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Analysis of Spatial Knowledge Construction Based on Ethnomathematics in Junior High School Student

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ABSTRACT

Mathematics is a science that has an important role in dealing with various problems in everyday life. It includes spatial abilities because it involves the ability of students to manipulate objects related to space. However, students' spatial abilities in geometry material are still relatively weak. This study aims to analyze and describe the construction of students' spatial knowledge based on ethnomathematics. This research is qualitative research with a descriptive approach. Data collection techniques in this study include information absorption sheets (reading), tests, and interviews. Data were analyzed using data reduction techniques, presentation, and conclusion drawing. The results showed that S1 could meet the five indicators of spatial ability, where S1 organized his knowledge based on assimilation and accommodation. Furthermore, S2 can meet five indicators of spatial ability and organize his knowledge by assimilation. While S3 only fulfills three indicators of spatial ability, this is due to a lack of accuracy and haste in answering questions. This study's findings show that learning associated with culture can improve students' mathematical abilities in spatial terms.

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1. INTRODUCTION

Mathematics is a science that has an important role in dealing with various problems that exist in everyday life. However, math taught by teachers is considered 'boring' because students think math is difficult. After all, it is nothing more than counting activities, formulas, and numbers, with scary notables causing students to dislike math.

From the perspective of constructivism, learning theory significantly influences mathematics learning. The application of constructivist approaches in mathematics learning depends on the specific knowledge possessed by students [1]. The stages of knowledge construction, namely assimilation and accommodation, are ways or steps students take to build their knowledge [2].

This relates to Spatial Ability, which involves the ability of students to think by mentally manipulating images, i.e., converting visual information seen by the eye into images or sketches [3]. Spatial ability is the talent to understand space relationships, represent, modify, and communicate symbolic information, and articulate and realize mental concepts [4]. Spatial ability is important for the field of mathematics and other studies. All involve the use of spatial abilities [5]. Therefore, spatial ability plays an important role in success in mathematics, especially in geometry, which relies heavily on visualization [6].

According to Sudirman and Alghadari, five components make up students' spatial abilities: (1) spatial perception, the ability to find points in space, determine the orientation of lines and objects, assess location, and understand the relationship between objects and process movement. (2) spatial visualization, namely, students can write what is known and asked, manipulate, rotate, and flip objects into different forms. (3) mental rotation, the ability to mentally rotate an object. (4) Spatial relations, the ability to represent an object and its relationship with other objects, and (5) Spatial orientation, the ability to determine the position of an object in space [5]. Developing spatial ability requires brain activity that involves a high level of imagination and high-level thinking skills in observing space and imagining shapes [7].

Based on the results of initial observations, it was found that students' spatial abilities in the material of building space were still relatively weak, and the subject did not understand the meaning of what was asked of the problem. At the time of observation, the material studied was building space. It turns out that almost one class of students has difficulty solving the spatial ability problems given, even the previous material has not been mastered as prerequisite material to the following material, such as introductory algebra in simplifying algebraic expressions, using basic operations such as addition, subtraction, multiplication, and division in geometry calculations. This impacts the material to be studied, namely building space, and the subject becomes confused in understanding the meaning of the problem. The ability for knowledge can be built through various problems and experiences experienced by students, both in everyday life and through situations created by teachers in the classroom. Therefore, forming this knowledge can be observed when students learn in the classroom. In research conducted by Teapon and Kusumah [8], Khofifah et al. [4], and Isnaini [9], in general, students' spatial abilities show a reasonably low level where the test used abstract mathematics, while in this study linking culture in mathematics.

From a psychomotor point of view, ethnomathematics can improve a person's psychomotor abilities and can be developed in learning mathematics at school [10]. One of the skills that every student must have is the ability to think geometry. Geometry has been known since ancient times and continues to develop with human culture [11]. Geometry concepts can be applied in math learning, and incorporating cultural elements in the process can be an innovation [12]. The purpose of learning geometry is to improve students' logical accuracy in mathematical skills, provide an understanding of the beauty of the surrounding natural forms, and improve the ability to think logically in the context of mathematics [13].

From the description that has been explained and based on the literature review related to the use of ethnomathematics to assist the learning process in the Spatial construction of students associated with culture, educators need to know the ability to construct students' spatial knowledge as a means of finding the development of facts of science principles inherent in students, the construction of spatial knowledge is closely related to the geometry of space buildings with ethnomathematics nuances. From previous studies, many examined the construction of spatial knowledge, but none related explicitly to ethnomathematics in the context of junior high school students. Therefore, the researcher chose to raise the topic "Analysis of Spatial Knowledge Construction Based on Ethnomathematics in Junior High School Students" as the focus of this research.

