Jurnal Math Educator Nusantara
Wahanapublikasikaryatulisilmiah di bidangpendidikanmatematika
p-issn:2459-9735 e-issn: 2580-9210
http://ojs.unpkediri.ac.id/index.php/matematika

The spatial reasoning of junior high school student in solving spatial problems in terms of brain dominance

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Article received : 15 September 2022,
article revised : 08 November 2022,
article Accepted: 14 November 2022.
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***Abstract**: Building space is a material from geometry at the junior high school level, but there were still students who found it difficult to learn it, because the students needed spatial reasoning in studying and solving spatial problems. Brain Dominance is one of the factors that in fluence spatial reasoning. This research got aims to determined the spatial reasoning of junior high school students in completing the material in terms of brain dominance. This research was a descriptive study with a qualitative approach. The supporting instruments for this research were questionnaires, tests, and interviews. Data validation method used triangulation technique. Data analysis was carried out sequentially starting from data reduction, data presentation and conclusion drawing. The results of this study indicated that students with Right Brain Dominance performed spatial reasoning by depicting objects while students with Left Brain Dominance performed spatial reasoning by means of calculations either through formulas or comparisons and there were factors from within students that also affected the spatial reasoning of students.*

Keywords: Brain Dominance; Geometry; Spatial Reasoning

Penalaran Spasial Siswa SMP Dalam Menyelesaikan Masalah Bangun Ruang Ditinjau Dari Brain Dominance

Abstrak: Bangun ruang adalah materi dari geometri pada jenjang SMP namun masih ada siswa yang sulit mempelajarinya, karena dalam mempelajari dan menyelesaikan masalah bangun ruang memerlukan penalaran spasial. BrainDominance salah satu faktor yang mempengaruhi penalaran spasial. Penelitian ini bertujuan untuk mengetahui penalaran spasial siswa SMP dalam menyelesaikan materi bangun ruang ditinjau dari braindominance. Penelitian ini merupakan penelitian deskriptif dengan pendekatan kualitatif. Instrument pendukung penelitian ini berupa angket, tes, dan wawancara. Metode validasi data menggunakan Triangulasi teknik. Analisis data dilakukan secara berurutan dimulai dari reduksi data, penyajian data dan penarikan kesimpulan. Hasil penelitian ini menunjukkan bahwa siswa dengan Right Brain Dominance melakukan penalaran spasial dengan cara penggambaran objek sedangkan siswa Left Brain Dominance melakukan penalaran spasial dengan cara perhitungan baik melalui rumus atau pun perbandingan dan terdapat faktor dari dalam siswa yang juga mempengaruhi penalaran spasial dari peseta didik.

Kata Kunci: Bangun Ruang; Brain Dominance; Penalaran Spasial

INTRODUCTION

Mathematics education has an important role to gain the ability to compete in today's rapid development, so mathematics is an important medium for solving problems in science and everyday life (Fauzi & Arisetyawan, 2020). But in reality there are still students who have difficulty

CITATION FORMATS: Fantriadi, M. R., Lusiana, R., & Astuti, I. P. (2022). The spatial reasoning of junior high school student in solving spatial problems in terms of brain dominance. *Jurnal Math Education Nusantara: Wahana Publikasi karya Tulis Ilmiah di Bidang Pendidikan Matematika. 8(2), 134-146. https://doi.org/10.29407/jmen.v8i2.18494*

understanding mathematical material, especially geometry. Whereas topics in mathematics can be related to real life, one of which is through geometry (Rahayu & Jupri, 2021). This shows that learning geometry has not been able to achieve the desired results. This is reinforced by (Sutikno, 2017) which states that most of the students have difficulty understanding geometric shapes or images caused by a number of factors, namely the lack of student interest in mathematics, students lack of exploration, and so on that can affect student learning outcomes. This is reinforced by the data obtained based on the results of the average test scores of junior high school students, there are many students whose scores are below the KKM (Setiawan, Fauzan, & Arnawa, 2021).

Spatial thinking is carried out daily lives, one of which is in the field of geometry (Duarte, 2021). Spatial reasoning is one that affects students' difficulties during the learning process of geometry, especially in building materials (Runtukahu & Kandou, 2014). Spatial reasoning which is part of spatial abilities where this is also an important element in geometry, where if students have good spatial reasoning it will make it easier for them to understand geometric material, especially in building spaces even though they only study for a short time, this means if students have good spatial reasoning either will get satisfactory learning outcomes (Nurdiansyah, 2017). Spatial reasoning is needed in solving mathematical problems, especially geometry which has an abstract object of study such as in spatial material, the process of spatial reasoning in the spatial component is influenced by basic spatial concepts and task representation in solving problems (Latifah & Budiarto, 2019).

