descriptive statistical calculations showed the control class average gain was 54.2, median 56, mode 57, and deviation default 25.9. So that the acquisition of the smallest and largest value ranges in the control class is

97 and the class length is 17. There were 15 students or about 46.9% of the 32 students in the control class who had scores below the average, while 53.1% or 17 students scored around average or above the average. Obtaining pre-test scores before receiving treatment with conventional learning strategies.

Then the acquisition of post-test value data is obtained by calculating the results of the student worksheet assessment from working on the instrument in the form of description questions, after receiving treatment with the Brain Based Learning strategy. The post-test data were then analysed to see the final picture of the experimental class students' mathematical communication skills. Based on the summary of post-test acquisition data, it can be explained that from 32 students there is the highest score, namely 147. In addition, descriptive statistical calculations show the average gain of the experimental group is 102.4, median is 106.5, mode is 128, and standard deviation is 28.5. So that the acquisition of the smallest and largest range of values in the experimental class is 94 and the length of the class is 16. There are 18 students or about 56.25% of the 32 students in the experimental class having post-test results above the average. Obtaining post-test scores after receiving treatment with Brain Based Learning strategy.

The summary of the post-test acquisition data, explained that from 32 students the highest score was 121. In addition, descriptive statistical calculations showed the control class average gain was 69.1, median 76, mode 79, and standard deviation 27.6. So that the acquisition of the smallest and largest ranges of values in the control group is 105 and the class length is 18. The results of the data analysis show that 56.25% or 18 students got post-test results around average or above average. Obtaining post-test scores after receiving treatment with conventional learning strategies. The next stage is to test the normality of students' mathematical communication skills through the normality test of the Lilliefors test by making a comparison between Lcount and Ltable. The normality test gain is recognized as normal (accepted) if $L_{count} < L_{table}$, while the post-test gain is recognized as abnormal (rejected) if $L_{count} > L_{table}$. Table 2 presents the results of the normality test from the posttest results for the experimental class and the control class.

Table 2. Normality Test of Students' Mathematical Communication Ability

No.	Class	L_{Count}	L_{table}	Conclusion
1.	Experiment	0.109	0.157	Normal
2.	Control	0.089	0.157	Normal

The results of the normality test in the experimental class obtained the results of the calculation of the Lcount value of 0.109. Meanwhile, the calculation result for the L_{count} for the control class is 0.089. The value of L_{table} for both classes is equal to 0.157 because it has the same number of samples, namely 32 students with a significant level of 0.05. Through the results of the calculations, the experimental class and the control class both got a smaller L calculated value than the table L value, so that the data from the two sample groups could be declared normally distributed. Furthermore, the acquisition of research data was also analysed by homogeneity test through the use of the Bartlett test. Table 3 presents the results of the homogeneity test through the Bartlett test.

Table 3. Homogeneity Test of Students' Mathematical Communication Ability

Class	Variant Source	X^2_{count}	X^2_{table}	Conclusion
Experiment Control	*Post-test* *Post-test*	0,029	3,841	Homogeneous

Obtaining the Bartlett test for students' mathematical communication skills, the results of the calculation of the calculated X^2 value are 0.029. In addition, the value of X^2 table is 3.841 because dk is 1 and the significance level is 0.05. Thus, the conclusion is that X_{count} is smaller than X_{table}, so that the experimental class and control class in this study are recognized as homogeneous. The last is hypothesis testing. The purpose of testing the hypothesis in this study is to prove the rejection or acceptance of the formulated null hypothesis. According to the results of the normality and homogeneity tests, it was recognized that the data from the experimental class and control class were normally distributed and homogeneous. Next, the researcher tested the hypothesis through a t-test. Table 4 presents the results of the t-test calculation.

Table 4. Hypothesis Test

df	α	t_{count}	t_{table}	Conclusion
62	0.05	8.25	1.99	H_0 rejected H_1 accepted

The t-test obtained in this study, namely t_{count} = 8.25, for the t_{table} value because the significance level is α= 0.05 and dk = 62 so that the t_{table} is 1.99. Then the acquisition of t_{count} is greater than t_{table}, 8.25> 1.99 or in other words the null hypothesis statement can be rejected and the alternative hypothesis statement accepted. Therefore, with the acceptance of the alternative hypothesis, it is proven that there is a positive significant difference effect with the implementation of the Brain Based Learning strategy on the mathematical communication skills of fifth grade students at SDN Pangadegan 07 Pagi, South Jakarta.

