

SPATIAL CAPABILITIES THROUGH THE AUDITORY KINESTHETIC VISUALIZATION SELF REGULATED LEARNING MODEL IN THE COVID-19 ERA

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Abstract

The purpose of this study was to describe the answer process made by students in solving spatial ability questions through the Visualization Auditory Kinesthetic (VAK) learning model in the Covid-19 era. This type of research was conducted using a qualitative case study method on students' spatial abilities. The sample in this study was seventh-grade junior high school students from the purposive sampling technique and was taken by the initial screening results. The instruments used in data collection are observation and documentation. The results of this study indicate that spatial abilities through the Visualization Auditory Kinesthetic (VAK) learning model students can better understand the material because this model is better able to understand the material with their respective learning styles. The spatial ability consists of orientation, mental rotation, visualization, perception, relation, and disembedding. It turned out that many students answered correctly with a complete answer process on aspects of orientation, visualization, and perception. The rest on aspects of mental rotation, relation, and disembedding, there are still some students who have not answered correctly, and the answer process is complete. Therefore, it should be noted that aspects that cannot be answered correctly need improvements in the learning process or in questions that support aspects of mental rotation, relation, and disembedding spatial abilities to understand the geometry material better.

Keywords: Spatial Ability; Visualization; Auditory Kinesthetic

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Introduction

Mathematics is one part of education that can train students to think critically (Şöhretoğlu et al., 2018). The role of students in learning mathematics will determine whether the student has understood or not the material being taught. But in fact, the lack of students' roles in learning causes students not to be interested in participating

in mathematics lessons because students only receive the knowledge given by the teacher. In line with (Saputri, 2014), states students have difficulties in learning mathematics

because mathematics is a lesson about abstract things, so it is difficult to understand and boring, and mathematics only knows about numbers. The subject matter of mathematics in elementary, junior high, and high school is geometry, algebra, numbers, statistics, and probability. However, the most disliked, tedious, and complex material for most students to understand and learn is geometry. Students have to visualize, describe, and compare geometric shapes in various positions to understand them in geometry.

Furthermore, the objectives of learning geometry, as reported in (McAllister, Whiteford, Hill, Thomas, & Fitzgerald, 2006), are (a) to develop spatial awareness, geometric intuition, and the ability to visualize, (b) to provide a breadth of geometric experience in both 2-dimensional and 3-dimensional space, (c) to develop knowledge and understanding of and ability to use properties and theorems of geometry, (d) to encourage the development and use of conjecture, deductive reasoning and proofs, (e) to develop skills of applying geometry through modeling and problem-solving in the real world, (f) to develop skills in using ICT in the context of geometry, (g) to induce positive attitudes towards mathematics, (h) to develop an awareness of the historical and cultural heritage of geometry in society and contemporary applications of geometry. states that the objectives of learning geometry are to develop the ability to think logically, to develop spatial intuition, to impart knowledge to support other materials, and to be able to read and interpret mathematical arguments.

Study (Hui et al., 2017) Aspects of concept formation and spatial visualisation in geometry were investigated. Understanding the concept of geometry requires the ability to visualize images in both two-dimensional and three-dimensional space, one of which is spatial ability. Linearly Ryu, et all (2007 : 137) the purpose of this research is to analyse the spatial visualization ability of mathematically gifted elementary school students using tasks that require them to distinguish relevant constituents of a three-dimensional object from its two-dimensional representation by mentally manipulating or rotating it. (Gagatsis & Geitona, 2021) suggested that spatial ability is a single component that has a strong relationship with achievement in mathematics. Huang, et all Spatial ability has been recognized as one of the most important factors affecting the mathematical performance of students. Previous studies on spatial learning have

mainly focused on developing strategies to shorten the problem-solving time of learners for very specific learning tasks. The results of the researcher's preliminary study on students at SMP Negeri 1 Binjai where students were asked to solve the following question

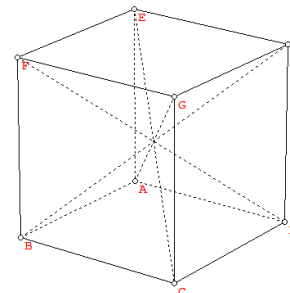


Figure 1
Cube ABCD.EFGH

Consider figure 1. cube ABCD.EFGH. A diagonal space line is drawn through the vertices to form a pyramid.

