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Analysıs Of Students' Problem-Solvıng Abılıtıes On *Hıgher Order Thınkıng Skıll* (Hots) Geometry Problems In Terms Of Spatıal Reasonıng

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ABSTRACT

Geometric concepts in mathematics possess abstract properties that require a spatial reasoning process. Evaluating problem-solving abilities through HOTS (Higher-Order Thinking Skills) questions focusing on spatial reasoning is crucial for enhancing students' skills. The aims of this research are: (1) To understand the process of students' problem-solving skills in geometry HOTS based on spatial reasoning; (2) To analyze and pinpoint the challenges faced by students in solving geometry problems through HOTS questions that involve spatial reasoning. This study employs a qualitative approach with data analysis following the Miles and Huberman model, comprising data collection, data reduction, data presentation, and conclusion. The data gathered includes test outcomes, interviews, and documentation. The participants consist of 2 fifth-grade teachers and 3 students from SD N Lulut 05 and SD N Lulut 03. The findings indicate the necessity of regular training for students to effectively tackle HOTS questions and avoid difficulties. The test results showed that the spatial reasoning of the two schools reached 32% in the high category, while the HOTS geometry problem solving reached 30% in the high category. Students with strong spatial reasoning skills excel in solving HOTS problems, whereas those with moderate to low abilities encounter challenges in geometry problem-solving. Therefore, the spatial reasoning skills of students with different proficiency levels vary in addressing geometric problems compared to those with high mathematical abilities. A tailored learning strategy is essential to cater to the diverse needs of these students.

Keywords: problem-solving ability, Geometry, HOTS, Spatial Reasoning.

ABSTRAK

Materi geometri dalam matematika memiliki sifat abstrak yang menuntut proses penalaran spasial. Analisis kemampuan pemecahan masalah dengan soal-soal HOTS (Higher-Order Thinking Skills) yang berfokus pada penalaran spasial sangatlah diperlukan. Hal ini dilakukan untuk menemukan cara dalam meningkatkan kemampuan pemecahan masalah peserta didik. Tujuan penelitian ini adalah sebagai berikut: (1)

Mengidentifikasi proses kemampuan pemecahan masalah peserta didik pada HOTS geometri yang ditinjau dari penalaran spasial; (2) Menganalisis dan mengidentifikasi kesulitan pemecahan masalah peserta didik pada HOTS geometri yang ditinjau dari penalaran spasial. Penelitian ini menggunakan metode kualitatif dengan teknik analisis data menggunakan model Miles and Huberman yang terdiri dari empat tahapan diantaranya: pengumpulan data, reduksi data, penyajian data, dan penarikan kesimpulan. Data yang terkumpul berupa hasil tes, wawancara, dan dokumentasi. Partisipan dalam penelitian ini adalah 2 guru kelas 5 dan 3 peserta didik pada sekolah SD N Lulut 05 dan SD N Lulut 03. Hasil penelitian menunjukkan bahwa siswa harus dilatih secara teratur untuk menghadapi soal HOTS sehingga mereka tidak mengalami kesulitan. Hasil tes menunjukkan bahwa penalaran spasial kedua sekolah mencapai 32% dalam kategori tinggi, sedangkan pemecahan masalah geometri HOTS mencapai 30% dalam kategori tinggi. Peserta didik yang mempunyai kemampuan penalaran spasial baik dalam menyelesaikan pemecahan masalah HOTS juga baik, sementara itu peserta didik berkemampuan sedang dan rendah mengalami kesulitan dalam memecahkan masalah geometri sehingga penalaran spasial peserta didik berkemampuan sedang dan rendah berbeda dalam memecahkan masalah geometri yang berkaitan dengan penalaran spasial siswa berkemampuan matematika tinggi. Diperlukan rancangan pembelajaran yang dapat mengakomodasi kebutuhan peserta didik tersebut.

Kata Kunci: Kemampuan Pemecahan Masalah; Geometri; HOTS; Penalaran Spasial.