Mathematics learning at each level of education has its own characteristics according to the development of students (Nuryami, Janan, & Hasanah, 2022). Junior high school students who are in the operational stage of Piaget's theory have been able to think using a number of symbols and certain formal logic, one of which is about spatial (Hidayat, Tristanti, Nurwiani, & Iffah, 2021). Building space is one of the geometry materials studied in junior high school where students will often use reasoning spatial analysis in particular to determine the elements in the spatial structure. Spatial reasoning includes the process of understanding and collecting various information from objects / shapes in a space and the relationships between them so that a conclusion will be obtained about these objects to complete certain tasks (Hidayat & Fiantika, 2017). The conclusion that students get from their spatial reasoning is the result of gathering information to solve a problem, and each student will get information and different problem solving according to the experiences stored in the brain.

The human brain has several parts that affect a person's way of thinking and one of these parts is the hemisphere (hemisphere) which consists of one pair in each brain, namely the right hemisphere and the left hemisphere (Basyir, 2017). Brain Dominance according to Oktafiani (2020) is a brain condition that regulates all human activities that have a tendency to use one part of it in the process of receiving information and thinking in everyday life. Thinking, and problem solving students' brain dominance is also part of the main system in the brain which is also an important factor in student success in problem solving.

The potential for spatial reasoning of each student will be different, where the different is due to differences in brain dominance of each student. Everyone’s brain

dominance is influenced by the brain's adaptation process in overcoming various tesks according to their respective conditions (Nithyanantham & Regis, 2021). A perseon's characteristics in processing information vary according to the dominance of each person's brain (Sukmaangara & Madawistama, 2021). People who have left brain dominance (the left brain is superior) are people who carry out all their actions mathematically according to both their own plans and the plans of others, while people who are right brain dominance (right brain superior) are people who often think unexpected or beyond logic in general and trying to make it happen (Ali & Raza, 2017).

Students at the junior high school level still have difficulty in learning mathematics, especially geometry material which is caused by a number of factors, one of which is students' weak spatial reasoning. This study will discuss spatial reasoning, brain dominance and the process of solving spatial problems. This study will analyze the spatial reasoning of 9th grade junior high school students on the material of spatial structure in terms of brain dominance. Where we will find out how the spatial reasoning of each student in solving problems by using the advantages he has, such as easier to understand an image than numbers or vice versa according to brain dominance.

The purpose of this research is to find out the spatial reasoning of junior high school students in solving spatial problems in terms of brain dominance, based on this goal, it is hoped that the results of this study can help all members of an educational institution, especially junior high school, in carrying out learning better by paying attention to spatial reasoning and brain student's dominance

METODE

Types of research

The research method includes qualitative research. Qualitative methods analyze data in the form of stories or descriptions (Levin & Forward, 2021). The method allows to obtain predetermined results or more (Mosley, Robinson, Coyne, Breakspear, & Carter, 2019) This study aims to determine students' spatial reasoning when solving problems of building space based on brain dominance, where students in one class will build based on brain dominance, 2 students will then be selected as representatives to complete the test and interview questions.

Place and time of research

This research was conducted at the Ibnu Batutah Junior High School which is located at Hamlet Kluwung, RT. 17/RW. 05, Cabean Village, Kec. Sawahan, Kab. Madiun because when conducting observations at schools the researchers found the fact that students in this school came from various different backgrounds so that they were in accordance with the conditions of the research sample to be carried out. This research was conducted in the even semester of the 2021/2022 academic year starting from May to June, this research was carried out directly at schools.

Data collection technique

Data collection techniques in a study are one of the most important parts of a study where this section deals with data to be obtained for later analysis and in this study the techniques used by researchers are questionnaires, test work, and interviews.

Instrument

The support used is a brain dominance questionnaire consisting of 35 multiple choice questions, a problem-solving test question in the form of a description of spatial structure, and an interview guide which contains a number of questions regarding aspects of spatial reasoning. According to t(Cahyati, Risalah, & Muchtadi, 2021) the aspects of spatial reasoning are as follows.