2. METHOD

The approach used in this research is qualitative research using a descriptive approach [14]. This research was conducted to provide an objective picture or description of a situation or phenomenon that occurred in the field [15]. The procedures used include descriptive data in the form of descriptions of written and oral words expressed by research subjects. The data in this study were obtained from the results of think-aloud obtained when the subject read the information absorption sheet and worked on problems and interviews through recordings and videos of research subjects so that the data was obtained in the form of writing and oral statements of students through think-aloud. In this study, data collection techniques include information absorption sheets used to see the construction process of students based on assimilation and accommodation schemes as a form of knowledge construction [16]. Written tests in the form of ethnomathematics-based problem solving consist of problems that contain each indicator of the spatial knowledge component and semi-structured interviews, where questions are tailored to the ethnomathematics problems presented and documentation [17]. All activities are documented and recorded to reveal the process of student knowledge construction. After the data is obtained, data validity is tested using triangulation techniques and source triangulation [18]. Qualitative data analysis techniques have three flows: reduction, data presentation, and conclusion drawing [19].

Research subject

The selection of subjects in this study was to use a *purposive sampling* technique to select subjects based on specific criteria, namely:

1. Prospective research subjects are students of class IX, based on the recommendation of the mathematics teacher, who obtained as many as nine students with student criteria: 3 active students, three medium students, and three passive students.
2. Prospective Subjects have studied or are currently studying the material of building space as a prerequisite of Spatial ability.
3. Prospective Subjects were asked to work on one description question that had been given by writing it on the question paper, and then the students' answers were grouped into three groups based on how they were done.
4. From the groups obtained, it was known that the answers of the prospective subjects were saturated (the same), so the researcher took one student from each group to be used as a research subject [20].

Data Collection

This research method collects data through several techniques, including information absorption (reading) sheets, tests, and interviews.

Data Analysis Technique

Qualitative data analysis techniques have three flows: reduction, presentation, and conclusion.

1. Data reduction is a stage where researchers focus on simplifying, abstracting, and transforming the rough data recorded from field observations [19].
2. The results of student recordings when reading information absorption sheets, analyzing student answer sheets in the form of description questions, and then the results of interviews are analyzed with good language so that the data is ready to use.
3. Data presentation is the process of organizing information so that it is possible to draw conclusions and take action by presenting the results of recording students when reading information absorption sheets, the stage of solving *spatial* test questions in the form of *think-aloud* description questions, then presenting the results of interviews after students have finished doing the test questions in the form of narrative descriptions.
4. While in the field, qualitative researchers are constantly concluding.

3. RESULTS

3.1. Exposure First Subject (S1)

3.1.1 Subject Data Exposure Problem Number 1

S1 first reads question number 1 in its entirety with the think-aloud method. After that, S1 seems to think before answering the question, but S1 can find the information in the problem and then describe the answer by writing what is known, asking, and answering thoroughly. Furthermore, S1 wrote the answer according to the previously known formula, namely finding the contents of lemang where lemang and bamboo have the same geometric shape, namely tubes. It can be seen based on the following description.

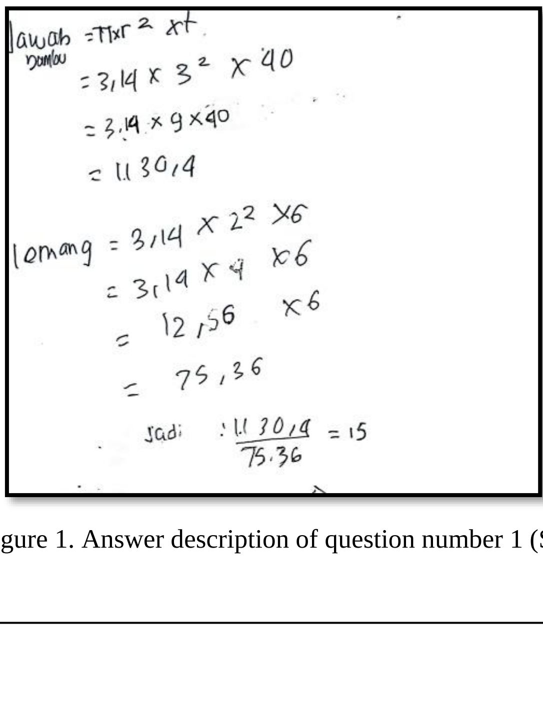

Figure 1. Answer description of question number 1 (S1)

Based on interviews and *think-aloud* results, it can be seen that S1 can fulfill *spatial perception* and *spatial* visualization to answer question number 1 by linking existing knowledge with new knowledge. In this solution, the subject fulfilled the spatial perception and visualization indicators, where the subject could correctly answer the questions and maintain consistency during the interview.