INTRODUCTION

People in the twenty-first century need exceptional thinking skills due to rapid advances in science and technology (Saraswati &; Agustika, 2020). One way to improve and develop the quality of education and produce graduates who are superior, proficient, and have a high fighting spirit is through learning and assessment that focuses on higher-order thinking skills (Pratiwi et al., 2023). The use of HOTS questions in learning outcome assessment can hone students' abilities and skills, in line with the demands of 21st-century competencies (Dicky Dermawan & Arrahim, 2023). Evaluation using HOTS (High Order Thinking Skill)-based questions is highly recommended for all levels of educational units to be used in various forms of assessment in learning (Rorimpandey et al., 2023). Based on this, higher-order thinking skills can make students able to solve problems in everyday life, one of which is in mathematics learning.

Mathematics is a scientific discipline obtained from reasoning (Ernawati et al., 2021). In addition, Mathematics is abstract, so its teaching needs to be associated with real applications in daily life that aim to facilitate the discovery of concepts and the development of students' mathematical abilities based on their previous experience and knowledge (Mega & Faisal Madani, 2023). Furthermore, according to Hudoyo, H, (1990) mathematics is pleased with ideas (ideas), rules, relationships that are arranged logically so that mathematics is related to abstract concepts. The concept of geometry is studied in grade 5 of elementary school with the scope of materials constructing and decomposing several spatial structures and their combinations, recognizing spatial visualizations, comparing characteristics between spatial buildings (Badan Standar, Kurikulum dan Assesmen Pendidkan Kemendikbudristek Indonesia, 2022).

The concept of geometry is the result of a person's interaction with their environment, learned from an early age, introduced to left-right positions, geometric shapes, directions, and the ability to connect numbers with geometry (Hasanah &; Kumoro, 2021). Because geometry has drawing and visualizing objects, it takes a person's ability to recognize, produce, examine, operate, and reflect on objects, images, relationships, movements, and spatial transformations

called spatial reasoning (Nuriswaty et al., 2020). Spatial reasoning is an important skill for mathematics that can demonstrate children's early spatial skills predicting mathematical understanding so that they can visualize objects in space, understand spatial relationships between objects, and transform objects (Clements & Battista, M. T., 1992; Davis &; Spatial Reasoning Study Group, 2015 Woolcott et al., 2022).

Mastering problem-solving skills is an important foundation for achieving smooth learning, this ability requires students to have a qualified understanding of concepts, be able to analyze problems well, and be skilled in connecting relevant concepts (Kurino et al., 2023). Problem-solving ability in mathematical competence, and its role is very significant in the mathematics learning process (Almuhaimin Sarnav Ituga & Alman, 2023). The main standards of the mathematics learning process in the National Council of Teachers of Mathematics (NCTM) Standards (2000) explain that there are four mathematical abilities including problem *solving skills*, communication skills, connection skills, reasoning abilities, and representation skills(Maulyda, 2020). The ability to solve mathematical problems has an important role in the mathematics learning curriculum, so education must prepare a new generation who have the ability to think at a higher level in solving a problem (Amalia & Hadi, 2021). Polya views problem solving as an attempt to overcome difficulties and achieve goals that are not easily achieved. He described the steps including understanding the problem, planning or designing problem-solving strategies, carrying out planning, and re-examining the correctness of the results or solutions (Aini & Mukhlis, 2020).

Geometric problem solving often requires learners to understand the relationships between objects and to think requires higher-order thinking skills. However, there are some difficulties in solving geometry, students find it difficult to imagine and answer the questions presented with visualization because they are familiar with routine questions or can only answer questions with a cognitive level of remembering, understanding, and applying (Aini, 2022; Kusnadi et al., 2023); Duranovic &; Didic, 2023) The results of observations at the elementary school level obtained data that students' problem-solving abilities were relatively low, as seen from the results of the problem-solving ability test of grade VI students, obtained that 62% of students still have not reached KKM (Siregar &; Firmansyah, 2021). Furthermore, HOTS-oriented assessment has not been fully achieved properly from assessment planning, assessment implementation, and management of HOTS-oriented assessment results (Rizki et al., 2022).

