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ANALYSIS OF STUDENTS' SPATIAL ABILITIES REVIEWED FROM GENDER DIFFERENCES IN CLASS X

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ABSTRACT
Spatial skills are important for studying geometric shapes. People who have good spatial abilities can easily imagine objects in three dimensions. Factors that influence differences in student abilities include gender differences. The aim of this research is to describe students' spatial abilities in terms of gender differences. The type of research used is quantitative-qualitative research. Spatial ability test results data are calculated and presented in quantitative form and analyzed qualitatively. This research was conducted at SMA Negeri 3 Ambon class X Science 1 with a total of 36 students consisting of 12 male students and 24 female students. In determining the subject of this research, a purposive sampling technique was used, namely taking data sources with certain considerations. The research subjects selected to be interviewed were 6 students with the assessment criteria for spatial ability test questions consisting of 1 male student and 1 female student with high spatial ability, 1 male student and 1 female student with moderate spatial ability, and 1 male student with moderate spatial ability. male and 1 female student with low spatial abilities. The largest percentage of student test results are in the low category. Based on the results of the spatial ability test, it shows that in the element of spatial perception, male subjects are more likely to meet the indicators of the ability to identify objects vertically and horizontally even though the position of the object is manipulated. Meanwhile, female subjects tend to use their spatial abilities as indicators of the ability to distinguish lines, horizontal and vertical planes in spatial figures. In the spatial visualization element, male subjects are more likely to fulfill the indicators than female subjects regarding stacks of unit cubes whose position or shape has been manipulated and visualizing stacks of unit cubes from more than one point of view. For the element of mental rotation, male subjects tend to be more capable than female subjects of rotating, imagining rotation and describing a flat shape or spatial structure correctly after rotation. However, elements of spatial orientation of female subjects are more likely to determine the appearance of objects from different perspectives than male subjects. In the spatial relations element, male subjects are more likely to determine the relationship of an object with other objects than female subjects.
Keywords: Gender, Spatial Abilities, Student

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PRELIMINARY

Spatial ability is the ability to think through the transformation of mental images (Imamuddin, 2018). According to Harmony & Theis (2012), spatial ability is the ability to capture the world of space accurately or the ability to visualize images, which includes the ability to recognize shapes and objects accurately, make these changes, describe something or an object in the mind and change it into a real form. , as well as sensitivity to balance, relationships, form and space.

NCTM (2000) clearly describes the importance of students' spatial abilities, stating that mathematics program instruction must pay attention to geometry and spatiality, so that all students can use visualization and spatial reasoning to solve problems within and outside mathematics. If viewed from the context of everyday life, spatial abilities also need to be improved, Syahputra (2013) states that children really need spatial abilities in exploration activities, for example when they draw, color, stick, origami, and so on. This also refers to

Barked and Engida ((Burhan & Mulbar, 2018), who argue that spatial ability is a major intellectual factor that is not only important for mathematics and science, but is also important for success in many jobs. For example, someone who has a career as a pilot really needs high spatial abilities for a good understanding of the location of the land/field while he is maneuvering. Likewise, a captain definitely needs high spatial abilities when carrying out his duties.

Zulkarnain (2021) stated that with spatial abilities, students will find it easier to visualize objects, because geometry material is abstract material. In this way, it can stimulate students' interest in learning, not just accepting concepts, students can also imagine and describe geometric shapes that are still abstract so that geometry in mathematics can be seen more clearly. This means that spatial abilities are very important to optimize in learning mathematics, especially geometry. According to Nasution (2017), spatial ability is a skill that involves the ability to think about images and the ability to record, change and recreate aspects of the visual world.

Each student has different spatial abilities. These differences in ability can also be studied from a gender aspect. Ismi (2021) found that male and female subjects had the same spatial visualization abilities as demonstrated by their ability to determine the composition of an object after its position and shape were manipulated. Meanwhile, in solving problems related to spatial orientation and spatial relations, male subjects use their spatial abilities more dominantly than female subjects. Another research conducted by Narpila (2019) found that there were differences in the spatial intelligence of male and female students, namely that the spatial intelligence of male students was better than the spatial intelligence of female students. This is also supported by research from Maccoby and Jacklin (Subarinah et al., 2018) which states that men and women have different abilities, namely men are superior in visual spatial abilities than women.

Based on the results of an interview with one of the mathematics subject teachers at SMA Negeri 3 Ambon, information was obtained that the majority of students had

difficulty In learning mathematics specially for geometry topic. Students are difficult to solve the problem that differ from th example. Male students are happier when chalanged with images. Then they also enjoy imagining picture problems and then solving them without having to write them down. This is differ from female students, they also enjoy learning about pictures-pictures, but they cannot imagine the pictures given if they are not written down. Male students tend to understand the material given more quickly than female students. So, the aim of this study is determine and describe the spatial abilities of class X male and female students at SMA Negeri 3 Ambon.