3.1.2 Data Exposure of the First Subject Problem Number 2

S1 first reads problem number 2 with the *think-aloud* method, then looks at S1, who thinks hard to understand the problem. S1 rereads and pays attention to the first picture, which has a complete corner point. S1's answer can be seen in the following figure:

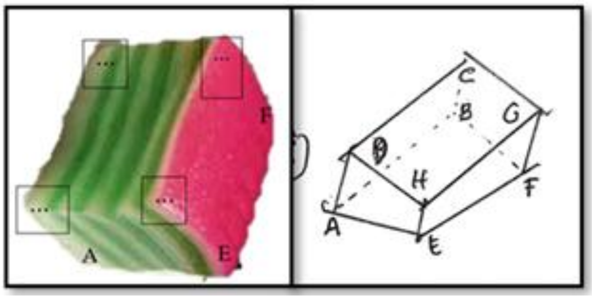

Figure (a) Figure (b)

Figure 2. Description of answer to question number 2 (S1)

When S1 tries to illustrate the imagined image, it can be seen that S1 thinks hard in rotating the object so that it gets points D, H, C, and G. At this stage, S1 can determine the location of the points contained in the object and fulfill the ability of *spatial visualization*. This also fulfills the mental rotation ability, where S1 can rotate objects mentally in three-dimensional space. This can be seen based on the following interview results:

P : *What information can you understand from the problem?*

S1 : *e... What I understand is how to determine the picture angles of the traditional cake.*

P : *Does picture (a) provide clear information so you can solve it?*

S1 : *It is unclear because the picture is blurry, e... and one point is not visible. Point that is not visible, kak. But I can solve it because I imagined that. Point d was not visible in the picture (a).*

Although S1 revealed that point D is not visible in the picture, S1 can directly mention the information in the picture and imagine that point D is behind the cake so S1 can flip the object correctly.

3.1.3 First Subject Data Problem Number 3

S1 first read question number 3 with the *think-aloud* method. Based on the results of *think-aloud,* S1 seemed hesitant to redraw the traditional cake, then S1 observed the first cake that had been illustrated, and S1 immediately described what was seen from the side of the cake in question. This can be seen in the following picture:

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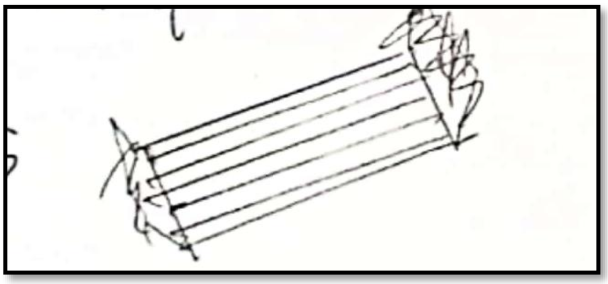

Figure 3. Description of answer to question number 3 (S1)

Although the drawings made by S1 are less neat, S1 gets the desired side of the cake according to what he sees, and this fulfills the spatial orientation indicator where S1 can determine the position of a spatial object when viewed from various sides. This fulfills the spatial relation ability where S1 can understand the relationship between the example given and related problems.

3.2. Second Subject Exposure (S2)

3.2.1 Data Exposure of the Second Subject Problem Number 1

S2 began to read the whole problem based on *thinking aloud,* which is the result of *thinking aloud.* Next, S2 wrote down what was known from the problem, namely, the length of the bamboo is 40 cm and has a diameter of 6 cm. Then, the side length is 6 cm and has a diameter of 4 cm. Based on the results of S2's answers and interviews, S2 can understand the meaning of the problem given by writing what is known and not writing what is asked, but based on the results of the interview, S2 stated that he forgot to write what was asked from the problem when explored deeper through interviews, S2 knew what was asked and this meets the spatial visualization indicator by combining old knowledge to S2's new knowledge. Furthermore, S2 worked on the description question, where he wrote that the value of phi was 3.14. This can be seen from the picture below:

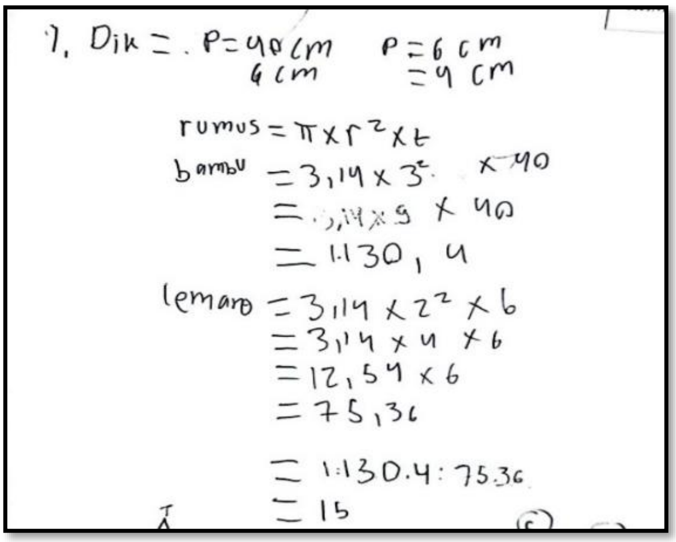

Figure 4. Answer description of question number 1 (S2)

It can be seen that S2 can determine the radius of the diameter of the bamboo and lemang. The reason for the answer described above can be seen based on the following interview:

P : *What is the procedure that you used to solve problem number 1?*
S2 : *I use the volume formula based on what I already know. known*
P : *Then, are you sure you used the formula correctly?*
S2 : *Sure*
P : *Does what is known relate to what is asked so that you can solve the problem*
S2 : *It is related because the bamboo is shaped like a tube…. And then, the contents of the glue are also in the shape of a tube. The glue is also tubular, so it is related to the solution.*

It can be seen that S2 is very confident in what has been done in the right way. S2 can fulfill the spatial perception ability where S2 can imagine cutting bamboo into smaller pieces to get 15 pieces of lemang for one bamboo. In addition, S2 can also visualize the shape of lemang into a tube, facilitating S2 in solving the problem.

3.2.2 Data Examination of the Second Subject Problem Number 2

S2 began to understand the description question by imagining the geometric shape of the layer cake, then S2 redrew the cake into a block shape by looking at the known points of the cake, namely points A, E, and F. Then S2 wrote down the empty points, namely D, H, C, and G. This can be seen based on the following answers:

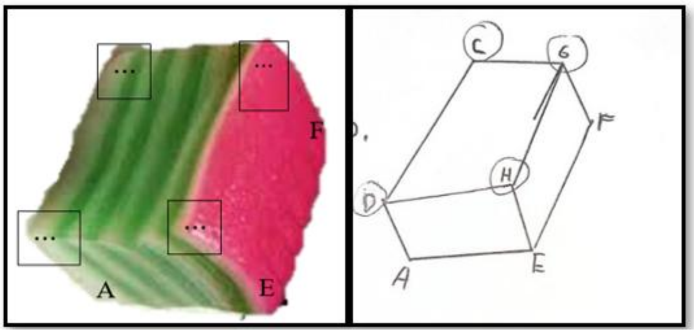

Figure (a) Figure (b)
Figure 5. Description of answer to question number 2 (S2)

S2 has been correct when turning the object. Although S2 has difficulty seeing the invisible points, S2 can find the missing points if rotated. It can be seen based on the following interview transcript:

P : *How can you ensure you have flipped the correct object to get empty dots?*
S2 : *I imagined flipping this space ..... into a second space by setting the known corner points and the second one by setting the known corner points.*
P : *Does picture(a) provide complete information so that you can solve the problem*
S2 : *I think it is incomplete because the D angle is not visible,*

Although S2 stated that the question information is incomplete, based on the answer, S2 can know that the invisible point in the first picture is point D. This fulfills the *spatial perception* ability, then S2 can fulfill the *mental rotation* and *spatial visualization* abilities, namely turning the object correctly to get the empty points, namely points D, H, C, and G. The next step is to solve the problem.

3.2.3 Data Exposure of the next step is to Solve the Problem

It can be seen that S2 found the answer by remembering the shape of the cake. S2 seemed to have eaten the cake, which made it easier for S2 to solve the problem. This can be seen based on the following *think-aloud*:

S2 : *The cake, ... is a layer cake, ... means the shape is the same as the usual… which is Cube-shaped. If you look at the side, it looks like a rectangle with many layers.*

You can see the description of S2's answer below:

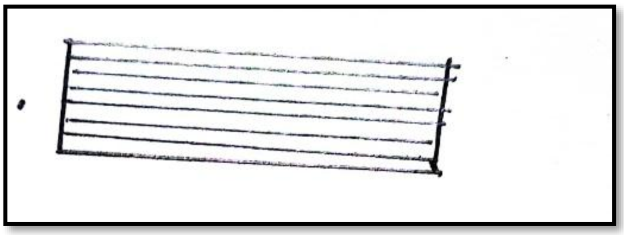

Figure 6. Answer description number 3 (S2)

S2 can immediately understand what is asked and imagine traditional cakes often found in everyday life. This can fulfill the ability of spatial orientation where S2 can determine different shapes from the position of a spatial object when viewed from various sides. This is reinforced by the results of the interview, which can be seen as follows:

P : *What information can you understand from question number 5?*
S2 : *Here, we are told to depict the side or sides of the cake if it is viewed from different Directions. So we look at the side side of the cake and how it looks.*
P : *Does the example above relate to the one brought?*
S2 : *No, sis, because the picture below is one layer...*

S2 is very confident in what he has done, even though the question S2 states it is unrelated. This shows the inaccuracy in the answers and interviews. This has not fulfilled the *spatial relation* ability, where this ability is the subject's representation of an object with other objects.