Tabel 1. Aspects of Spatial Reasoning

No.	Spatial Reasoning Aspect	Indicator
1.	Spatial Visualization	Imagining or changing the image of the spatial pattern of a spatial form in which there are changes in other visual arrangements.
2.	Spatial Orientation	the skills of imagine how an object/image will be manipulated to determine the position of the object or the result of the transformation on the object seen from that perspective with the observer either mentally or physically,
3.	Mental Rotation	cognitive process in which a person imagines how 2D and 3D objects will appear after being rotated.

Students in one class will be given a brain dominance questionnaire to group students into 2 categories, namely students with Right Brain Dominance and Left Brain Dominance, then after knowing the score of each student's questionnaire will be selected 1 student Right Brain Dominance and 1 student Left Brain Dominance with a score which will be given test questions and interviews.

Data validation

The method used in this study was carried out with the method of triangulation technique in which the researcher would compare the data obtained from the distribution of the questionnaire conducted at the beginning, the results of the yes work carried out afterwards, and in the end conducted interviews to obtain the desired results. questionnaires, taking tests, interviews.

Data analysis technique

In this study through a number of stages starting from data reduction by summarizing the data obtained, presenting data by selecting the important parts of data collection, and drawing conclusions by paying attention to and connecting the important parts to the data obtained.

RESULTS AND DISCUSSION

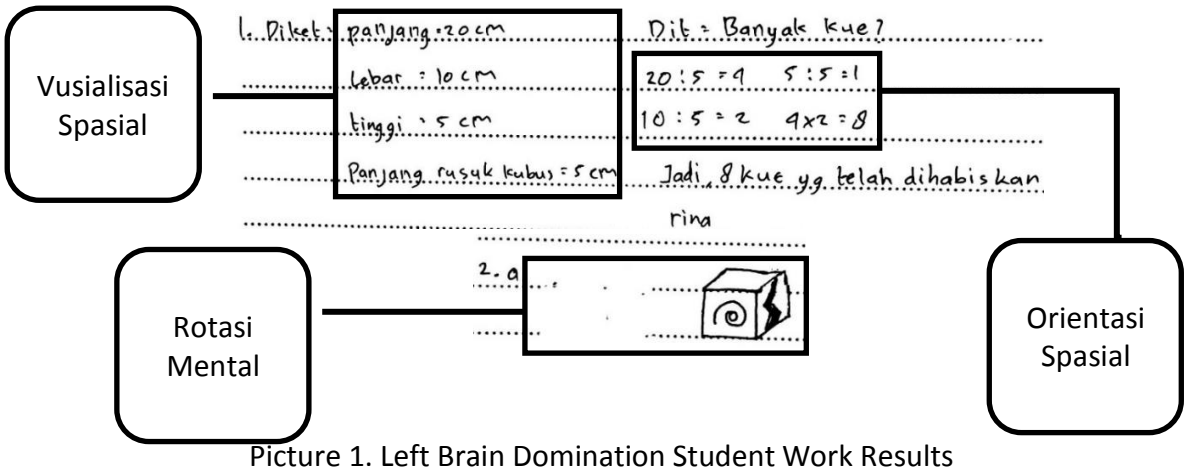
Results

This study begins by giving a brain dominance questionnaire to each student in the class and assigning a score for each result in order to determine the category of each student, here are the scores from the results of each student's questionnaire:

Tabel 2. Brain Dominance Questionnaire Results

Name	Answer A	Answer B	Information
(ASF)	14	21	RBD
(AAM)	15	20	RBD
(AZF)	21	13	LBD
(ASK)	19	16	LBD
(AAS)	19	16	LBD
(AAR)	22	13	LBD
(CGNWS)	19	16	LBD
(HQA)	21	14	LBD
(KAS)	23	12	LBD
(KS)	13	22	RBD
(LSI)	13	22	RBD
(LTNA)	14	21	RBD
(NAM)	20	15	LBD
(NQA)	27	7	LBD
(NWS)	20	15	LBD
(NNL)	14	21	RBD
(NM)	23	12	LBD
(NAN)	15	20	RBD
(NANP)	22	13	LBD
(NHS)	17	18	RBD
(QAH)	20	15	LBD
(RAA)	13	22	RBD
(SN)	19	16	LBD
(SSS)	18	17	LBD
(SAN)	21	14	LBD

Based on the results of the questionnaire and recommendations from the school, several students with high scores were selected, so the subjects of this research were HQA students for LBD (Left Brain Dominance) representatives and KS students for RBD (Right Brain Dominance) representatives. After that, HQA students and KS students would do the test questions that have been prepared by the researcher, and will take part in an interview session with the researcher regarding the results of his work in completing the test questions given. Research results are presented in the form of graphs, tables, or descriptive. Analysis and interpretation of these results is required before they are discussed.



