P-ISSN 2527-5615
E-ISSN 2527-5607

Kalamatika: Jurnal Pendidikan Matematika
Volume 10, No. 1, April 2025, pages 31-46

THE IMPACT OF VIRTUAL GEOBOARD-BASED LEARNING MEDIA ON ELEMENTARY SCHOOL STUDENTS' SPATIAL THINKING

Linda Astriani[1], Nur Meilia Andini[2]

[1]Universitas Muhammadiyah Jakarta, Jl. KH. Ahmad Dahlan, Tangerang Selatan, Indonesia.
lindaaastriani@umj.ac.id
[2]Universitas Muhammadiyah Jakarta, Jl. KH. Ahmad Dahlan, Tangerang Selatan, Indonesia.
nurmeilia02@gmail.com

ABSTRACT

This research was motivated by the observation that students had low ability in visualizing flat shapes, particularly when solving problems related to plane geometry. This study aimed to investigate the effect of virtual geoboard-based manipulative learning media on the spatial thinking skills of fourth-grade students. This research employed a quantitative approach with a posttest-only control group design and purposive sampling as the sampling technique. The samples consisted of two classes from all fourth-grade classes at SDN Pondok Aren 02: the experimental class, which used virtual geoboard media (Class IVB, 32 students), and the control class, which did not use virtual geoboard media (Class IVC, 26 students). Both groups were confirmed to have a normal distribution and to originate from a homogeneous population. The results of the study showed that: 1) the use of virtual geoboard media had a significant effect on students' spatial thinking skills. 2) There was a notable difference in the average posttest scores between the experimental and control classes, demonstrating the strong impact of virtual geoboard media on enhancing students' spatial thinking.

ARTICLE INFORMATION

Keywords

Manipulative tool
Spatial thinking
Virtual Geoboard
Elementary school

Article History

Submitted *Sep 20, 2024*
Revised *Feb 20, 2025*
Accepted *Feb 21, 2025*

Corresponding Author

Linda Astriani
Universitas Muhammadiyah Jakarta
Jl. KH. Ahmad Dahlan, Tangerang Selatan, Indonesia
lindaastriani@umj.ac.id

How to Cite

Astriani, L. & Andini, N. M. (2025). The Impact of Virtual Geoboard-Based Learning Media on Elementary School Students' Spatial Thinking. *Kalamatika: Jurnal Pendidikan Matematika, 10*(1), 31-46.

https://doi.org/10.22236/KALAMATIKA.vol10no1.2025pp31-46

INTRODUCTION

In Society 5.0, educators must be able to navigate and utilize digital information effectively (Khoiriah et al., 2023). Education should aim to enhance students' skills, attitudes, and thinking to prepare them for rapid technological advancements. Technology has become an integral part of school learning, including in mathematics, which is essential for supporting students' understanding across various disciplines (Astriani & Akyuni, 2024).

Many students struggle with geometric shapes, which often requires teachers to provide additional guidance in solving geometry-related problems (Anjarsari, 2018). In mathematics, particularly in geometry, students frequently encounter difficulties in connecting two-dimensional (2D) shapes with three-dimensional (3D) objects found in real-life contexts. This makes it challenging for them to distinguish between flat shapes and 3D forms (Gargrish et al., 2020). Such challenges are often caused by students' limited ability to describe flat shapes and construct them independently.

Spatial thinking is a critical skill in mathematics, especially in the study of geometry (Pavlovičová & Švecová, 2015). Latifah and Budiarto (2019) also noted that students with strong spatial thinking abilities tend to perform better in mathematics. According to Anggriawan et al. (2017), students' spatial thinking abilities may be underdeveloped due to a lack of spatial experiences in their daily lives.

Alimuddin and Trisnowali (2019) defined spatial thinking as the ability to interpret and manipulate spatial dimensions, visualize objects from various perspectives, and understand the relationships between shapes, colors, and spaces. In addition, spatial thinking involves perceiving, imagining, and constructing objects within spatial contexts (Shofilah et al, 2021) . Hawes et al., (2022) emphasized the importance of spatial thinking in mathematics, as it helps students understand spatial relationships. This skill can be developed through the use of virtual and physical manipulative learning tools, one of which is the virtual geoboard (Saidu & Salahudeen, 2016).

A geoboard is a visual manipulative tool that teachers can use to help students understand geometry concepts more effectively, including the properties of plane figures and the calculation of their perimeter and area, thus making these concepts easier to comprehend (Sopian et al., 2020). Geoboard media offer concrete visual evidence, allowing students to observe changes in shape through the 'size' feature and understand that increasing the perimeter does not necessarily result in an increase in area (Loong, 2014).