- How many pyramids are formed?
- Are the pyramids congruent?
- What shape is the base of each pyramid?

Beberapa jawaban dari siswa	
Penyelesaian : a. 5 limas yang berbentuk kubus b. Tidak c. Segitiga 1. a. 2 buah b. Ya, karena memiliki sisi-sisi yg sama & memiliki luas sama Panjang limas memiliki tinggi yang sama panjang. c. Jajar genjang	Siswa menuliskan n banyaknya limas tetapi tidak dapat menuliskan limas-limas mana saja yang dimaksudkan Siswa hanya melihat gambar bahwa limas yang terbentuk hanya 2 yaitu bagian atas dan bawah saja Kemampuan siswa dalam melihat dan memvisualisasikan gambar ke ruang 3 dimensi masih kurang Siswa hanya melihat gambar saja bahwa alas kubus berbentuk jajar genjang
Penyelesaian : a. 9 b. Ya, karena memiliki sisi yang sama dan medula atas yang sama panjang c. Jajar genjang	

Figure 2
Students' Answers in the Preliminary Test

From these data, it can be seen that students have not mastered the geometry material, with students' spatial abilities still relatively low. Completing student answers is still significantly less varied and tends to be the same. Students have not visualized the

shape of three-dimensional space in their minds in solving these problems. This means students who construct the spatial structure find it difficult to either be two-dimensional or three-dimensional. (Maier, 1996) Spatial-visual skills are frequently and extensively avoided, the way that geometrical polyhedra are already projected in oblique parallel perspective

Study (Pittalis, Mousoulides, & Christou, 2007) Spatial ability has been considered to be closely related to academic achievement, particularly to success in mathematics. This emphasizes the importance of spatial abilities for students and becomes a challenge for teachers to plan creative, effective, and efficient learning. (Abdussakir, 2009) Geometry material initially considered difficult by students can be easily understood through fun but a meaningful learning process. Based on these problems, if the learning model used is correct, the students' spatial ability will be high, supported by a learning atmosphere in various directions and paying attention to ways that can facilitate and accelerate the acquisition of information by students.

Therefore, it is necessary to design a geometry lesson that can develop spatial abilities, namely a study that makes it easy for students to understand geometric problems to complete their answers in writing and visually. To improve spatial skills by considering the heterogeneous state of students, school conditions, learning environments, and student learning styles, and in the era of the Covid-19 pandemic.

Researchers choose an alternative that can be used by applying the Visualization Auditory Kinesthetic (VAK) learning model. Sancocho et al. (Huda & Saputri, 2018) state that the Visualization Auditory Kinesthetic (VAK) learning model is a strategy that utilizes the potential that students already have (involving emotions, the whole body, all the senses, and all emotional depth and breadth). by training and developing it to

achieve effective and optimal understanding and learning.

The Visualization Auditory kinesthetic (VAK) learning model gives students the freedom to see, listen, and feel or touch directly either in groups or individually on the material presented in the lesson. In the Visualization Auditory Kinesthetic (VAK) learning model, students can train and develop their potential, provide direct experience, and maximize involvement in finding and understanding a concept through physical activities such as demonstrations, experiments, observations, and active participation discussions.

Before the Covid-19 pandemic, most education in Indonesia was conducted directly, namely by face-to-face classroom learning. Learning that is carried out face-to-face now in schools positively impacts the cognitive and social-emotional aspects and positively impacts the language aspect. However, in contrast to the past two years, every school in Indonesia or other countries learns online. Online learning for school children is a collaborative program with school principals/teachers and parents to assist and strengthen the delivery of materials and information during the Covid-19 pandemic.

Based on the explanation above, it is necessary to research spatial abilities through the Visualization Auditory Kinesthetic (VAK) learning model in the Covid-19 era. The problem in this study is how do students in solving spatial ability questions make the answer process? The Visualization Auditory Kinesthetic (VAK) learning model in the Covid-19 era?. The research aims to describe the answer process made by students in solving spatial ability questions through the Visualization Auditory Kinesthetic (VAK) learning model in the Covid-19 era.