3.3 Data Exposure of the Third Subject (S3)

3.3.1 Data Presentation of the Third Subject Question Number 1

S3 looks to understand the problem, but S3 is wrong in summing up the volume. S3 does not realize thatπ it also has a value. If it is a multiple of 7, then use 22/7, and if it is not a multiple of 7, then use 3.14, but S3 does not add up the value of π. This can be seen based on the following *think-aloud* results:

S3 : *So the volume of bamboo is* $\pi \times r^2 \times h$ *then…* $9 \times 40 = 360$ *Now find the volume of bamboo by the volume of the lemang as the tube. With* $4 \times 6 = 24cm^2$*, then find the lemang piece by dividing the volume of the bamboo by the volume of the* *lemang,* $\frac{360}{24} = 15$. *Then we get many pieces of lemang for one 15 pieces of bamboo.*

This can seen based on the following answer descriptions:

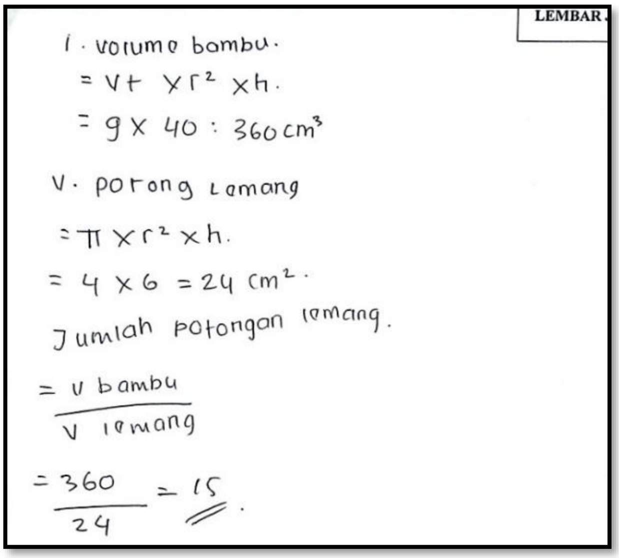

Figure 7. Answer description of question number 1 (S3)

When working on the problem, S3 did not write known and asked. S3 directly wrote the answer on the answer sheet. Based on S3's answer sheet, the researcher interviewed to find out the reason why S3 did not write known and asked, but S3 can understand what is known and asked of the problem, as can be seen from the following interview results:

P : *Why didn't you write what you know and what you are asking on the answer sheet? Answer sheet?*
S3 : *I usually do not write down the known and asked questions every time working on the problem.*
P : *Do you know what is known and asked about the question?*
S3 : *Ee... what is known is that there is a length of bamboo 40 cm diameter of 6 cm, then the length of the lemang piece is 6 cm with a diameter of 4 cm.*

S3 does not write what is known and asked from the problem, but S3 can understand the problem's meaning based on the interview results above. This can fulfill the *spatial visualization* indicator based on students' abilities. This can be seen based on the following interview:

P : *What is the procedure that you followed to solve the problem?*
S3 : *By determining the volume of bamboo...*$\pi \times r^2 \times h$ *, then* $9 \times 40 = 360\ cm^2$ *then determining the volume of lemang* $4 \times 6 = 24\ cm^2$. *The total volume of bamboo divided by the total volume of lemang = 360/24=15*
P : *Why don't you write down the result of* π *and add up diameter and height only?*
S3 : *I do not know, sis. I think the*π *is not summed up.*

In this case, S3 does not realize that the results obtained are correct because $\frac{\pi}{\pi}$ The result is one, and if added up, then the result is correct 15. Then, S3 did not fulfill the ability of *spatial perception.* This is due to a lack of accuracy in working on the first problem, so S3 did not realize that the results were correct, but the way of working was less precise.

3.3.2 Data Exposure of the Third Subject Problem Number 2

S3 starts reading the whole problem based on *think-aloud. The* results of student answers can be seen as follows.