Based on the difficulties that occurred in previous research, it can be analyzed that learners have difficulty solving geometry problems. They have difficulty imagining and imagining answers to problems presented through visualization because they are used to ordinary questions or can only answer questions with a cognitive level of memory and understanding. This is the source of those problems. Preliminary studies conducted by researchers support this study. The results of interviews with grade 5 teachers at SDN Lulut 05 and SDN Lulut 03 showed that students faced difficulties imagining and solving geometric math problems because of geometric characteristics in the form of objects and visualizations. Based on PTS and PAS, researchers found that students had difficulty solving these problems.

Previous research that discusses solving HOTS problems is a description of the ability of grade V students in SDN 027 to be tenuous in solving HOTS problems in fraction calculation operations. The findings of this study are that students cannot perform multiplication and

fraction division operations properly because they can only correct computational errors due to carelessness or errors remembering previous knowledge (Lukman, 2022). Furthermore, research on higher-order thinking skills in solving HOTS problems in mathematics subjects was found by this study, namely that grade V students of SDN 1 Padang Sambian tend to have sufficient HOTS thinking skills and are still low in answering questions in the cognitive realm of C6, while student obstacles are found in the process of making or forming mathematical sentences (Saraswati &; Agustika, 2020).

The stages of problem solving according to John Dewey in (Syahri et al., 2024) consist of: (1) presenting the problem, (2) defining the problem, (3) formulating hypotheses, (4) testing hypotheses, and 5) formulating recommendations for problem solving. Polya in (Romadhoni &; Setyaningsih, 2022) discusses 4 stages in solving problems, namely understanding the problem, planning for problem solving, implementation of planning, and re-checking. Problem solving skills according to Krulik-Rudnick are (1) Reading and thinking; (2) Investigate and Plan; (3) Choosing a strategy; (4) find an answer; (5) Describing and Conveying (Sesa et al., 2022).

Previous research that examines spatial reasoning, namely research on the exploration of spatial reasoning in solving geometry problems based on gender, revealed that the findings in this study reveal that spatial reasoning is important to build and develop because it helps students understand a geometry concept that shows male students are more dominant in spatial visualization, female students are more dominant in spatial orientation, and rotation mentally have the same spatial reasoning ability (Aini and Suryowati, 2022). Spatial orientation was found to be a unique contributor in all mathematical models, and object-based spatial skills (mental rotation and spatial visualization) varied in their contribution to mathematical performance depending on math content and gender (Harris et al., 2021). Both studies address spatial reasoning based on gender.

At the elementary school level, mentally rotating certain representations and imagining and drawing three-dimensional shapes are important (Fujita et al., 2020). Learning geometry that involves interaction and collaboration between students will be invaluable, allowing students to learn from each other as well as build a deeper understanding of the subject matter. Students' problem-solving abilities are mostly at an average level and need to be improved (Choi &; Kim, 2021). Both studies discussed spatial reasoning and its performance in mathematics.

Based on previous studies, differences in research to be carried out can be analyzed based on objectives, instruments, and variables to be studied. First, the purpose of this study is to analyze the problem-solving of students on *geometry higher order thinking skill* (HOTS) problems in terms of spatial reasoning; second, the instruments in this study are tests, observations, and interviews that have different contents, especially in test instruments in the form of spatial reasoning questions and HOTS question tests; third, research variables by combining two variables of spatial reasoning and creative thinking skills give contribution to the problem solving *of higher order thinking skill* (HOTS) geometry.

Based on the facts explained both juridically, theoretically, and empirically, by what is expressed by experts, it shows the need for an in-depth analysis of "**Analysis of Student Problem Solving Ability on *Higher Order Thinking Skill* (HOTS) Geometry Problems**

Reviewed from Spatial Reasoning" The objectives of this study are as follows: 1) Identify the process of students' problem-solving skills in geometry HOTS reviewed from spatial reasoning; 2) Analyze and identify the difficulty of solving students' problems in geometry HOTS reviewed from spatial reasoning.

METHOD

Type and Design

This study employs a qualitative approach to uncover new knowledge, including both the familiar and the unfamiliar. The research is exploratory in nature, with no quantitative measurements taken. The resulting discoveries may involve describing a situation (descriptive), categorizing or grouping a situation (comparative), and examining the relationship between different categories (constructive) (Sugiono, Prof. Dr., 2022).