Method

(Starman, 2013) One type of descriptive qualitative research is in the form of research using a case study method or

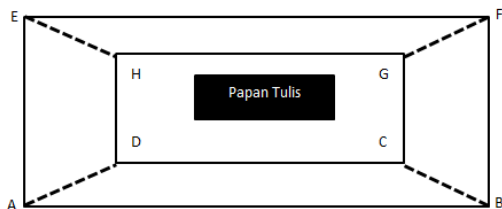
approach. This research focuses intensively on one particular object studied as a case. The case study research aims to focus intensively on a specific thing studied as a case. The case study approach allows the researcher to remain holistic and significant.

The case study approach collected data from various sources, and the results of this study only apply to the investigated cases. This study uses purposive sampling to determine the number of samples used as sources by using specific considerations. Data collection techniques in this study using the instrument of observation and documentation aimed at students as the research subject used to add, confirm, and confirm the results of the investigation. This research also went through the stages of initial screening, was at the stage the distribution is carried out spatial ability test questions that students do to find out the pattern of students' answers on geometry material.

Results And Discussion

The results of the research are to describe the answer process made by students in solving spatial ability questions through the Visualization Auditory Kinesthetic (VAK) learning model in the Covid-19 era as follows:

1. If the classroom is generally in the form of a block model, we call it a block ABCD.EFGH (EFGH) on the top plane. Imagine that the blackboard is placed on the DCGH plane, and you are taking lessons.



Source: Modified (Sugilar, 2013)

- a. How many sides are there in the classroom, and what shape are the sides of the classroom? Explain
- b. How many diagonals can you make from the classroom? Explain!
- c. How many diagonal areas are there that divide your class into two equal sizes, and what shape is the diagonal of the space? Explain!

The discussion is:

Completing the answer to question number 1 measures spatial ability with its aspect is orientation. Orientation is the ability to recognize the arrangement or form of space in general and accurately (identify the characteristics of building spaces in general) with imagined changes from the perspective of a given object. The indicator is that students can mention the general aspects of building structures (cubes and blocks) by imagining changes from the given perspective. One example of the answer process completed by students who are taught with the learning model Visualization Auditory Kinesthetic (VAK) is as follows:

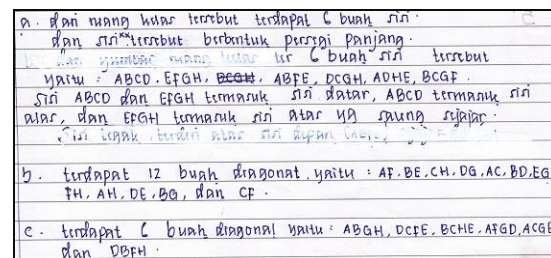


Figure 3
Students' Answers on Spatial Ability with Orientation Aspects

Based on Figure 3, the process of solving problem number 1. It seems that students have been able to mention the general characteristics of building structures (cubes and blocks) by imagining changes from the given perspective. This means that for solving problem number 1, students have been able to guess the shape of the space in question, mention the number of sides, side diagonals, and diagonal planes of the wake, and mention the characteristics of the body

correctly and completely. While some students complete other answers, namely as follows:

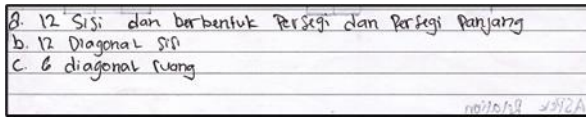
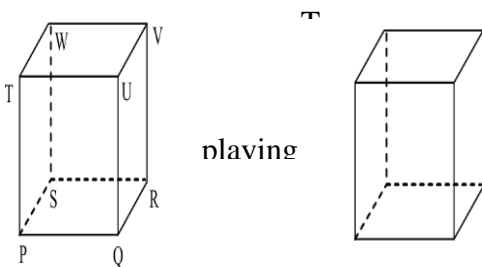


Figure 4

Students' Answers on Spatial Ability with Orientation Aspects

Based on Figure 4, it is obtained that the completion of question number 1. It seems that students have not mentioned the general characteristics of building structures (cubes and blocks) by imagining changes from the given perspective. This means that for solving problem number 1, students have not been able to guess the shape of the space in question and have not mentioned the number of sides, side diagonals, and the body's diagonal plane say the characteristics of the area.