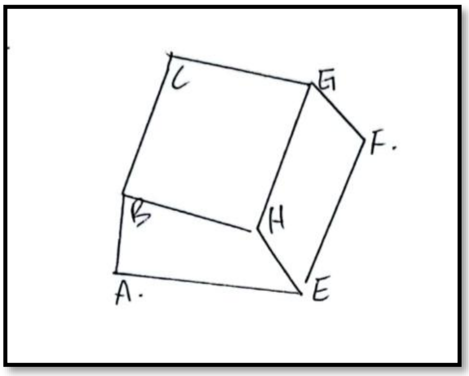

Figure 8. Answer description of question number 2 (S3)

When working on the third problem, S3 was wrong in determining one corner point of the layer cake. It appears that S3 has difficulty seeing empty points, as seen from the default subject when working on the problem. S3 cannot rotate the rotated point, and when asked about the missing point, S3 answers in an unsorted order. This has not fulfilled the ability of mental rotation. Due to S3's lack of accuracy in determining a point, this also does not meet the spatial visualization where S3 cannot determine the exact corner points.

3.3.3 Data Exposure of the Third Subject Problem Number 3

S3 expressed the problem by voicing based on think-aloud S3 seems to understand the cake, which, when viewed from the side, can describe a form of image and, if seen, will get a different picture. At this stage, S3 understood the differences between all sides when viewed differently. It can fulfill spatial orientation, where S3 can identify the position of an object when viewed from various directions by linking new knowledge with the knowledge it already has. The description of the answers to S3 can be seen as follows:

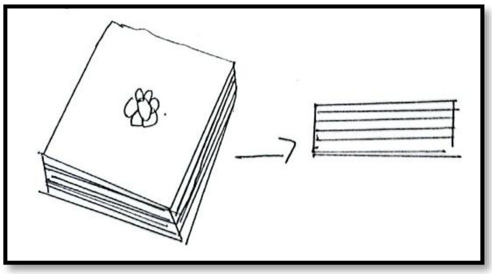

Figure 9. Answer description of question number 3 (S3)

Based on the interview results, it can be seen that S3 has answered the questions correctly, and S3 is very confident that the results of his work are correct. This is because S3 ate the cake contained in the example, making it easier for S3 to imagine the cake from various perspectives. This fulfills the ability of *spatial relations*, where S3 can represent an object with other objects, and S3 can associate new knowledge with the knowledge it already has.

4. DISCUSSION

Based on the result of research conducted in class IX in the 2024/2025 school year, the following data were obtained:

Table 2 Spatial knowledge construction indicators on the research subject

No.	Subject	Spatial Ability Indicators	Knowledge Construction	
		Spatial perception	Assimilation	Accommodation
1	Subject 1 (S1)	√	–	√
	Subject 2 S2)	√	√	–
	Subject 3 (S3)	–	–	–
		Visualization Spatial	Assimilation	Accommodation
2	Subject 1 (S1)	√	√	–
	Subject 2 S2)	√	√	–
	Subject 3 (S3)	√	√	–
		Mental Rotation	Assimilation	Accommodation
3	Subject 1 (S1)	√	–	√
	Subject 2 S2)	√	√	–
	Subject 3 (S3)	–	–	–
		Spatial Relation	Assimilation	Accommodation
4	Subject 1 (S1)	√	√	–
	Subject 2 S2)	√	√	–
	Subject 3 (S3)	√	√	–
		Spatial Orientation	Assimilation	Accommodation
5	Subject 1 (S1)	√	√	–
	Subject 2 S2)	√	√	–
	Subject 3 (S3)	√	√	–

4.1 Data presentation of knowledge construction in spatial perception ability

Based on the results of the written test research and interviews through think-aloud, S1 understands the question's meaning. However, it appears that S1 experiences disequilibrium when answering the question by thinking and muttering signs of thinking before answering the question. This shows that S1 compiles his knowledge by accommodation by not answering the question directly. While S2 and S3 at this stage understand the problem by assimilation by answering the question directly, this aligns with research conducted by Mulyani [16]. In this case, spatial perception ability is the ability of students to identify the orientation of points and lines in math problems and determine geometric relationships between objects in problem problems. Based on the results of tests and interviews, S1 writes what is known and asked from the problem, and S2 only writes what is known, but S1 and S2 can immediately solve the problem based on prior knowledge, based on the results of interviews, S2 can explain what is known and asked from the problem.

However, S3 did not write down what was known and asked about the problem because he was not used to writing it down every time he worked on a problem, and S3 had an error in solving it. After an interview, S3 did not realize the mistakes contained in his solution. This is in line with research conducted by Cholilah [21], Where errors often occur are misperceptions about visualization, determining concepts, orientation errors, and even inaccuracy. There must be citations and references from other research results in the discussion. Compare your research results with relevant research.