Discussion

Brain Based Learning strategy enables real experience in the learning process. There are five components in the brain's natural learning system, namely: 1) The curious brain, arouses interest in new things. This is a component of the brain that tends to become more active when we are faced with new ideas and challenges. 2) The meaningful brain, meaning is more important than information. The brain seeks meaning through imitation. Imitation enables the brain to store knowledge in memory. 3) The emotional brain, emotions and intelligence come from different parts of the brain, but both work integrally and inseparable and can be enhanced using stimuli and challenges. 4) The social brain, our brain is social. Interaction and social conditions affect stress levels. The learning process will be more effective if it is carried out in a situation that is pleasing to the learner where the process of building a structure of understanding, cooperative learning, and social interaction is possible in it. 5) The conscious and subconscious brain, learning involves conscious and subconscious processes. Learning does not only occur in the classroom, but also in everyday life (Solihah et al., 2018; Ulfa., 2020).

The steps of the Brain Based Learning model according to Jensen are as follows: 1) Pre-Exposure. This stage gives the brain a review of the new learning before really delving into it. 2) Preparation. The stage of creating curiosity. 3) Initiation and Acquisition. The stage of entering learning materials. Provide group projects that facilitate students to build knowledge and understanding of a subject matter based on their own learning experiences. 4) Elaboration. The processing stage requires pure thinking skills from students. One group presents the results of their group work and another group responds to the presentation so that class discussion occurs. 5) Incubation and Memory Entry. This stage emphasizes the importance of rest and repetition time. Do some stretching and relaxation. 6) Verification and Confidence Checking. Both teachers and students need to confirm their learning. Quiz (Verbal and/or written). Write a journal about what you have learned. 7) Celebration. This stage involves emotions, make this stage exciting, cheerful and fun. Close the lesson with a celebration or appreciation (Fauzia., 2021; Kusuma et al., 2020; Purnama, 2016).

Data collection in this study was carried out by taking pre-test data on Monday, April 4, 2022, which was given to the experimental class and control class. The experimental class pre-test data got an average result of 44.25 while the control class got an average result of 54.2. Furthermore, the two classes were given mathematics learning with different treatments, the experimental class with Brain Based Learning strategy and the control group with conventional learning strategies. Brain Based Learning strategy is applied to the experimental class. Learning is carried out in four meetings within a month or once a week which is scheduled every Friday. In the learning process Brain Based Learning strategy has 7 stages (Fauzia., 2021; Kusuma et al., 2020; Purnama, 2016) namely: first, Pre-exposure. This phase gives the brain a review of the new learning before really digging further: Pre-exposure helps the brain build a better conceptual map (Al-Balushi & Al-Balushi, 2018; Sari et al., 2019).

At this stage. the teacher greet and instruct students to pray before starting the lesson, the teacher checks the attendance of students as a discipline, the teacher conditions the class atmosphere to be ready to follow the learning process, such as instructing students to keep all books that are not related to the learning that will take place, and teachers Guiding students in class to do Brain Gym movements to help students concentrate during the learning process. Second, Preparation. At the preparation stage, the teacher gives an initial explanation of the material to be studied and relates the material to everyday life and students respond to what the teacher says, the teacher re-checks the students' understanding of the prerequisite material, the teacher motivates students by showing examples of material in the text. In everyday life, the teacher conveys the sub-materials to be studied in outline, the teacher conveys the learning objectives to be achieved, and the teacher conveys the approaches and learning models that will be used in the learning process. This phase is a phase in creating curiosity or pleasure (Al-Balushi & Al-Balushi, 2018; Jensen, 2011; Sari et al., 2019).