This finding is supported by research from Ningrum and Napitupulu (2021), which showed that the use of geoboard learning media significantly improves students' performance in calculating the perimeter and area of flat shapes. A virtual geoboard, in particular, is an interactive mathematical tool designed to simulate the functions of a physical geoboard, helping students explore geometry concepts digitally. Virtual geoboards are accessible online, for example, via the website Toytheater.com. An example of the virtual geoboard interface can be seen in Figure 1.

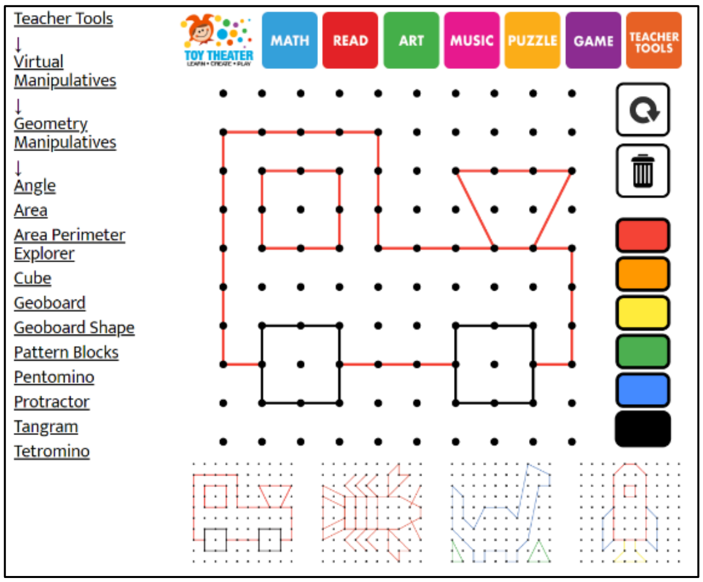

Figure 1. Virtual Geoboard Media Display

Masturoh and Khaeroni (2017) stated that the use of geoboard media allows students to calculate the perimeter and area of parallelograms and triangles by constructing flat shapes. After forming the shapes using rubber bands, students count the number of nails within the structure to determine the perimeter and area. The procedure proposed by Masturoh and Khaeroni can also be applied to virtual geoboard media, which is accessible via the Toytheater.com website, as used in this research. The steps for using virtual geoboard media are as follows: 1) Select the desired color by clicking the color box on the right side of the interface; 2) choose one of the points on the virtual geoboard and drag it to another point to create a line; 3) swipe right or left on the template menu to select one of the predefined shapes to copy or to create a new shape. In addition, students can delete the shapes they have created and start over, enabling repeated practice and exploration.

Toytheater.com offers a wide variety of educational math, literacy, and art activities and games. The platform focuses on early childhood education and is trusted by many teachers for providing safe and effective educational content. The website supports learning by offering free, accessible, and high-quality online educational tools. The Toytheater.com website represents an application of information technology, which, according to Fauzi and Samsudin (2022). can simplify various processes for educational institutions.

In line with one of the key characteristics of the Independent Curriculum, virtual manipulative learning media, such as the Toytheater.com Virtual Geoboard, can help develop students' soft skills and extend meaningful learning time. Integrating technology into the learning process is a crucial step in modern education, reflecting the principles of the Independent Curriculum (*Kurikulum Merdeka*), which emphasizes the importance of technology-supported instruction.

In the era of Society 5.0, teachers are expected to enhance their ability to develop digital learning media that can foster students' skills, particularly their spatial thinking in mathematics. Therefore, the use of learning media that leverages the advantages of the Independent Curriculum, especially technology-based tools — is essential for facilitating effective teaching and learning.

In the context of education, media functions as a tool or device for delivering learning materials from teachers to students (Karo-karo, 2018). In a study investigating the effects of a problem-based learning model supported by augmented reality, Nurwijaya (2022) found that one of the challenges students face regarding spatial thinking is a reduced ability to create mental visual representations and use technological tools effectively.

Similarly, research by Paradesa (2016) reported that students with low visual-spatial thinking skills often struggle to describe, interpret projections, and reconstruct geometric concepts using technology. These findings suggest a gap between the development of educational media and students' readiness to fully engage with such tools. This research aims to explore whether virtual geoboard media can significantly influence students’ spatial thinking or whether other factors play a role, which require further investigation.

Based on the previous discussion, creative learning ideas are needed to enhance students' spatial thinking skills. One such strategy is the use of virtual geoboard-based manipulative learning media, which can be accessed via the Toytheater.com website, to strengthen students’ understanding of two-dimensional geometry. In line with the objectives of this study, which seeks to examine the influence of virtual geoboard media on students' spatial thinking and assess the extent of this influence, it is expected that the findings will confirm the significant role of virtual geoboard media in improving students' spatial thinking, particularly in relation to flat shape material.

