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Application of the Jigsaw Type Cooperative Learning Model with the Guided Discovery Method Used by Prompt Tools on the Surface Area of Curved Sided Template

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Abstract
*Curved-sided geometric shapes have a high level of abstraction, often leading to misconceptions and difficulties in visualizing three-dimensional shapes. The Jigsaw cooperative model can enhance interaction and conceptual elaboration through the division of learning roles among students, while the guided discovery method helps students understand concepts and the origins of formulas more deeply. The use of teaching aids also provides concrete experiences that can strengthen visualization and reduce misunderstandings. The synergy of these three approaches has the potential to create more effective, active, and meaningful learning, while meeting the demands of current learning and curriculum that emphasize collaboration, exploration, and conceptual understanding. The study used a qualitative descriptive approach because the purpose of the study was to describe the application of the jigsaw cooperative learning model with the guided discovery method assisted by teaching aids on the surface area of curved-sided geometric shapes. The research subjects were grade IX students. Data were collected through observation, tests, and documentation. Based on the results of observations of student attitude assessments, the percentage of cooperative attitudes was obtained at*85,29%*, a responsible attitude of*83,82%*, a self-confident attitude of*75%*, and a meticulous attitude of*75%*.. Based on student learning outcomes, the average student score is*69,41*, and 71% of students met the Minimum Competency Criteria (KKM). These findings confirm that this learning strategy is effective in creating an active and meaningful learning environment.*

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1. INTRODUCTION

Learning the surface area of curved-sided geometric shapes (cylinders, cones, and spheres) at the junior high school level is crucial because this material not only fulfills the national curriculum objectives of measuring and solving contextual problems, but also trains spatial reasoning and problem-solving skills that are crucial for subsequent mathematics and STEM subject learning (K. Education & Technology, 2022). Learning this material fosters skills in modeling real-world situations (e.g., calculating coating materials, liquid volumes, or designing 3D objects) so that students are able to connect mathematical formulas with practical applications in everyday life (Zhang, 2021). Recent research evidence also shows a strong relationship between spatial reasoning skills and mathematics achievement, reinforcing the importance of concrete experiences, visualization, and the use of aids (manipulatives or software such as GeoGebra) when teaching curved-sided geometric shapes (Xu & Sun, 2025). Therefore, strengthening conceptual objectives (understanding geometric elements and relationships), contextual exercises, and the use of learning media that facilitate 3-D exploration need to be a focus in junior high school teaching to build a solid foundation for higher-level mathematics learning (Navianto, 2023).

Several recent empirical studies report that students' mastery of the concept and solution of surface area problems of curved-sided solid shapes (cylinders, cones, spheres, and composite shapes) is still low. The results of Aprilia et al.'s (2024) research show a weak link between the concept of three-dimensional space and two-dimensional representations, reliance on memorizing formulas without fundamental understanding, and predominantly lecture-based learning practices without the use of teaching aids or contextual teaching materials that exacerbate student difficulties. Kusumah et al. (2020) emphasize the problem of modeling and interpreting information in curved-sided solid problems at the secondary school level. Adilah et al. (2025) emphasize the urgent need for a teaching approach that combines manipulatives, interactive visualizations, and tiered problem-solving tasks so that mastery of the surface area of curved-sided solid shapes at the secondary school level can be improved.

One cooperative learning model, the jigsaw, encourages positive interdependence, as each student holds a piece of information that must be understood and taught to their group members, thus increasing individual and collaborative responsibility (Slavin, 2019). Furthermore, this model has been shown to improve conceptual understanding, communication skills, and social skills, as the discussion process within expert and home groups allows students to construct knowledge more deeply (Aronson & Patnoe, 2011). Recent research also shows that Jigsaw can increase learning motivation, active participation, and learning outcomes in various subjects, especially when combined with appropriate media or learning strategies (Nurhayati & Hakim, 2022). Implementing the Jigsaw cooperative model is expected to increase interaction and concept elaboration through the division of learning roles among students, thus effectively creating active, inclusive, and meaningful learning.

To support the jigsaw cooperative learning model, the guided discovery learning method is used, because it can help students understand the concept and origin of the surface area formula for curved-sided solids in more depth. The results of research by Anjarwati et al., (2022) showed moderate to large effects on learning outcomes and critical thinking skills after the GDL intervention. In addition, the implementation of guided discovery in a blended format or combined with tools (e.g., GeoGebra, digital modules, or AIGC-generated materials) strengthens student engagement, learning motivation, and science process skills, thereby increasing the impact on concept retention and knowledge transfer to contextual problems (Nasution et al., 2025). Several recent field studies have also found that GDL increases students' creativity and fluency and is effective across various levels (elementary to high school) and subjects (mathematics, science), especially when teachers provide appropriate scaffolding and structured instruction during the discovery phase (Oudat et al., 2025). Practically, current evidence recommends the integration of guided discovery into curriculum design that emphasizes inquiry, technology support, and teacher training to maximize the benefits of this active learning (Nia Pratama Ristiani et al., 2025).