Picture 1. Left Brain Domination Student Work Results

From the results of the work of HQA students, it shows that in the aspect of spatial visualization students can determine the actual size of the shapes that exist after students read the questions thoroughly, HQA has been able to perform aspects of spatial visualization well by determining the size of the shapes that are built as a whole. as excerpts from the following interview.

Tabel 3. Spatial Visualization of Left Brain Dominance Students

P	Jenis bangun apa yang ada pada soal?
N	Balok dan kubus
P	Bagaimana dengan ukurannya?
N	Balok mempunyai panjang 20 cm lebar 10 cm dan tinggi 5cm sedangkan kubusnya punya panjang rusuk 5 cm

In the aspect of spatial orientation, students can state the shapes of the shapes in the questions after students read the questions thoroughly, which is followed by paying attention to the shapes on the questions from a certain point of view while adjusting them to known sizes, HQA performs spatial orientation in the process. although it does not draw the shape of HQA using spatial orientation by comparing the size of the block with the cube according to the problem, this is reinforced from the following interview excerpt.

Tabel 4. Left Brain Domination Students' Spatial Orientation

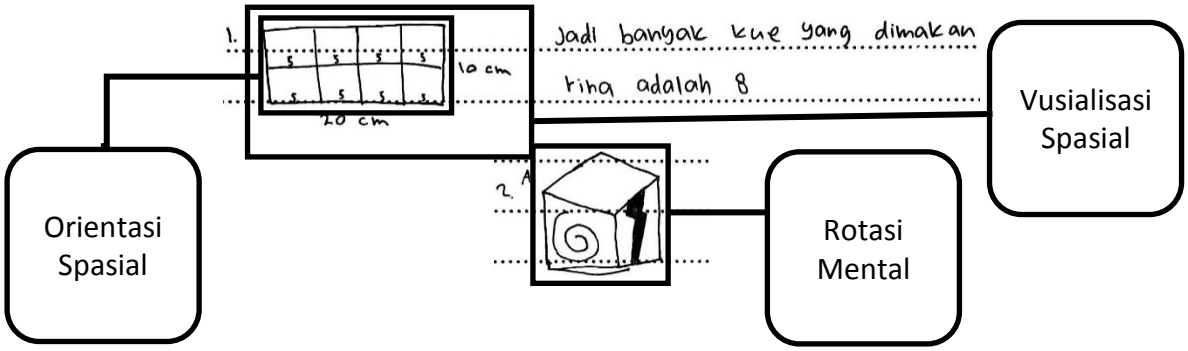
P	ok selanjutnya apakah kamu membayangkan bangun-bangun pada soalnya beserta ukurannya?
N	Ya
P	Dari sudut pandang mana kamu membayangkannya?
N	Depan dan samping dan atas

In the mental rotation aspect, students can state the changes that occur in a shape after experiencing a rotation according to certain provisions, both changes in the position of the wake or in the shape of the shape, HQA performs the mental rotation aspect well by

determining the change in the position of the shape in the question as in the following interview excerpt.

Tabel 5. Mental Rotation of Left Brain Domination Students

P	Coba tunjukkan perubahan apa saja yang terjadi pada sisi-sisi kubus itu,
N	Yang ini ( ) menjadi yang ini ( ) lalu yang ini ( ) menjadi yang ini ( ) dan yang ini ( ) menjadi yang ini ( )



Picture 2. Right Brain Domination Student Work Results

From the results of the work of KS students, it can be seen in the spatial visualization aspect that students can determine the actual sizes of the shapes in the questions after students have read the questions thoroughly, KS has been able to do the spatial visualization aspect well by determining the sizes of the shapes that have been built. as in the following interview excerpt.

Tabel 6. Students' Spatial Visualization of Right Brain Domination

P	Jenis bangun apa yang ada pada soal?
N	balok dan kubus
P	Ukuranya bagaimana?
N	Baloknya memiliki panjang 20 cm dan lebar 10 cm dan tinggi 5 cm kemudian kubus punya panjang rusuknya 5 cm

In the aspect of spatial orientation, students can state the shapes of the shapes in the questions after students read the questions thoroughly, which is followed by paying attention to the shapes on the questions from a certain point of view while adjusting them to known sizes, KS can perform aspects of spatial orientation. By drawing the shape in the question with the point of view of the upper part only in order to determine the final result sought from the problem, this is reinforced in the following interview excerpt.