METHOD

This research employs a quantitative approach combined with experimental methods. A quantitative approach is characterized by a systematic, planned, and clearly structured process, beginning from the formulation of the problem to the design of the research methodology (Azis et al., 2022). The experimental method is used to examine how one or more variables influence another variable, with the goal of validating the relationship between them. This study uses a quasi-experimental design using a posttest-only control group. This design focuses on comparing the effects of treatment between two groups: an experimental group that receives the treatment and a control group that does not. The design of this research is presented in Table 1.

Table 1. Research Design

Class	Treatment	Posttest
Eksperimental Class	X	O_1
Control Class		O_2

Source: Maheswari and Pramudiani (2021)

The population of this study consisted of all fourth-grade students, totaling 92 students. The research samples were selected from two classes out of the three available, specifically class IVB, which consisted of 32 students and served as the experimental group, and class IVC, which consisted of 26 students and served as the control group. The samples were selected using a purposive sampling technique.

This study involved two variables: the independent variable (X), which was the use of virtual geoboard media, and the dependent variable (Y), which was students' spatial thinking ability. The spatial thinking indicators used in this study refer to the indicators proposed by Maier (1996), as cited in Isnaniah (2016), and are presented in Table 2.

Table 2. Spatial Thinking Indicators

No.	Indicators	Sub-indicators
1.	Spatial Perception	The ability to observe a space or parts of a space placed horizontally or vertically.
2.	Spatial Visualization	The ability to imagine or describe the shape of a space whose parts have changed or shifted.
3.	Mental Rotation	The ability to rotate a space mentally, quickly, and precisely.
4.	Spatial Relations	The ability to understand the spatial form of an object or part of an object and the relationship between its parts.
5.	Spatial Orientation	The ability to physically or mentally locate oneself in space or to orient oneself in a specific spatial situation.

Data collection techniques in this research consisted of tests and documentation. A test is a series of steps designed to assess an individual's or group's abilities, knowledge, attitudes, intelligence, skills, or talents (Winarni, 2018). Meanwhile, documentation refers to materials that include various types of records such as photos, videos, disks, artifacts, and monuments (Kusumastuti et al., 2020).

The test used in this research was an instrument sheet consisting of 15 descriptive questions. Before being applied in the research, the test instrument underwent a construct validity test to determine whether it was appropriate for use. Following the validity test, the instrument was also tested for reliability.

Initially, the instrument consisted of 15 items. After validation by experts, 10 items were declared valid and suitable for use. The construct validity test confirmed that the 10 items met the validity criteria, and the reliability test showed a reliability value of 0.811, which exceeds the minimum threshold of 0.60, indicating that the instrument is reliable.

The research instrument grid, after passing the validation and trial process, is presented in Table 3.

Table 3. Research Instrument Grid

No.	Indicators	Sub-indicators	Number
1.	Spatial Perception	The ability to observe a space or parts of a space placed horizontally or vertically.	1 and 2
2.	Spatial Visualization	The ability to imagine or describe the shape of a space whose parts have changed or shifted.	3 and 4
3.	Mental Rotation	The ability to rotate a space mentally, quickly, and precisely.	5 and 6
4.	Spatial Relations	The ability to understand the spatial form of an object or part of an object and the relationship between its parts.	7 and 8
5.	Spatial Orientation	The ability to physically or mentally locate oneself in space or to orient oneself in a specific spatial situation.	9 and 10

The data analysis in this study consisted of prerequisite test analysis, including a normality test using the Kolmogorov-Smirnov method and a homogeneity test using Levene's test, as well as hypothesis testing using an independent samples T-test.

RESULT AND DISCUSSION

The Results of Data Analysis

This section presents the results of data analysis, including instrument testing, descriptive statistics, pre-analysis testing, and hypothesis testing to examine the effect of virtual geoboard-based learning media on students' spatial thinking.

Instrument Testing

The results of the validity and reliability tests for the research instrument are presented in Tables 4 and 5.

Table 4. Results of the Validity Test

Item No.	r_{value}	r_{table}	Description
1	0.548	0.339	Valid
2	0.614		Valid
3	0.458		Valid
4	0.516		Valid
5	0.606		Valid
6	0.725		Valid
7	0.782		Valid
8	0.664		Valid
9	0.726		Valid
10	0.605		Valid

Table 5. Results of the Reliability Test

Reliability Statistics	
Cronbach's Alpha	N of Items
.811	10

The instrument initially consisted of 15 items before being validated by experts. After the validation process, 10 items were deemed appropriate for use. The results of the construct validity test confirmed that all 10 items were valid. Additionally, the reliability test produced a value of 0.811, which exceeds the acceptable threshold of 0.06, indicating that the instrument is reliable.

Descriptive Statistic Test

The average scores for each indicator obtained by students in both the experimental and control classes are presented in Table 6.