METHODS

The type of reserace is is descriptive qualitative research. Data from spatial ability tests are calculated and presented in quantitative form and analyzed qualitatively. Researchers use quantitative research to obtain an overview of the level of students' spatial abilities, then the results of qualitative data analysis are used by researchers to expand and strengthen the results of quantitative research.

This research was carried out at SMA Negeri 3 Ambon from 17 February to 17 March 2023. The data source in this research was students in class X Science 1 SMA Negeri 3 Ambon with the total number of students in class X Science 1 being 36 students consisting of 12 male students and 24 female students. This research used purposive sampling technique, namely sampling data sources with certain considerations (Sugiyono, 2013). The subjects in this research were 6 students of class and able to communicate well. The largest percentage of student test results are in the low category. The subjects taken for interview were 1 male student and 1 female student with high spatial abilities, 1 male student and 1 female student with moderate spatial abilities, and 1 male student and 1 female student with low spatial abilities.

The main instrument is the researcher himself and supporting instruments namely spatial ability tests and interview guides. The test questions consist of 8 descriptive questions to measure the level of students' spatial abilities which were adapted from an instrument developed by Ismi (2021) with 6 questions, namely elements of spatial perception, spatial visualization and mental rotation abilities and Hibatullah (2020) with 2 questions, namely elements of spatial relation and spatial abilities orientation. And it has been validated by two Mathematics Education lecturers and one mathematics teacher at SMA Negeri 3 Ambon

Data analysis in this research is quantitative data analysis and qualitative data analysis. Quantitative data in the form of spatial ability test results were analyzed using descriptive statistics. Then categorized based on the Benchmark Assessment (PAP) adapted from Ratumanan & Laurens (2015) as follows:

Table 1. Benchmark Assessment

Interval	Kategori
$x \geq 75$	High
$60 \leq x < 75$	Medium
$x < 60$	Low

PAP is used to see student learning outcomes, which are then followed up in selecting subjects to be interviewed. Student spatial ability test scores are obtained from:

$$\text{Value} = \frac{\text{Total score obtained}}{\text{Maximum score}} x100 \quad (1)$$

Meanwhile, qualitative data analysis using data analysis techniques proposed by Miles and Huberman (Sugiyono, 2013), namely data reduction, data presentation, and drawing conclusions.

RESULT AND DISCUSSION

Students' overall spatial abilities

Based on the results of the spatial ability tests consisting of spatial perception, spatial visualization, mental rotation, spatial relations, and spatial orientation the average student score was 38.74. If student test results are grouped into very high, medium and low categories, it will be the frequencies and percentages obtained are as follows.

Table 2. Classification of Spatial Ability Test Results for Class X Science 1 Students at SMA Negeri 3 Ambon

Categori	Male		Female	
	f	%	f	%
High	1	8.33%	1	4.17%
Medium	2	16.67%	3	12.5%
Low	9	75%	20	83.33%

Based on the table above, it can be obtained that 1 male student (8.33%) and 1 female student (4.17%) are in the high category, 2 male students (16.67%) and 3 female students (12.5%) were in the medium category and 9 male students (75%) and 20 female

students (83.33%) were in the low category. So it can be concluded that the largest percentage of spatial ability test results are in the low category.

Analysis of student spatial ability test and interview results

There were 6 subjects in this study, namely S1, S2, S3, S4, S5, and S6. Based on the results of the spatial ability test of the 6 subjects, the following data was obtained.

Table 4. Benchmark Assessment Results

No.	Subject Study	Mark	Category
1	S1	94.73	High
2	S2	78.95	High
3	S3	68.42	Medium
4	S4	68.42	Medium
5	S5	57.89	Low
6	S6	57.89	Low

From the results shown in the table above, it is obtained that subject studies that are in the high category with an interval of x values ≥ 75 are S1 and S2, subjects who are in the medium category with an interval of values 60 ≤ x < 75 are S3 and S4, and subjects who are in the low category with an interval of x values < 60 are S5 and S6. Referring to the test results obtained, the researcher carried out an interview process with the aim of finding out the extent of the spatial abilities of each research subject.

Based on the research results, the following discussion is obtained for each subject.

High ability subjects (S1 & S2):

Based on the results of the spatial ability analysis of test and interview results, undergraduate subjects met 7 indicators of spatial ability correctly and 1 other indicator was still inaccurate and wrong. Meanwhile, S2 meets 6 indicators of spatial ability correctly, but the other 2 indicators are still incomplete and wrong.