1. Pay attention to the following picture



Name each corner point! Give the reason!

The discussion is:

Completing the answer to question number 2 measures spatial ability with its aspect is mental rotation. Mental rotation is the ability to think (mentally) about the rotation (translation) of 2-D or 3-D image objects accurately. The indicator can state the shape or position of a spatial figure due to rotation or translation (by way of imagining). One example of the answer process completed by students taught by the

Visualization Auditory Kinesthetic (VAK) learning model is as follows:

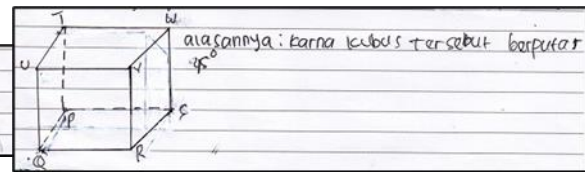


Figure 5

Students' Answers on Spatial Ability with Mental Rotation Aspects

Based on Figure 5. the process of solving problem number 2. It appears that students have been able to state the shape or position of awake as a result of rotation or translation (by imagining). This means that for solving problem number 2, students have been able to imagine and rotate the image of the cube and find out how much the shape of the space is rotated. While some students complete other answers, namely as follows:

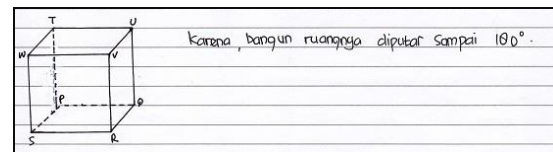
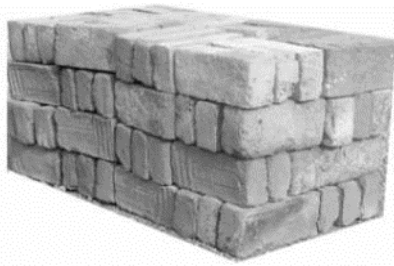


Figure 6

Students' Answers on Spatial Ability with Mental Rotation Aspects

Based on Figure 6. the process of solving problem number 2. It seems that students have not been able to state the shape or position of awake due to rotation or translation (by imagining). This means that for solving problem number 2, students have not been able to imagine and rotate the cube image and know how much the shape of the space is rotated.

1. Pay attention to the arrangement of the bricks below!



Source: (Hertel, Hochweber, Mildner, Steinert, & Jude, 2014)

How many bricks are there to make it up? Explain!

The discussion is:

They are completing students' answers to question number 3 measures spatial ability with visualization aspect. Visualization is the mental ability to manipulate (by imagining) to capture and describe changes in the shape of an object from the displayed stimulus to its basic form (rotation, turning, or changing the arrangement of 3-D objects). Through imagery, the indicator can state a spatial object stimulus's actual condition (shape). One example of the answer process completed by students taught using the Visualization Auditory Kinesthetic (VAK) learning model is as follows:

Batu bata yang menyusun balok tersebut adalah: 96 buah
karena dalam 1 baris batu bata terdiri dari 12 buah batu bata .
kalikan 4 baris = 12 x 4 baris = 48 buah
Sebaliknya juga begitu 12 buah batu bata dikali 4 baris
= 12 x 4 baris = 48 buah
Jadi 48 x 2 = 96 buah

Figure 7
Students' Answers on Spatial Ability with Visualization Aspects

Based on Figure 7. the process of solving problem number 3. It appears that students have been able to state the actual condition (shape) of a spatial object stimulus through imagery. This means that three students have expressed the need to form the truth, explain it in detail, and complete solving problem numbers. While some students complete other answers, namely as follows:

96 buah

Figure 8

Students' Answers on Spatial Ability with Visualization Aspects

Based on Figure 8. the process of solving problem number 3. It appears that students have not been able to state the actual condition (shape) of a stimulus object through imagery. This means that for solving problem number 3, students only write down the correct answer and have not been able to state the actual condition of the form and explain it thoroughly.