Table 6. Average Score for Each Indicator

Indicator	Experimental Class	Control Class
	Average Value	Average Value
Spatial Perception	7.38	7.65
Spatial Visualization	5.84	4.62
Mental Rotation	6.28	4.58
Spatial Relations	6.81	5.04
Spatial Orientation	6.50	4.73
Total	32.81	26.62

Pre-Analysis Test

Table 7 shows that the significance value for the experimental class is 0.123, which is greater than 0.05, indicating that the data follows a normal distribution. Similarly, the significance value for the control class is 0.10, which is also greater than 0.05, indicating that the data follows a normal distribution. Next, the data was tested for homogeneity. The results of the homogeneity test are presented in Table 8.

Table 7. Result of Normality Test

Class	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
Experimental Class	.143	32	.123
Control Class	.166	26	.100

Table 8. Results of the Homogeneity Test

Test of Homogeneity of Variance				
	Levene Statistic	df1	df2	Sig.
Based on Mean	.052	1	56	.821

Table 8 indicates that the significance value for the homogeneity test is 0.821, which is greater than 0.05, suggesting that the sample is drawn from a homogeneous population.

Hypothesis Test

Hypothesis testing in this research serves two functions: (1) to assess the influence of virtual geoboard media on students' spatial thinking, which can be determined by comparing the significance value obtained with the alpha (α) value (0.05), and (2) to evaluate the magnitude of the influence of virtual geoboard media on students' spatial thinking, which is assessed by comparing the obtained t-count value with the t-table value. The t-table value is obtained from the t-table distribution with degrees of freedom (df) = N (number of samples) and is 2.003. The results of testing this hypothesis are presented in Table 9.

Table 9. Result of Independent Samples Test

Independent Samples Test			
Spatial Thinking	t	df	Sig. (2-tailed)
Equal variances assumed	4.621	56	0.000

Table 9 demonstrates that the t-count value of 4.261 exceeds the t-table value of 2.003, indicating a significant difference in the average scores between students in the experimental class and those in the control class. Since the significance value (2-tailed) obtained is 0.000, which is less than 0.05, the hypothesis testing criteria are met, suggesting that there is an effect from using manipulative learning media based on the virtual geoboard on the spatial thinking of fourth-grade students at SDN Pondok Aren 02 on plane figures.

Discussion

This research involved two samples: the experimental class, which used virtual geoboard media, and the control class, which only used conventional methods. Based on the results of hypothesis testing, it is evident that students who used virtual geoboard media performed better in spatial thinking compared to those who did not use the media. This is supported by the average posttest score of 32.18 for the experimental class students, compared to 26.62 for the control class students. These results align with research conducted by Sabil et al. (2022), which found that the use of virtual geoboard media to understand the concept of flat shapes positively influenced both students' responses and their understanding of the concept in mathematics learning.

In this study, experimental class students demonstrated greater ease in answering the posttest questions compared to the control class students. This confirms that virtual geoboard media significantly contributes to students' spatial thinking. A comparative analysis of students' spatial thinking, expressed in percentages, can be seen in Table 10 below.

Table 10. Percentage Value of Each Indicator

Indicator	Experimental Class	Control Class
Spatial Perception	92.25%	95.62%
Spatial Visualization	73%	57.75%
Mental Rotation	78.5%	57.25%
Spatial Relations	85.12%	63%
Spatial Orientation	81.25%	59.12%

Analysis of students' answers can generally be seen through a comparison of the percentages for each spatial thinking indicator above. This shows that experimental class students were able to answer posttest questions covering all five spatial thinking indicators, with two questions for each indicator, as reflected in the percentage values for the second to fifth indicators. Furthermore, a detailed analysis of the answers from both the experimental and control class students can be seen in Figure 2.

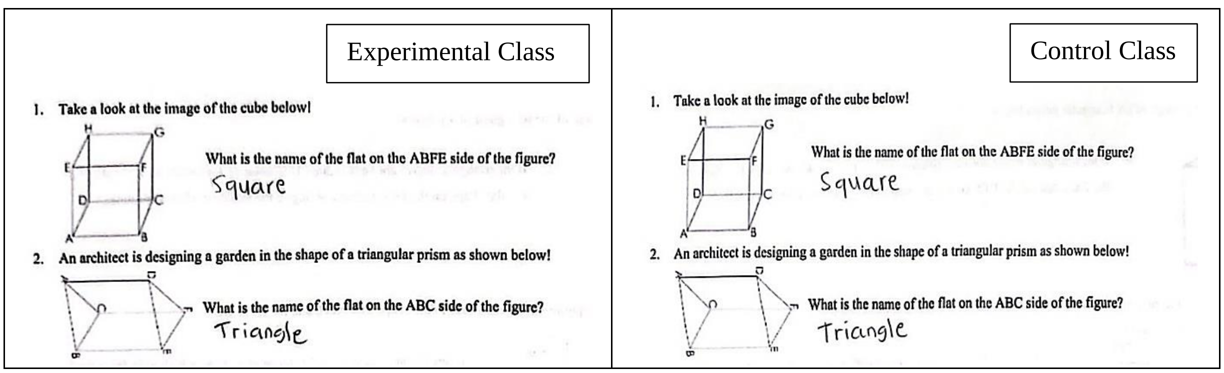

Figure 2. The Answers of the Experimental Class and Control Class for Questions 1 and 2