So, based on the description above, it can be seen that S1 and S2 can fulfill the ability of spatial perception, namely being able to compare two volumes of tubes if lemang is put into bamboo, getting pieces of lemang of the same size. However, the interview results show that S3 has not fulfilled the spatial perception ability. S3 does not realize that the work results are correct, but S3 is less careful in understanding the solution.

4.2 Data presentation of knowledge construction in spatial visualization ability

In the process of knowledge construction during problem-solving related to spatial visualization indicators, there are several problems related to spatial visualization indicators, based on the results of the answers of the three subjects shown through the answer sheet and interviews through think aloud, the three subjects constructed their knowledge through an assimilation process where S1, S2, and S3 could understand what was asked in the problem, but S2 forgot to write what was asked in the problem, and S3 immediately wrote the answer because S3 was not used to making known and asked. However, based on the results of interviews with the subjects, the three subjects can explain what is known and asked and the accuracy of the answer to the solution. In solving the problem, the subject can combine old knowledge, namely the quadrilateral pyramid, with new knowledge by imagining how the shape of the pyramid will open into a pyramid net. Furthermore, S1 and S2 can flip the object correctly to get empty points in the problem. S1 and S2 can find the pyramid's diagonal length, fulfilling the spatial visualization ability. This aligns with research conducted by Cholilah [21], which reveals that the results of acquiring student answers after being analyzed get many scores. Students with good spatial abilities will efficiently work on problems related to visualization. In this study, as many as 27 out of 50 students could answer spatial visualization questions correctly. This is also relevant to research by Mahendra [22], which states that spatial visualization ability is related to the ability to the cube space, and spatial visualization ability is a strong predictor in students' reasoning about spatial geometry.

Based on the description above, it can be concluded that S1, S2, and S3 can fulfill the spatial visualization ability where this ability writes what is known and asked, manipulates, rotates, flips objects into different forms, and visualizes cultural problems into mathematics. This is also in line with research by Khofifah et al. [4], which revealed that from the average score of students' spatial abilities to get high scores on spatial visualization indicators, students' spatial visualization abilities were classified as good based on the acquisition score with an average of 66.67%.

4.3 Data presentation of knowledge Construction in spatial mental rotation

In the knowledge construction process, the three subjects smoothly understood the problem and immediately worked according to their completion procedures. It can be seen that S1, during the interview, seemed to think before answering the question by muttering eee.... As a sign of thinking before answering directly, S1 compiles knowledge based on accommodation by adjusting old knowledge with new knowledge from the surrounding environment. This aligns with research conducted by Kurniati et al. [9], which found that S6 experienced disequilibrium by rotating the ABEF plane centered on A, and S6 could construct and imagine the picture correctly. Meanwhile, S2 smoothly solved the problem, and it can be said that S2 compiled knowledge by assimilation. However, S3 is wrong in determining the empty points in the problem. This is caused by S3's lack of accuracy in answering the question and rushing to solve the problem, resulting in errors in the image rotation. This means that S1 compiles its knowledge based on the accommodation process in line with research by Mulyani [16], with the study's results that students experience disequilibrium, which can be characterized by mumbling, which shows that they think hard to answer questions. At the same time, S2 compiles knowledge by assimilation. At the interview stage, S1 and S2 boldly revealed that the subject did not see any hidden points. At this stage, the subject was required to choose and understand the types of alternative procedures often encountered. This is in line with research conducted by Febriana [23]. High and medium-ability students used the same problem-solving strategy, namely by imagining the rotation of objects to different positions and seeing the similarity of shapes. Meanwhile, low-ability students imagined the rotation of objects when solving the problem.

Based on the description above, it can be said that S1 and S2 can fulfill the indicators of mental rotation, namely, the subject can identify (the ability to rotate an object mentally) from one position to another by adjusting the aspects of the problem presented through the information absorption sheet and problem sheet. However, S1 takes time to understand the shape of traditional cakes related to the problem given. However, S3 has not fulfilled the indicators of mental rotation ability because S3 is less careful in solving the problem and is in a hurry to rotate the image to get a different point from S1 and S2. This is in line with research by Kurniati [9], where the subject fulfilled the procedure step in solving the problem and was able to collect information through observation, but the calculation was incorrect, resulting in an invalid conclusion. This is consistent with research conducted by Nuna et al. [24]; factors that influence students not being able to solve questions well are because students do not understand the meaning of the questions, so students are not able to solve problems correctly.