1. Look at the picture below!
- Draw a flat shape from the picture above
- a. When viewed from above
 - b. When viewed from the front
 - c. When viewed from the right

The discussion is:

Completion of students' answers to question number 4 measures spatial ability with the aspect of perception. Perception is the ability to recognize that the size and shape of the subject remain the same even though the stimulus is different based on how we perceive it from that perspective. The indicator can state the actual shape or size of a display (inspiration) 3-D based on what is felt.

One example of the answer process completed by students taught using the Visualization Auditory Kinesthetic (VAK) learning model is as follows:

a. bila dilihat dari atas	b. bila dilihat dari depan	c. bila dilihat dari samping kanan

Figure 9
Students' Answers on Spatial Ability with Perception Aspects

Based on Figure 9. the process of solving problem number 4. It seems that students have been able to state the actual shape or size of a 3-D display (stimulus) based on what is felt. This means that for solving problem number 4, students can imagine waking up space and imagining it into a flat shape when viewed from various

sides. While some students complete other answers, namely as follows:

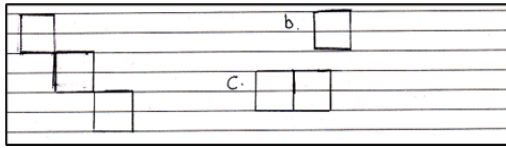
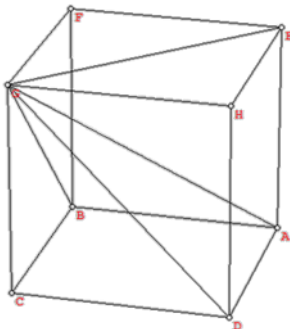


Figure 10

Students' Answers on Spatial Ability with Perception Aspects

Based on Figure 10. the process of solving problem number 4. It seems that students have not been able to state the actual shape or size of a 3-D display (stimulus) based on what is felt. This means that for solving problem number 4, students cannot imagine waking up space and imagining it into a flat shape when viewed from various sides correctly.

1. Look at the cube picture below!



- a. How many of each shape can be formed? What is the total number of shapes formed?
- b. Write down what shapes are in the cube?
- c. What conclusions can you draw?

The discussion is:

Completing students' answers to question number 5 measures spatial ability with its aspect is a relation. The relation is the ability to see two or more objects about themselves or to one another in space. The indicator can state the relationship of elements in 3-D (lines, planes, and points) of the displayed stimulus. One example of the answer process completed by students taught using the Visualization Auditory Kinesthetic (VAK) learning model is as follows:

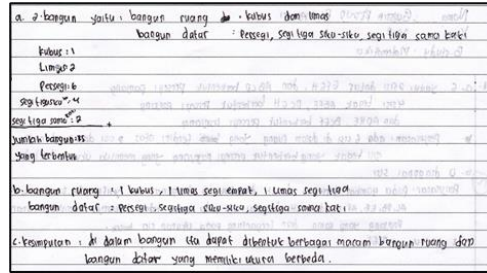


Figure 11

Students' Answers on Spatial Ability with Relation Aspects

Based on Figure 11, the process of solving problem number 5. It appears that students can state the relationship of elements in 3-D (relationships of lines, planes, and points) of the displayed stimulus. This means that for solving problem number 5, students can imagine and state the relationship between flat shapes and any shapes formed in the shape of space. While some students complete other answers, namely as follows:

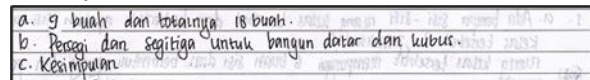


Figure 12

Students' Answers on Spatial Ability with Relation Aspects

Based on Figure 12. the process of solving problem number 5. It seems that students have not yet expressed the relationship of elements in 3-D (relationships of lines, planes, and points) from the displayed stimulus. This means that for the completion of question number 5, students have not been able to imagine and state the relationship of flat shapes and any shape of space formed in the shape of space correctly.

1. Know the shape of the cube model:
 - a. Draw a cube ABCD. EFGH. Make the diagonals of the space in the cube!
 - b. What shapes are formed in the cube you made? Explain!
 - c. If the side of the cube is 8 cm, what is the height of the shape created from the diagonal of the space in the cube?