Third, initiation and acquisition. Students read books from various sources related to the sub-subject of drawing straight-line graphs, students are formed into several groups consisting of 4-5 people, each group is distributed LKPD, students are given directions that each group must do each activity on the LKPD by discussing together with their group friends, students are asked to observe the problems presented in each activity contained in the LKPD, then students are led to ask questions related to the things observed in the activities contained in the LKPD. This stage is the stage of creating connections or when the

neurons "communicate" with each other (Fauzia., 2021; Jensen, 2011; Sari et al., 2019). Fourth, Elaboration. Students in groups try to get ideas in solving problems given by the teacher, students discuss and collect the necessary information by reading books or various existing learning resources to solve the problems presented in the LKPD, students in groups are directed to analyze, reason and discuss problems in order to write down the solutions to the problems presented, students are asked to find other alternative solutions in solving problems on the LKPD, students are led to issue ideas, ideas or main thoughts in solving the problems presented, students are asked to re-examine the work that has been done, some groups are asked to present the results of their discussions in front of the class while other groups provide responses, from the results of the presentation students are expected to can see possible answers to the problems solved, students are directed to find the most unique solution, students are asked to make conclusions about the results of the presentation, and students are given feedback or reinforcement of the conclusions that have been made.

The elaboration stage provides an opportunity for the brain to sort, investigate, analyse, test and deepen learning. This is the processing stage, where it is time to make learning more meaningful (Fauzia., 2021; Jensen, 2011; Sari et al., 2019). Fifth, Incubate and insert memory. at this stage students stretch or relax while watching learning videos that support the material being studied, during the learning video playback, the teacher gives some simple questions related to the material that has just been studied. This phase emphasizes the importance of rest and time for repetition is an important thing (Al-Balushi & Al-Balushi, 2018; Jensen, 2011; Sari et al., 2019). Sixth, Verification and confidence checking. At this stage, the teacher checks whether the students have understood the material that has been studied by asking some questions to the students, the teacher checks whether the students have understood the material that has been studied or not. Students also need to know whether they have understood the material or not. Seventh, Celebration and integration. The teacher gives rewards to the group based on the success of the group learning, the teacher asks reflex questions, the teacher informs the material to be studied at the next meeting, in closing the teacher together with the students do small celebrations such as cheering and clapping together, the teacher ends the lesson by linking the material with religious and social values (Al-Balushi & Al-Balushi, 2018; Jensen, 2011; Sari et al., 2019).

While the implementation of conventional learning strategies carried out in the control class, teaching and learning activities are more directed to the teacher centre, so that when studying the researchers only provide verbal explanations. This situation resulted in students not actively seeking information independently and made students' mathematical communication skills less developed optimally. The mathematical communication ability of students in the experimental and control classes can be seen in the increase in the difference between the average scores of the pre-test and post-test results. The average pre-test result in the experimental class is 44.25 and the post-test is 102.4, while the average pre-test result in the control class is 54.2 and post-test is 69.1. The average gain of the experimental class by applying the Brain Based Learning strategy showed an increase of 58.15 points higher than the average gain of the control class with an increase of 14.9 points, so that the mathematical communication skills of students in the experimental class experienced a significant increase compared to that of the experimental class. control class.

Based on statistical calculations of the research data obtained through the t-test, the t-count gain is 8.25. Meanwhile, the value of t table with dk (number of samples minus two) is 62 and a significant level of 0.05 is 1.99 which is smaller than the t-count value, thus making the alternative hypothesis accepted and the null hypothesis rejected. The accepted alternative hypothesis statement states that there is a positive impact with the implementation of the Brain Based Learning strategy that is able to bring about an increase in the mathematical communication skills of fifth grade students at SDN Pangadegan 07 Pagi, South Jakarta. The difference in the average value of the post-test results of the two classes can also show that the Brain Based Learning strategy has a more positive impact and students' mathematical communication skills in the experimental class are better than the control class, because the average experimental class is 102, 4 while the average control class is 69.1. The development of students' mathematical communication skills can be caused by learning activities that support students in developing their thinking skills. Emphasis on activities that require students to relate the material to real problems in their daily activities.

4. CONCLUSION

The improvement in mathematical communication of fifth grade students at SDN Pangadegan 07 Pagi, South Jakarta, in the experimental class occurred significantly compared to the control class. The results of statistical calculations on research data obtained through t-test, the acquisition of t count is 8.25. Meanwhile, the value of t table with dk (number of samples minus two) is 62 and a significant level of 0.05 is 1.99 which is smaller than the t-count value, thus making the alternative hypothesis accepted. The

accepted alternative hypothesis, states that by applying Brain Based Learning strategy has a positive impact on the mathematical communication skills of class V SDN Pangadegan 07 Pagi South Jakarta in learning mathematics.

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