Data and Data Sources

This study examined how students from SDN Lulut 05 and SDN Lulut 03 in Klapanunggal, Bogor Regency, approach geometry problems involving spatial reasoning. The data for the study was collected by observing 2 fifth-grade teachers and 3 students from each school. The data included the outcomes of a spatial reasoning test (4 questions) assessing spatial orientation, mental rotation, and spatial visualization, along with the results of a HOTS geometry problem-solving test (4 questions) evaluating analytical thinking (C4), synthesis (C5), and creation (C6) levels. Additionally, the researcher conducted interviews with the students using a guide consisting of 5 problem-solving skills steps: reading and thinking, investigating and planning, selecting strategies, finding answers, and presenting.

Data collection techniques

The participants in this study are 2 grade 5 teachers, 2 students at SD N Lulut 05 school with high ability, and 1 student at SD N Lulut 03 with high ability. The data collected was in the form of test results, observations from interview activities, and documentation. The data is written in words based on field records and physical evidence in the form of products resulting from the activities of the research subjects, to be collected and analyzed research data. The following are research instruments that will be carried out:

Table 2.1. Spatial Reasoning Test Instrument Grid (Test 1)

No	Spatial Reasoning Indicator	Question Indicator	Question Form	Question Number	Lots of questions
1.	Spatial orientation	Determine the position of an object relative to that of the observer.	Essay	1	1
2.	Mental Rotation	Determine the spin results of 2D and 3D objects.	Essay	2	1
3.	Spatial Visualization	Build solid objects from a specific net and vice versa.	Essay	3 dan 4	2

Source: (Ramful et al., 2016)

Table 2.2. Instrument Grid Proficiency Test HOTS Problem-solving (Test 2)

No	Troubleshooting Aspects	HOTS indicator	Question Indicator	Question Form	Question Number	Lots of Questions
1.	Reading and Thinking	C4 (*Analyze*)	Analyze the information received, then divide it into smaller parts to recognize patterns or relationships.	Essay	6	1
	Investigating and Planning					
	Choosing a Strategy					
	Find answers					
	Describe and convey					
2	Reading and Thinking	C5 (*Evaluate*)	Assess solutions, ideas, and methodologies using existing standards to ascertain their benefits.	Essay	7	1
	Investigating and Planning					
	Choosing a Strategy					
	Find answers					
	Describe and convey					
3.	Reading and Thinking	C6 (*Create*)	Design a problem solver.	Essay	8,9	2
	Investigating and Planning					
	Choosing a Strategy					
	Find answers					
	Describe and convey					

Table 2.3. Interview Guideline Instrument Grid

No	Aspects of Problem Solving Ability	Indicator	Question
1.	Reading and Thinking	Restate the problem in your own words	What did you do to understand the problem?
2.	Investigating and Planning	Is there enough information	How do you see the building of the space?

3.	Choosing a Strategy	Work backwards	How do I work on moving those cubes?
4.	Find answers	Use geometric skills	How do you change the shape of the webs to build the space?
			What did you do to find the answer to the question?
5.	Describe and convey	Answer verification	Is there anything else you'd like to tell us about it?
			Tell me how you solved the geometry problem?

Data analysis

This study applies the Miles and Huberman model to analyze data, which involves four stages: (1) data collection, where the researcher analyzes test data, observations, interviews, documentation, and field notes gathered during field research; (2) Data reduction, which includes condensing information by summarizing, selecting, and organizing essential elements, focusing on key aspects; (3) Presentation of data, by merging information to present it in a clear and understandable format; (4) concluding by synthesizing data collected through various methods, continuously verifying the preliminary conclusions to arrive at a more suitable conclusion. According to Miles and Huberman in Sugiono (2022), qualitative data analysis is thorough as it is conducted interactively and continuously.

In qualitative research, there are four ways to check the validity of data: credibility (internal validity); transferability (external validity/generalization); dependability (reliability); and confirmability (objectivity).