Tabel 7. Student's Spatial Orientation of Right Brain Domination

P	Apakah kamu membayangkan bangun-bangun pada soalnya beserta ukurannya?
N	Ya
P	Dari sudut pandang mana kamu membayangkannya
N	Dari atas
P	Dari atas saja
N	Samping dan depan juga
P	Lalu kenapa di gambar yang atas saja (menunjuk pada hasil pekerjaan peserta didik)
N	Karena jika dari atas semua kubusnya terlihat
P	Kalau dari samping kubusnya terlihat berapa
N	Cuma 2
P	Kalau depan
N	4

In the mental rotation aspect, students can state the changes that occur in a shape after experiencing a rotation according to certain provisions, both changes in the position of the wake or in the shape of the shape, KS performs the mental rotation aspect well where KS can determine changes in the position of the existing wake appropriately. as in the following interview excerpt.

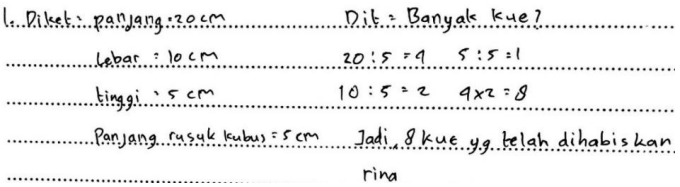
Tabel 8. Mental Rotation of Right Brain Domination Students

P	ok lalu coba tunjukkan perubahan apa saja yang terjadi pada sisi-sisi kubus itu,
N	Dari yang ini () ini () ini () menjadi seperti ini () ini () ini ()
P	Satu-pertsatu
N	Dari yang ini () ke () lalu ini () ke ini () terakhir ini () ke ini ()

Discussion

Left Brain Dominance Student Spatial Reasoning

Spatial visualization has been mastered by junior high school students by being able to determine real shapes (Azizah, 2022). Spatial visualization carried out by Left Brain Dominance students when working on problem solving tests through the explanations that students wrote about the size of the real shape according to the problem even though on the results of the test, students stated the size not directly but by substituting it into the calculation plan that they used after reading the problem in detail. thorough.



Picture 3. Reasoning for Spatial Student Left Brain Domination

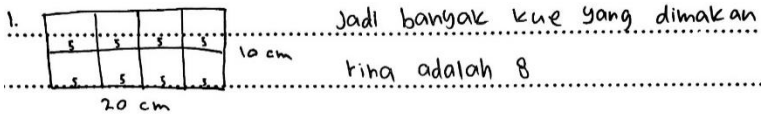
Murtafiah, Oktafian, & Lusiana (2020) stated that Left Brain Dominance students who are more dominant in mathematics (lessons that often use logic) are able to know how to solve problems according to the questions. Basically, students with Left Brain Dominance are better able to process information in the form of letters and numbers deductively or logically (Belecina & Ocampo, 2019).

The spatial orientation of Left Brain Dominance students has not been able to clearly show the condition of the wake and pays more attention to the formulas related to the shape, female students and if anyone is able to do spatial orientation then to show it Left Brain Dominance students use a comparison of the sizes of build one with the other as the object of comparison. This is in accordance with the results of Sukmaangara, Muhtadi, & Madawi (2021) research where Left Brain Dominance students carry out their expertise, namely analysis which is used to make a single unit of space by dividing it into several small shapes of the same size then the new student calculates the volume of each. -each build the space. Left Brain Dominance students who think more often about numbers and logic will use division or comparison methods (Murtafiah, Oktafian, & Lusiana, 2020). Students with left brain dominance have a focus on analytical, logical and accurate thinking. have a structured, neat and systematic way of working (Lusiana & Andari, 2022).

The mental rotation possessed by Left Brain Dominance students has not been able to explain the rotations that occur in a wake properly, and still have difficulty showing changes in conditions from waking up before rotation in wake to after rotation in wake. Left Brain Dominance students are not good at spatial aspects (Basyir, 2017). This is supported by research by Azizah (2022) in which junior high school students who took the spatial ability test had difficulty working on the problem, especially in the mental rotation section. Although there are several incidents that show students doing mental rotation well, there are a number of other important factors that support it, such as motivation in learning or how to learn.