In Figure 2, it can be seen that both experimental and control class students answered 'square' for question number one and 'triangle' for question number two. Question number one asks for the identification of a square, and question number two asks for the identification of a triangle. These two questions represent the first indicator of spatial thinking, namely spatial perception. In these questions, students are required to observe the flat shapes found on specific sides of the spatial shapes provided in the images. This demonstrates that both experimental and control class students are able to identify a flat shape within a spatial shape, whether the shape is positioned horizontally or vertically.

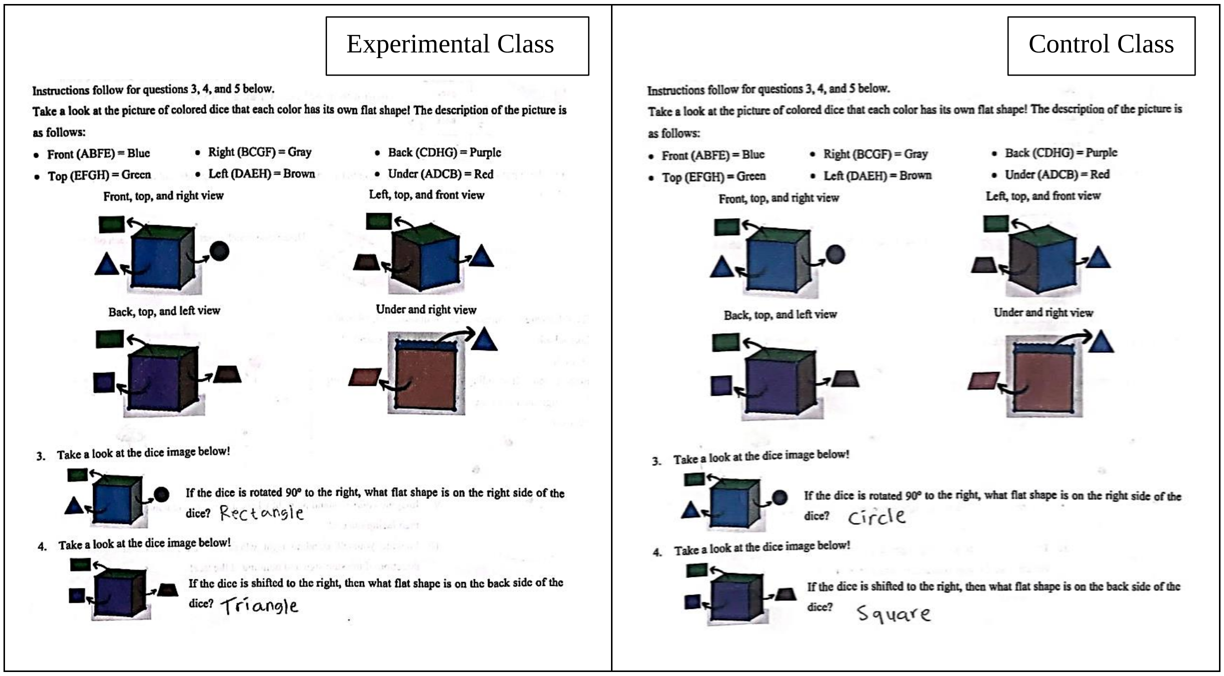

Figure 3. The Answers of Experimental Class and Control Class for Questions 3 and 4

In Figure 3, it can be seen that for question number three, experimental class students answered 'rectangle,' while control class students answered 'circle,' with the correct answer being 'rectangle.' In question number four, experimental class students answered 'triangle,' while control class students answered 'square,' with the correct answer being 'triangle.' These two questions correspond to the second indicator of spatial thinking, namely spatial visualization. In these questions, students are asked to imagine the image of a die spinning according to the instructions and then describe the results of this visualization activity. Based on the answers to these two questions, it is evident that experimental class students are able to effectively imagine and describe a spatial shape in motion. In contrast, control class students were unable to visualize and describe it accurately.