RESULTS AND DISCUSSION

Through a series of studies, including spatial reasoning tests, HOTS problem-solving tests, interviews about geometry problem-solving steps, and test result documentation, the following findings were obtained:

Problem Solving Ability of Students on Geometry HOTS Problems

The test was carried out in 2 stages, namely stage 1 spatial reasoning test and stage 2 HOTS question test. Here are the results of both tests:

Table 3.1. HOTS Problem-Solving Ability Test Results, Spatial Reasoning SDN Lulut 05 and SD N Lulut 03

School	No	Category	Sum	Percentage	School	No	Category	Sum	Percentage
Spatial Reasoning									
SD N Lulut 05	1.	Elevated	15	33 %	SD N Lulut 03		Elevated	10	31 %
	2.	In between	21	46 %			In between	15	47 %
	3.	Minimal	9	20 %			Minimal	7	21 %
		Unique Child	1	1 %			Unique Child	1	1 %
			46	100 %				33	100 %
HOTS Troubleshooting Capabilities									

SD N Lulut 05	1.	Elevated	16	35 %	SD N Lulut 03	Elevated	8	25 %
	2.	In between	6	13 %		In between	7	21 %
	3.	Minimal	23	51 %		Minimal	17	53 %
		Unique Child	1	1 %		Unique Child	1	1 %
			46	100 %			33	100 %

Based on the table, it shows that the spatial reasoning of the two schools reached 32% in the high category, while the HOTS geometry problem solving reached 30% in the high category. This is in line with feedback from classroom teachers (NDS) who show that the average student excels in spatial reasoning but struggles with solving HOTS problems:

"*AMP : Have you ever used HOTS problems in solving geometry problem?*

NDS : If I use the HOTS problem, I have mom, but not often, because of this hot problem Of course, it must be trained continuously, yes to children, not only that it is possible My shortcomings are also as a teacher in delivering material that is not suitable with Student or maybe there are some things that I might not be interested in it is like for example the ability of the student himself seen from IQ or intelligence."

The same answer as the grade 5 teacher at SD N Lulut 03 who was interviewed in a different place:

" YN : Ever too, yes, it's just possible that children find it difficult"

According to grade 5 teachers at SD N Lulut 05 and SD N Lulut 03, they have used HOTS questions before, but students find it difficult and need continuous training. The habits of students in doing HOTS-type practice questions are expected so that there will be no more difficulties in solving mathematical problems (Amalia &; Hadi, 2021). characteristics of HOTS questions describe the real situation aspect of the task well and can be achieved by providing a lot of information about the situation and applying it widely. The strategy for developing higher-order thinking skills (HOTS) questions in the 2013 curriculum is to measure higher-order thinking skills, based on contextual problems, not routine (not familiar), and using various question forms (Fanani & Kediri, 2013).

Students with medium and low spatial reasoning abilities are excellent at solving HOTS problems, but students with medium and low abilities have difficulty solving geometry problems. The spatial reasoning of students with high mathematical ability is different from that of students with medium or low mathematical ability (Latifah &; Teguh Budiarto, 2019). In the study evaluating the spatial reasoning mathematics program, it was shown that students have a better ability to visualize and understand spatial mathematical concepts as well as students can imagine objects and understand their relationships with each other (Mulligan et al., 2020). Furthermore, research on the identification of basic spatial reasoning skills of Japanese students through 3D geometry problem solving, This study found a series of tasks to assess these skills, including mentally rotating given representations, visualizing and sketching 3D shapes. This ability plays a crucial role in solving 3D geometry problems in elementary schools (Fujita et al., 2022).

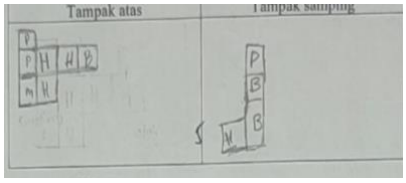
The Process of Student Problem Solving Ability in Geometry HOTS Problems Viewed from Spatial Reasoning

Based on the test results, participants who have good spatial reasoning and good HOTS problem-solving skills were selected by one person representing SD N Lulut 05 and SD N Lulut 03. Here is an elaboration on three spatial reasoning constructs:

Spatial Orientation

Participants 1 (DV)

Based on the test results, it shows that students are able to determine the position of an object relative to that of the observer, can imagine the position of an object if it is seen at the top and can be seen on the side even though the direction is still not right, and be able to describe the appearance of the cube arrangement when seen from above and seen from the side.