4.4 Data presentation of knowledge construction in spatial relation

Based on the results of the think-aloud and interviews, it can be seen that the three subjects can quickly understand the problem given, and S1, S2, and S3 correctly determine the concept of completion so that they get the answer correctly. The process carried out by the three subjects in identifying problems is seen based on the results of think-aloud, answer sheets, and interviews. The construction process of S1, S2, and S3 occurs by assimilation. This is following research by Kurniati et al. [9]. The subject can identify the elements contained in the problem to determine the final result of the cube surface area by combining prior knowledge and new knowledge. The indicator of spatial relations is the ability to represent an object and its relationship with other objects by combining prior knowledge with new knowledge. The subject must determine the right method to solve the problem by linking the knowledge owned with new knowledge. Besides that, the subject must also see objects from various directions to get different shapes. This is consistent with research conducted by Hanifah [25], which found that the FI subject determines the relationship between parts before the building is formed in the spatial relation component. The FD subject draws cuts and then forms the image as specified.

Based on the results of think-aloud, answer sheets, and interviews, it can be concluded that S1, S2, and S3 can fulfill the ability of spatial relations where the subject can represent an object and its relationship with other objects by combining previous knowledge with new knowledge.

4.5 Data presentation of knowledge construction in spatial orientation

Based on the results of think-aloud, answer sheets, and interviews, the three subjects can understand the problem directly, and it can be said that in spatial orientation problems, the subject compiles his knowledge based on the assimilation process. At this stage, the subject understands the problem based on his knowledge by remembering the shape of traditional cakes often encountered and learning geometry before.

Spatial orientation ability is the ability to identify (the position of objects in a spatial context) by estimating the size and distance of space in ethnomathematics problems, and students can solve ethnomathematics problems by orienting the position of objects in a spatial context. This follows the research results [22], where spatial orientation ability in mathematics contributes significantly to geometry so that students can find the correlation between spatial orientation and geometry well. This is consistent with the research findings by Aini and Suryowati [26], which state that the subject can solve spatial orientation problems well so that the subject can solve the problems given. However, in spatial orientation, female students are more dominant in using spatial orientation abilities.

At this stage, the subject is required to identify an object that becomes a different form, and it can be seen based on the answer sheet of each subject that S1, S2, and S3 can fulfill the indicators of spatial orientation ability, where the subject can connect previous knowledge with new knowledge.

5. CONCLUSION

This study was conducted to analyze and describe the construction of spatial ability knowledge through Ethnomathematics-based problem-solving. Three research subjects were selected based on how they worked. It was found in the study that S1 fulfilled the five indicators of spatial ability as follows: (1) The ability to locate points in space, determine line and object orientation, assess location depth, understand geometric relationships between objects, and process movement. (2) The ability to rotate, manipulate, and flip objects into different shapes. (3) The ability to mentally rotate objects. (4) Ability to represent an object and its relationship with other objects. (5) The ability to determine the position of an object in a spatial context. S1 compiles knowledge based on assimilation and accommodation. This has been described in the description questions and interviews with S1, and the results of the answers are analyzed to determine S1's spatial abilities.

Then, S2 compiles knowledge by assimilation and constructs knowledge to solve problems from ethnomathematics. S2 can also fulfill five indicators of spatial ability, namely as follows: (1) able to directly locate points in space, determine line and object orientation, assess location depth, understand geometric relationships between objects, and process movement. (2) able to understand and flip objects into different forms. (3) S3 can also directly rotate an object to get a different point. (4) The ability to represent an object and correctly understand the concept of problem-solving. (5) S2 understands the position of an object in the context of space when viewed from various directions. It is just that during the working process, S2 forgot to write what was asked from the problem.

Furthermore, S3 compiles knowledge based on assimilation, but S3 has not fulfilled the indicators of spatial perception ability and mental rotation, where the five spatial abilities can be seen as follows: (1) The subject does not seem to understand the completion of the problem so he does not realize that the solution is correct, but the subject does not know the path taken. (2) The subject can understand and flip objects into different forms. (3) S3 has rotated the object to get a different point, but the subject has difficulty rotating the object to get the appropriate point, so S3 has not fulfilled the mental rotation indicator. (4) The ability to represent an object and the subject gets the concept of problem-solving correctly. (5) The ability to determine the position of an object in the context of space so that the subject sees the object in a different form when viewed from various sides. S3 can only fulfill three of the five spatial indicators when working on problems, and S3 has errors. This is due to the lack of subject accuracy and haste in solving the problem.

It can be seen that learning that is associated with culture can improve the spatial abilities of students who were previously one-class students and are still confused at work. When associated with culture, students can understand the meaning of the problem, but this study has limitations in providing learning tools associated with culture that are attractive to students. This can be used as an evaluation for teachers to create learning tools, such as electronic teaching modules based on augmented reality that can be used in learning mathematics which contains elements of student culture.

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