The discussion is:

Completing students' answers to question number 6 measures spatial ability with its aspect is disembedding. Disembedding is the ability that allows one to search for simple objects that are inserted into complex images. The indicator can state/select elements (simple things) to build a tricky thing (photo). One example of the answer process completed by students in the experimental class is the STAD type cooperative learning assisted by Wingeom as follows:

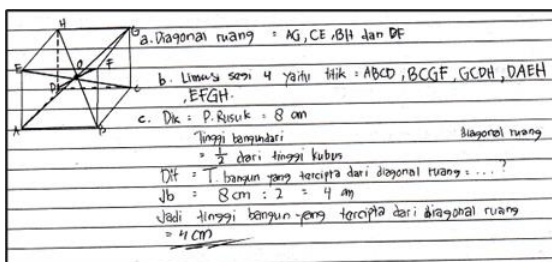


Figure 13
Students' Answers on Spatial Ability with Disembedding Aspects

Based on Figure 13, the process of solving problem number 6. It appears that students have been able to state/choose elements (simple objects) that can build complex things (pictures). This means that six students have imagined and explained an object (image) in the form of space for solving problem numbers. While some students complete other answers, namely as follows:

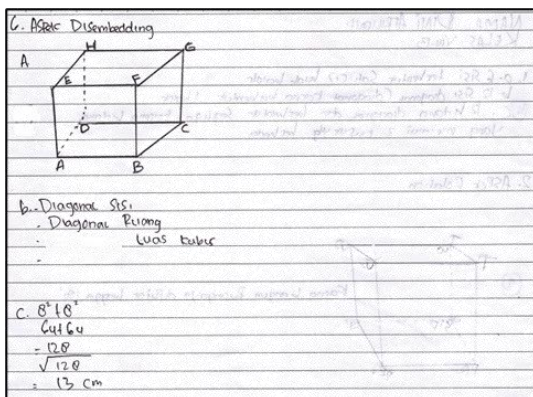


Figure 14
Students' Answers on Spatial Ability with Disembedding Aspects

Based on Figure 14, the process of solving problem number 6. It seems that students have not been able to state/choose elements (simple objects) that can build complex objects (pictures). This means that for solving problem number 6, students have not imagined and explained a thing (image) in the form of space correctly.

Thus, it can be concluded that completing student answers on aspects of spatial ability, namely orientation, mental rotation, visualization, perception, relation, and disembedding using the Visualization Auditory Kinesthetic (VAK) learning model, is more suitable for use in geometry material. The Visualization Auditory Kinesthetic (VAK) learning model is focused on providing a direct and fun learning experience. Direct learning experience by learning by seeing (visualization), learning by hearing (auditory), and learning with motion and emotion (kinesthetic). And this learning model is also emphasized combining physical movement with intellectual activity, and the use of all modalities can have a profound effect on learning. (Zainal et al., 2002) stated the improvement in the components of the spatial visualisation ability was varied, with the largest gain being on the engineering drawing tasks and the least on the mental rotation tasks the study did show that spatial visualization skills in general were improved after the teaching and learning activities

Conclusion

Based on the study results, conclusions were obtained on spatial abilities through the Visualization Auditory Kinesthetic (VAK) learning model. Students can better understand the material because, in this model, more students can understand the material with their respective learning styles. The spatial ability consists of orientation, mental rotation, visualization, perception, relation, and disembedding. It turned out that many students answered correctly with a complete answer process in the aspects of

orientation, visualization, and perception. The rest on the mental rotation, relation, and disembedding elements, some students have not answered correctly, and the answer process is complete. Therefore, it should be noted that factors that cannot be answered correctly and ultimately need improvements both in the learning process or in questions that support aspects of mental rotation, relation, and disembedding spatial abilities to understand the geometry material better. Spatial ability is very important for problem solving and geometry learning, where existing aspects must be developed to improve skills in spatial abilities that will increase students' awareness the importance of optimizing the conditions during learning. This research is limited to three dimensional geometry material, namely cube and inverted material. It is suggested that other reasearches will develop spatial abilities in other three-dimensional materials, such as prisms, pyramids, cones, tubes, and spheres.

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