Pigure 3.1 (D.PSOS-SW01-L5)

Based on the answers of the DV subject in Figure 3.1 Then an in-depth search was carried out, the following is a snippet of the results of the interview with DV:

Table 3.2. DV Spatial Reasoning Ability Quote Question 1 *(*W-SWSO01-L5)

CODE	INTERVIEW	Troubleshooting ability steps
AMP :	*"How do you see the arrangement of the cubes, or what you imagine, what you can know or tell you, how do you work on it"*	
DV :	*"I think it's the same as this, it turns out to be different, right, my mother said in this explanation, it is known that the block is still filled with cubes."*	Reading and thinking expresses problems in one's own words Investigate and plan with the information in the question so that you can answer how many cubes were rolled over
AMP :	*"That's the number one counting work, there is indeed the counting work, this is the number one heeh"*	
DV :	*"Indeed, this one was not able to draw it, it was also difficult, as long as the important thing is to be able to draw"*	Choosing a strategy to work backwards, finding answers with geometric skills
AMP :	*"That's right, so you can imagine from above, from above, like what the color will be, you can draw like that"*	
DV :	*"Ya "*	Describe and convey to verify answers

Based on the results of student tests and interviews, it can be concluded that DV can determine the position of an object relative to that owned by the observer. DV is not very confident in the image that has already been created. In terms of spatial reasoning, they are already able to position themselves on the image, which corresponds to the main properties of spatial reasoning, namely awareness of space, the relationship between the representation of spatial information, interpretation, and decision-making (Pradana &; Sholikhah, 2021).

Spatial Orientation according to Mix and Cheng, (2012); Uttal et al., (2013) in (Lowrie, et al., 2019) spatial orientation refers to the ability to reorient oneself in space. It involves the process of mapping spatial relationships at various scales and from different perspectives and

locations within the environment; this is considered different from object-based transformation. In addition, according to Lowrie et al., (2020) the task of spatial orientation requires a person to position himself physically or mentally in the place of an object to be manipulated to determine its position or the result of its transformation.

Mental Rotation

Participant 2 (MFAB)

Students can determine the results of the rotation of the 3D object correctly and answer how many times the cube is rolled to achieve its goal, as well as draw the results of the rotation correctly. As seen in the picture:

Pigure 3.2 (D.PSRM-SW04-L3)

Based on the answers of the MFAB subject in Figure 3.2 Then an in-depth search was carried out, the following is a snippet of the results of the interview with MFAB:

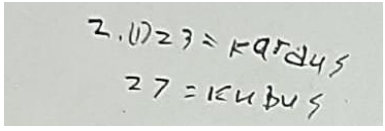
Table 3.2. MFAB Spatial Reasoning Ability Quote Question 2 (W-SWRM04-L3)

Code		Interview	Troubleshooting ability steps
AMP	:	*"How do you change the shape of the mesh or eh move the cube?"*	
MFAB	:	*"Roll over the cube and get to the X sign and see the color in front of you"*	Reading and thinking states the problem in its own words that in order to solve the problem by overthrowing, investigating and planning, choosing a strategy
AMP	:	*"Ooh so"*	
MFAB	:	*"Iya "*	Describe and convey
AMP	:	*"Let's see if your answer is really no, it's really amazing, so how many times has the cube been rolled over?"*	
MFAB	:	*"Five times"*	Finding answers using your geometric skills

Based on the results of the interview, students have carried out problem-solving steps by reading and thinking about problems, investigating and planning, choosing a strategy, finding answers and describing them. Mental rotation is a cognitive process by which a person imagines how 2-dimensional and 3-dimensional objects will appear after a point is rotated at a certain angle (Shepard &; Metzler, 1988). Another definition of (Hegarty &; Waller, 2005) mental rotation is a specific type of object-based transformation, which is often separated in analytical studies of factors from measures of spatial visualization.