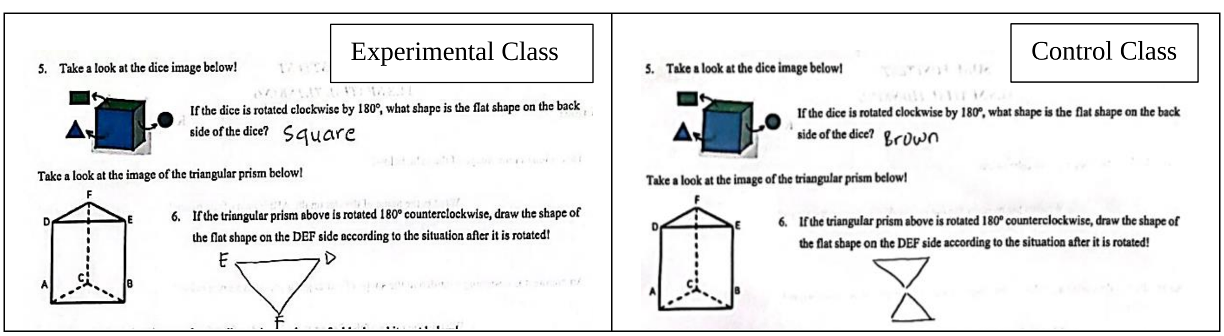

Figure 4. The Answers from Experimental Class and Control Class for Questions 5 and 6

In Figure 4, it can be seen that for question number five, experimental class students answered 'square,' while control class students answered 'brown,' with the correct answer being 'square,' as the question required identifying the shape of a flat surface, not the color of the die. In question number six, experimental class students correctly drew the position of a rectangular flat shape with side F at the bottom, while control class students drew two triangular flat shapes facing each other, without specifying the sides, where the correct answer was a square flat shape with side F at the bottom. These two questions represent the third indicator of spatial thinking, namely mental rotation. In both questions, students were asked to quickly and accurately rotate a geometric figure. Based on the answers to these two questions, it is evident that experimental class students are able to rotate a triangular prism quickly and accurately, while control class students were unable to do so effectively.

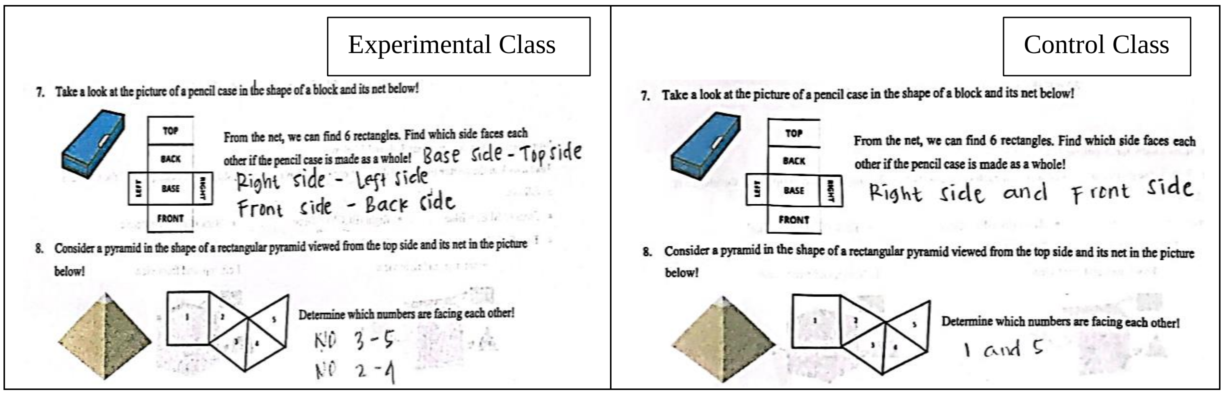

Figure 5. The Answers from Experimental Class and Control Class for Questions 7 and 8

In Figure 5, it can be seen that for question number seven, experimental class students answered, 'base side-top side,' 'right side-left side,' and 'front side-back side,' while control class students answered 'right side' and 'front side.' The correct answers were 'base side-top side,' 'right side-left side,' and 'front side-back side.' In question number eight, experimental class students answered '3-5' and '2-4,' while control class students answered '1' and '5.' The correct answers were '3-5' and '2-4.' These two questions represent the fourth indicator of spatial thinking, namely spatial relations. In these questions, students are asked to understand the parts of a block-shaped pencil box and a pyramid, as well as the relationships between the parts, by creating a net. Based on the answers to these two questions, it is clear that experimental class students have a better understanding of the relationships between the parts when they are made into nets, compared to control class students.