Based on test results and interview results on the results of research analysis, it shows that S1 and S2 subjects have the same ability in the element of spatial perception, namely being able to fulfill the indicators of distinguishing lines, horizontal planes and vertical planes in spatial shapes in question number 3 and identifying objects. vertically or horizontally if the position was manipulated in question number 4. Subjects S1 and S2 gave answers by describing the position of the water and the boat when the aquarium was tilted and were able to distinguish cylinders whose position was manipulated correctly. This is in line with research by Lestari et al., (2021) which states that male and female students who are in the high category can fulfill the spatial perception indicators, namely distinguishing lines, horizontal and vertical planes when the position of the object is

manipulated. In terms of the spatial visualization element, S1 subjects are more dominant than S2 subjects, as can be seen in question number 5 with the indicator of solving a problem related to objects that are stacks of unit cube shapes whose shapes have been manipulated, S1 subjects have a good understanding of the surface area of spatial shapes whose positions have been manipulated and provide the explanation is good and correct, but it is still wrong in finding the volume of the geometric shape. Meanwhile, subject S2 was unable to give the correct answer regarding the question given in this problem, but when subject S2 looked at the question repeatedly and was found to be able to determine the volume of the given geometric figure, he was still unable to find the surface area of the geometric figure. And also subjects S1 and S2 both met the indicators of ability to visualize a stack of unit cubes from more than one point of view in question number 6, both of them were able to describe the surface of the stack of cubes and were able to provide an explanation for the answer. This is in line with the results of research conducted by Imamuddin (2018) which stated that male students' spatial abilities in the spatial visualization element were superior to female students. Nurfadila & Mujib (2023) also stated that men are better than woman in visual and spatial skills, and men are also better in mathematics skills.

In the element of mental rotation, S1 and S2 subjects were both able to fulfill the indicators of rotating a spatial or flat shape and imagining the rotation of a spatial and flat shape correctly and are also able to describe two or three dimensional spatial shapes after rotation in questions number 7 and 8. S1 and S2 subjects have a good understanding of solving this problem and tend to be able to state the work steps correctly.

In the element of spatial orientation, subjects S1 and S2 were also able to meet the indicators of the ability to determine the appearance of objects from different perspectives. It can be seen that both of them are able to describe spatial shapes that appear from various directions correctly.

Regarding the spatial relations element in question number 2 with indicators of the ability to determine the relationship of an object to other objects, subject S1 was more able to solve the problem accurately and completely, but subject S2 completed this question incompletely, subject S2 was less careful in doing it. However, when S2 paid more attention to the questions, he was able to complete the answers correctly. This is also in line with research conducted by Ismi (2021) which found that male subjects used their spatial abilities more in problems related to spatial relations, namely determining the relationship of an object to other objects.

Intermediate ability subjects (S3 & S4):

Based on the results of the spatial ability analysis of test and interview results, S3 subjects met 4 indicators of spatial ability correctly and the other 4 indicators were still inaccurate and wrong. Meanwhile, S4 fulfills 4 indicators of spatial ability correctly, but the other 4 indicators are still incomplete and incorrect.

In the element of spatial perception, subjects S3 and S4 were equally unable to fulfill the indicators of distinguishing lines, horizontal planes and vertical planes in spatial figures in question number 3. Subjects S3 and S4 were unable to imagine how the water and boat would be positioned correctly if the aquarium was tilted. However, on the indicator of identifying objects vertically and horizontally if their position is manipulated in question number 4, subjects S3 and S4 are able to fulfill the indicator so that they give the correct answer and can distinguish between objects whose position is manipulated correctly. This is supported by Destiani (2021) that male and female students cannot fulfill all the indicators for the spatial perception element. Apart from that, there are also Agzistasari et al., (2023) findings where the subject was unable to solve the problem based on the indicators, namely the appearance of objects from different directions. It can be concluded that the subject was unable to solve the spatial perception indicator questions.

In terms of the spatial visualization element, subjects S3 and S4 have the same ability, namely not being able to fulfill the indicators for solving questions related to stacked objects of unit cube shapes whose shape has been manipulated in question number 5. The answers given are not appropriate or correct. Subject S3 admitted that he was not careful in solving this question so he made a mistake and also that subject S4 did not understand this question. Meanwhile, in fulfilling the indicator of the ability to visualize a stack of unit cubes from more than one point of view in question number 6, subjects S3 and S4 were able to describe the surface of the stack of cubes and were able to provide an explanation for their answer.