Students' Spatial Reasoning Right Brain Dominance

Spatial visualization has been mastered by junior high school students by being able to determine real shapes (Azizah, 2022). The spatial visualization of Right Brain Dominance students chooses to do it by describing the shapes directly rather than determining the sizes of each shape one by one such as its length and width and height, like this.



Picture 4. Reasoning of Spatial Student's Right Brain Dominance

Jafar, Sukayasa, & Lefrida (2017) argue that Right Brain Dominance Students describe shapes to make it easier to understand the problem so that students can find patterns in problems and then look for patterns in solving them correctly, depicting the shapes themselves according to the type and also the real sizes. According to events that occur,

students' spatial aspects will be more easily explained in education about graphics or images (Buckley, Seery, & Canty, 2018).

The spatial orientation carried out by Right Brain Dominance students is explained from the point of view where students describe the shapes that are in question simultaneously and also pay attention to the sizes of the shapes that are known and in accordance with the students' working process that has been prepared to get the completion of the solving test. given problem. Right Brain Dominance students rather than using numbers, it is easier to understand and understand information in the form of photos and images seen (Basyir, 2017). These results are in accordance with research by Belecina & Ocampo (2019) which states that students with Right Brain Dominance are more skilled in working on information processing tasks about spatial relationships. A similar incident with the research of Untari, Astuti, & Susa (2022) stated that in solving problems in learning mathematics, not only using formulas.

The mental rotation of Right Brain Dominance students did well where Right Brain Dominance students could explain the changes that occurred in the wake that underwent rotation and determine the position of the wake after a rotation was made on the wake and can also show the differences that occur in the condition of waking up before the rotation with conditions wake up when after the rotation, female students at the junior high school level are able to do mental rotation by predicting the wake after being rotated (Suparmi, Budayasa, & Setianingsih, 2022). Also in Oktafiani's research (2020) stated the same thing that Right Brain Dominance students were easier to process information in the form of images and imagination. Right Brain Dominance students are more appropriate to process information on three-dimensional shapes and images (Belecina & Ocampo, 2019).

Differences in Student Spatial Reasoning

From the explanation of the results of the research carried out and the analysis activities carried out by the researchers, it shows that the spatial reasoning done by students in solving the problem of building space is that students with Left Brain Dominance carry out the three main aspects of spatial reasoning where students' spatial visualization is able to show the size of the shapes in question. using a certain number of symbols, students' spatial orientation has difficulty applying it to the existing problems, and students' mental rotation also has difficulty determining changes that occur in a shape that is rotated several times, although the results show students are able to do it after several times. times tried. Meanwhile, students with Right Brain Dominance can perform the three main aspects of spatial reasoning, namely spatial visualization which is used to show the real sizes of a shape, then spatial orientation which is used to observe a shape from several different points of view correctly, and finally mental rotation It is used to determine changes in a shape that undergoes rotation, either changes in the shape or position of the wake.

The differences in students' spatial reasoning occur in the three aspects of spatial reasoning, namely spatial visualization aspects, spatial orientation aspects, and mental rotation aspects, but this is not something strange considering that the different ways of

responding to a student's problem are different according to the development of their respective brains. -each to form a tendency to use the brain (Brain Diominance). The following are the differences in the spatial reasoning of Right Brain Dominance and Left Brain Dominance students shown in this table.

Tabel 9. Differences in Students' Spatial Reasoning of Left Brain Domination and Right Brain Domination

Spatial Reasoning Indicator	Left Brain Domination Students	Right Brain Domination Students
Spatial Visualization	Spatial visualization is shown using various symbols or numbers	Spatial visualization is shown using the depiction of the object being discussed by adjusting the order in the problem
Spatial Orientation	Spatial orientation is shown if by comparing 2 possible objects	Spatial orientation is shown by how the object is depicted from a certain point of view such as the image from above so that it only has 2 sizes, namely length and width only or the image from the front so and height only
Mental Rotation	Mental rotation is shown by trying several times to rotate the object	Mental rotation is indicated by once again trying to rotate the object

CONCLUSION

Right Brain Dominance students who are superior in understanding pictures perform all three aspects of spatial reasoning, namely spatial visualization, spatial orientation and mental rotation by tending to use the depiction of shapes according to the events in the problem in solving spatial problems, while Left Brain Dominance students who are more excels in understanding symbols and numbers performing all three aspects of spatial reasoning by tending to use certain numbers and symbols and processing them with comparisons or examples in solving spatial problems.

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