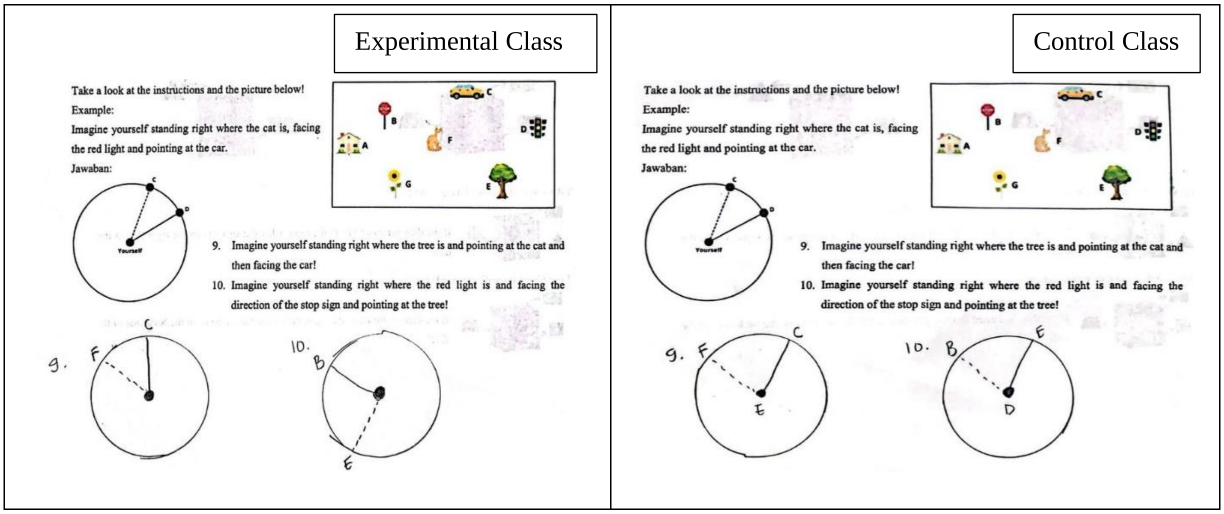

Figure 6. The Answers of Experimental Class for Questions 9 and 10

In Figure 6 above, it can be seen that for questions number nine and ten, the experimental class students answered correctly according to the instructions, while the control class students did not answer correctly. These two questions represent the fifth indicator of spatial thinking, namely spatial orientation. In both questions, students are asked to physically and mentally orient themselves by imagining themselves in a spatial situation. Based on the answers to these two questions, it is evident that experimental class students are able to orient themselves in a spatial situation by imagining themselves within the problem, while control class students are unable to do so.

CONCLUSION

Based on the research findings, which aim to examine the impact of virtual geoboard-based manipulative learning media on fourth-grade students' spatial thinking in relation to two-dimensional plane geometry, and the results of statistical calculations using the SPSS V.26 application, it can be concluded that virtual geoboard-based manipulative learning media has a significant influence on the spatial thinking of fourth-grade students, particularly in flat geometry material. Furthermore, based on the average scores obtained by the experimental and control class students, it is clear that there is a substantial difference in the average scores between experimental class students who used virtual geoboard media and control class students who either used conventional methods or did not use virtual geoboard media.

REFERENCES

Alimuddin, H., & Trisnowali, A. (2019). Profil Kemampuan Spasial dalam Menyelesaikan Masalah Geometri. *JPIn (Jurnal Pendidik Indonesia)*, *01*(01), 85–98.

Anggriawan, B., Effendy, & Budiasih, E. (2017). Kemampuan Spasial dan kaitannya dengan Pemahaman Mahasiswa Terhadap Materi Simetri. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *2*(12), 1612–1619. http://journal.um.ac.id/index.php/jptpp/

Anjarsari, E. (2018). Mengembangkan Kemampuan Spasial Siswa melalui Pendekatan Saintifik dalam Pembelajaran Matematika. *Reforma: Jurnal Pendidikan Dan Pembelajaran*, *7*(2), 55–61.

Astriani, L., & Akyuni, N. I. (2024). Analysis of Numeracy Skills in Grade Vi Elementary School Students in Solving Minimum Competency Assessment Questions. *Kalamatika: Jurnal Pendidikan Matematika*, *9*(1), 15–30. https://doi.org/10.22236/kalamatika.vol9no1.2024pp15-30

Azis, P. A., Trisna Rahayu, E., Kurniawan, F., Keguruan, F., Pendidikan, I., Singaperbangsa, U., & Abstract, K. (2022). Upaya Meningkatkan Gerak Lokomotor Siswa Sekolah Menengah Atas Dalam Pembelajaran Atletik Melalui Metode Bermain. *Jurnal Ilmiah Wahana Pendidikan*, *8*(15), 464–471.

Fauzi, M. S., & Samsudin, S. (2022). Smart School Berbasis Web Interaktif di SD Swasta Amaliyah Sunggal dengan Algoritma K-Means Cluster. *Jurnal Sisfokom (Sistem Informasi Dan Komputer)*, *11*(3), 332–341. https://doi.org/10.32736/sisfokom.v11i3.1479

Gargrish, S., Mantri, A., & Kaur, D. P. (2020). Augmented reality-based learning environment to enhance teaching-learning experience in geometry education. *Procedia Computer Science*, *172*(2019), 1039–1046. https://doi.org/10.1016/j.procs.2020.05.152

Hawes, Z. C. K., Gilligan-Lee, K. A., & Mix, K. S. (2022). Effects of Spatial Training on Mathematics Performance: A Meta-Analysis. *Developmental Psychology*, *58*(1), 112–137. https://doi.org/10.1037/dev0001281

Isnaniah. (2016). Analisis Spatial Abilities Mahasiswa Program Studi Pendidikan Matematika STAIN Bukittinggi. *MENARA Ilmu*, *10*(64), 89–103.