In the element of mental rotation, subjects S3 and S4 have different abilities. In the interview results, subject S3 in question number 7 appears to be able to rotate a shape and imagine the rotation of the shape the space correctly describes three-dimensional spatial shapes after rotation, but S3 subjects tend to be slower in working on questions so they lack time to solve them and give inappropriate answers. Meanwhile, in this problem, subject S4 was able to solve it correctly. However, subject S3 was superior in the indicator of the ability to rotate a flat shape and imagine the rotation of the flat shape and describe it after rotation in question number 8, while subject S4 in solving this problem was still

wrong when asked to rotate 270 degrees clockwise but the subject The S4 only rotates 180 degrees. This is also in line with the results of research conducted by Alimuddin & Trisnowali (2018) which states that related to mental rotation, male subjects predominantly use their spatial abilities compared to female subjects. In the element of spatial orientation, subjects S3 and S4 have the same ability, namely being able to fulfill the indicators of the ability to determine the appearance of objects from different perspectives in question number 1. It can be seen that both of them are able to accurately describe the appearance of spatial shapes when viewed from various directions. This is the same as Prastyo (2017) is research which found that male and female subjects with moderate spatial abilities had the same spatial orientation abilities.In the spatial relations element in question number 2 with the indicator of the ability to determine the relationship of an object with other objects, subjects S3 and S4 have the same ability it was shown that subjects S3 and S4 were less able to solve the questions completely.

Low ability subjects (S5 & S6):

Based on the results of the spatial ability analysis of the test and interview results, S5 subjects met 3 indicators of spatial ability correctly and the other 5 indicators were still incomplete and wrong. Meanwhile, the S6 meets 4 indicators of spatial ability correctly, but the other 4 indicators are still incomplete and wrong.

In the element of spatial perception, subjects S5 and S6 have different abilities, namely in the indicator of the ability to distinguish lines, horizontal planes and vertical planes in spatial figures in question number 3. It can be seen that subject S6 is superior to subject S5, namely that subject S5 cannot imagine exactly how there is a lot of water in the aquarium if it is tilted to the left, but in the interview results it was found that subject S5 was able to draw the exact position of the water and the boat, this shows that if subject S5 was more careful and understood the questions better then subject S5 could answer correctly. Meanwhile, subject S6 was able to fulfill the indicators so that he could draw the position of the water and the boat correctly. However, subject S5 was superior to subject S6 in terms of the ability to identify objects vertically and horizontally when their position was manipulated in question number 4. Subject S5 was able to differentiate between the cylinders given and give the right answer and explain it well. Meanwhile, subject S6 solved the questions incorrectly and could not provide a clear reason for this the answer given. This is in line with what Imamuddin & Isnaniah (2018) said that female students are weak in spatial perception abilities. Thus, men certainly have better vision and deeper perception than woman (Narpila, 2019).

In the spatial visualization element, subject S5 is more dominant than subject S6. In the indicator of the ability to solve problems related to objects that are stacks of unit cube shapes whose shapes have been manipulated in question number 5, it can be seen that subjects S5 and S6 are both unable to find the volume and surface area of the given space shapes. However, on the indicator of the ability to visualize a stack of unit cubes from more than one point of view in question number 6, subject S5 was able to answer the question correctly, but it was still incomplete, but when subject S5 looked repeatedly at the question given and appeared to be able to solve it completely. Meanwhile, subject S6 was unable to meet the indicators in this question.

In the element of mental rotation, subjects S5 and S6 have the same ability, namely being able to fulfill the indicators of rotating a spatial or flat shape and imagining the rotation of the spatial and flat shape correctly and also being able to describe a spatial shape in dimensions two or three after the rotation in questions number 7 and 8. Subjects S5 and S6 have a good understanding of solving this problem and can explain the work steps. In the element of spatial orientation, subject S6 is superior to subject S5. It can be seen that subject S5 cannot fulfill the indicator in question number 1, namely the ability to determine the appearance of objects from different perspectives. Subject S5 was unable to differentiate the appearance of cone if viewed from below and above. Meanwhile, subject S6 was able to fulfill the indicators in this question and was able to explain the answer well. In the spatial relations element in question number 2 with indicators of the ability to determine the relationship of an object to other objects, it is shown that subjects S5 and S6 are less able to solve the question completely. This is because the subject is less able to know the types of spatial shapes connected to the given object.

CONCLUSION

Based on the analysis and discussion process carried out by researchers and referring to the research questions, it can be concluded that the spatial abilities of class X students at SMA Negeri 3 Ambon, in this case the 6 students taken as research subjects include, in the element of spatial perception, male subjects are more likely to meet the indicators of ability to identify objects vertically and horizontally even though the position of the object is manipulated. Meanwhile, female subjects tend to use their spatial abilities as indicators of the ability to distinguish lines, horizontal and vertical planes in spatial figures. Male subjects are more likely to fulfill the indicators in the spatial visualization element than female subjects when it comes to stacks of unit cubes whose position or

shape has been changed and visualizing stacks of unit cubes from more than one point of view.

Male subjects are more capable than female subject of rotating mentally, imagining the rotation and correctly describing a flat shape or spatial shape after it is done. In the element of spatial orientation, female subjects are more likely to determine the appearance of objects from a different perspective than male subjects. Male subjects in the spatial relations element are more likely to determine the relationship an object to other objects than female subjects.

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