Spatial Visualization

Students have not been able to answer the question of spatial visualization of nets to build a block space, only in answering there are complete completion steps. As seen in the following image:



Pigure 3.3 (D.SHAN-SW07-L5)

Based on the answers of the DA subject in Figure 3.2 Then an in-depth search was carried out, the following is a snippet of the results of the interview with DA:

Table 3.2. DA Spatial Reasoning Ability Quote Question 3 (W-SWAN07-L5)

Code		*Interview*	*Troubleshooting ability steps*
AMP	:	*"How do you see the building of the space, tell us!"*	
DA	:	*"Calculate, keep adding, improving"*	Reading and thinking states the problem in its own words by stating that the problem needs to be calculated by adding and correcting
AMP	:	*"Corrected how, so folding What is known from the matter, how long is it"*	
DA	:	*"Length 6 cm, width of 9 cm, this is 3 cm"*	Investigate and plan with the information that has been obtained, namely knowing the information on the size, length, width and height of the building,
AMP	:	*"Then how to do it"*	
DA	:	*"Add hand"*	Choosing a strategy by revealing that in working using the hands
AMP	:	*"Why is there an addition indeed to find the volume of how?"*	
DA	:	*"Length, width continues high")*	Haven't found an answer because geometric features have not been used to the maximum

Based on these interviews, learners in solving problems are good because spatial visualization itself refers to the ability to imagine complex multi-step spatial transformations in objects, this is measured by tasks that involve imagining object-based transformations such as folding paper, or clean to solid conversion(Harris et al., 2021). In the face of complex problems, good problem-solving skills allow one to prioritize and assess the effectiveness of various solution strategies (Silmi Awalyatun Nisa & Roni Wahyu Wandani, 2023).

This study provides a better understanding of how spatial reasoning affects mathematical performance in elementary schools. The results of this study can be a guideline for teachers and educational institutions in designing a HOTS problem-solving geometry lesson plan based on spatial reasoning. The implementation of geometry problem-solving skills can be trained using HOTS questions. This study identifies students who have good spatial reasoning skills in solving HOTS problems Well, students with medium and low abilities have difficulties solving geometry problems, so the spatial reasoning of students with medium and low abilities is different in solving geometric problems related to the spatial reasoning of students with high mathematical skills. A learning design is needed that can accommodate the needs of these students.

The limitation of the research analysis of students' problem-solving abilities on geometry HOTS problems in terms of spatial reasoning is that the results of this study may only apply to the specific context in the elementary school studied. The generalization of results to a broader level needs to be done carefully. The use of descriptive qualitative methods in this study can involve the subjectivity of researchers in interpreting the data. Efforts to mitigate subjectivity should be considered by using data triangulation and engaging other researchers to verify the findings. Lastly, this study may require significant time and resources to collect qualitative data, involve teacher and learner participation, and conduct in-depth analysis.

Time and resource constraints can affect the number of samples involved and the depth of the analysis.

CONCLUSION

This study provides an understanding of students' problem-solving abilities on geometry HOTS problems in terms of spatial reasoning in SD N Lulut 05 and SD N Lulut 03 schools. By analyzing students' test results in terms of spatial reasoning, the results shows that the spatial reasoning of the two schools reached 32% in the high category, while the HOTS geometry problem solving reached 30% in the high category. This study identifies students who have good spatial reasoning skills in solving HOTS problems Well, students with medium and low abilities have difficulties solving geometry problems, so the spatial reasoning of students with medium and low abilities is different in solving geometric problems related to the spatial reasoning of students with high mathematical skills. A learning design is needed that can accommodate the needs of these students.

Spatial reasoning is the ability to understand and manipulate spatial information in the mind through various tasks related to placement, orientation, decomposition/recomposition, navigation, pattern making, scaling, symmetry recognition, and spatial reasoning. Geometry and spatial reasoning are thus highly interrelated, and most mathematics educators include spatial reasoning as part of their geometry curriculum. The importance of spatial reasoning in geometry is because geometry has abstract studies that require a spatial reasoning process.

Based on this, HOTS questions given to students can improve students' thinking skills to think beyond just remembering and understanding information when solving mathematical problems. HOTS questions can be one strategy to improve students' thinking. These questions can help students think more critically, creatively, and innovatively, and they can be trained continuously by teachers.

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