Karo-karo, I. R., & R. (2018). Manfaat Media dalam Pembelajaran. *Axiom: Jurnal Pendidikan Dan Matematika*, *7*(1), 91–96.

Khoiriah, S. U., Lubis, L. K. L. U., & Anas, D. K. N. (2023). Analisis Perkembangan Sistem Manajemen Pendidikan di Era Society 5.0. *JISPENDIORA: Jurnal Ilmu Sosial, Pendidikan Dan Humaniora*, *2*(2), 117–132.

Kusumastuti, A., Khoiron, A. M., & Achmadi, T. A. (2020). *Metode Penelitian Kuantitatif*. Deepublish. https://kubuku.id/detail/read/17419?fr=mobile

Latifah, N., & Budiarto, M. T. (2019). Profil Penalaran Spasial Siswa dalam Memecahkan Masalah Geometri Ditinjau dari Tingkat Kemampuan Matematika. *Jurnal Ilmiah Pendidikan Matematika*, *8*(3), 589–594.

Loong, K. (2014). Fostering Mathematical Understanding Through Physical and Virtual Manipulatives. *The Australian Mathematics Teacher*, *70*(4), 3–10.

Maheswari, G., & Pramudiani, P. (2021). Pengaruh Penggunaan Media Audio Visual Animaker terhadap Motivasi Belajar IPA Siswa Sekolah Dasar. *EDUKATIF: Jurnal Ilmu Pendidikan*, *3*(5), 2523–2530. https://doi.org/10.31004/edukatif.v3i5.872

Masturoh, I., & Khaeroni. (2017). Pengaruh Penggunaan Alat Peraga Geoboard Terhadap Hasil Belajar Siswa pada Pokok Bahasan Geometri. *PRIMARY*, *9*(02), 189–210.

Ningrum, A., & Napitupulu, S. (2021). Pengaruh Penggunaan Media Pembelajaran Geoboard Terhadap Hasil Belajar Siswa Pada Keliling Dan Luas Bangun Datar Kelas III SD. In *Cybernetics: Journal Educational Research and Social Studies* (Vol. 2, Issue 4). http://pusdikra-publishing.com/index.php/jrss

Nurwijaya, S. (2022). Pengaruh Model Pembelajaran Problem Based Learning Berbantuan Augmented Reality Terhadap Kemampuan Spasial Siswa. *Jurnal Ilmiah Pendidikan Matematika*, *5*(2), 107–116.

Paradesa, R. (2016). Pengembangan Bahan Ajar Geometri Transformasi Berbasis Visual. *Jurnal Pendidikan Matematika JPM RAFA*, *2*(1), 56–84.

Pavlovičová, G., & Švecová, V. (2015). The Development of Spatial Skills through Discovering in the Geometrical Education at Primary School. *Procedia - Social and Behavioral Sciences*, *186*, 990–997. https://doi.org/10.1016/j.sbspro.2015.04.189

Sabil, H., Andika Robiansah, M., Dewa Zulkhi, M., Damayanti, L., Delima Kiska, N., & Silvia, N. (2022). Online Geoboard Media in Mathematics Learning: Understanding the Concept of Two-Dimentional Figure. *Journal of Education Technology*, *6*(1), 12–18. https://doi.org/10.23887/jet.v6i1

Saidu, S., & Salahudeen, A. B. (2016). Effects of Geoboard and Geographical Globe on Senior Secondary School Students' Performance in Mathematics in Kaduna State. *Technology & Education (JOSTE)*, *4*(1), 140–148. https://www.researchgate.net/publication/311495195

Shofilah, D. A. et al. (2021). Profil Kemampuan Spasial Siswa dalam Menyelesaikan Masalah Geometri Spasial Ditinjau dari Tipe Kepribadian David Keirsey. *Kadikma*, *12*(2), 86–94.

Sopian, L. A., Yudha, C. B., & Oktaviana, E. (2020). Penerapan Media Papan Geoboard pada Pembelajaran Matematika. *Prosiding Seminar Nasional Pendidikan STKIP Kusuma Negara II*, 444–449.

Winarni, E. W. (2018). *Teori dan Praktik Penelitian Kuantitatif, Kualitatif, Penelitian Tindakan Kelas (PTK), Research and Development (R&D)*. Jakarta: Bumi Aksara. https://rb.gy/33h8ec