The use of teaching aids also provides concrete experiences that can strengthen visualization and reduce misunderstandings. The results of Stefan & Sagheer's (2024) study showed an increase in posttest scores in the group that received manipulative-based learning compared to traditional learning. Another study by Ahmad & Siller (2024) showed that teaching aids facilitate the transition from concrete to pictorial and then symbolic representations (Concrete-Pictorial-Symbolic), thereby reducing abstractions that hinder the understanding of mathematical concepts and strengthening the formation of students' cognitive structures. Furthermore, literature studies and systematic reviews show positive effects on motivation, engagement, and learning retention, indicating higher student interest and participation when material is presented with relevant manipulative media (Fitri et al., 2024). Field research in the Indonesian context also found an increase in understanding and learning scores after teaching aid interventions, confirming the pedagogical benefits while highlighting the need for teacher training and tool availability as determining factors for successful implementation (Kartika, 2024).

The synergy of these three approaches has the potential to create more effective, active, and meaningful learning, while simultaneously meeting the demands of today's learning and curriculum, which emphasize collaboration, exploration, and conceptual understanding. Therefore, the research question is how does the application of the jigsaw type cooperative learning model with the guided discovery method assisted by teaching aids on the surface area of curved-sided geometric shapes?

2. METHOD

This research is a descriptive study with a qualitative approach. It aims to describe students' learning experiences using the jigsaw cooperative learning model with guided discovery methods assisted by teaching aids on the surface area of curved solids. As Creswell (2014) emphasized, qualitative research focuses on in-depth descriptions of individual experiences.

The primary instrument in this study was the researcher. Supporting instruments were student attitude observation sheets and test questions to assess students' understanding of the surface area of curved solids. All data is presented as is, based on the facts and phenomena found in the field.

The attitude assessment criteria according to Permendikbud No. 81A of 2013 are:

Very good : when getting a score$3,33 < skor \leq 4,00$
Good : when getting a score$2,33 < skor \leq 3,33$
Enough : when getting a score$1,33 < skor \leq 2,33$
Not enough : when getting a score$\leq 1,33$
where the final score uses a scale1 until 4.

To calculate the final score, use the formula:

$$Final\ Score = \frac{score\ obtained}{Shoes} \times 4$$

Total shoes= 16

To indicate learning success, the school's KKM standard is used, namely that students are declared to have completed if they obtain a minimum score of 70. The final score uses a scale of 1 to 100. The final score is calculated using the formula:

$$Final\ Score = \frac{score\ obtained}{total\ shoes} \times 100$$

Evaluation Criteria:

Very Good (A) : when getting a score$80 < score \leq 100$
Good (B) : when getting a score$60 < score \leq 80$
Enough (C) : when getting a score$40 < score \leq 60$
Less (D) : when getting a score$20 < score \leq 40$
Very Poor (E) : when getting a score$0 \leq score < 20$

Then, to calculate the average student score, the following formula is used:

Rate-rate $= \frac{Total\ scores\ of\ all\ students}{Number\ of\ students}$

The research subjects were ninth-grade students. This class was chosen because the surface area of curved solid shapes is taught at that level. There were 17 students.

3. RESULTS AND DISCUSSION

Learning Implementation

Preliminary Activities

The introductory activity began with greetings and asking how the students were. Then, they asked one of the students to lead a prayer. They checked student attendance (17 out of 20 students were present). They asked students to prepare the necessary equipment and supplies.

Providing apperception to recall previous material that serves as a prerequisite for the material to be taught, namely, rectangles and circles. Conveying the learning objectives to be achieved and motivating students.

Apperception and motivation at the beginning of learning play a crucial role in fostering students' cognitive and affective readiness for learning. Apperception serves to connect new knowledge with students' existing experiences or concepts, thereby facilitating the process of constructing new knowledge and enhancing conceptual understanding (Sanjaya, 2019). Meanwhile, motivation at the beginning of learning is a key driver that fosters students' interest, attention, and active involvement throughout the learning process (Uno, 2021). Research shows that providing appropriate apperception and motivation can improve students' focus, participation, and learning outcomes because they feel more prepared and engaged with the material to be learned (Rahmawati & Setiawan, 2022). Therefore, teachers need to design meaningful opening activities by linking them to real-life contexts and providing positive reinforcement to create a conducive and productive learning environment.

Next, provide stimulus by asking questions such as: 1) mention examples of curved-sided geometric shapes in everyday life!2) Have you ever made a birthday hat? 3) How do

you calculate the surface area of the birthday hat?. Then, convey a general description of the learning activities (syntax) that will be implemented. The introductory activities are shown in Figure 1 below.

Figure 1. Opening Learning Activities

Core activities

Grouping Phase (Formation of Original Groups)

The teacher groups students into groups of 4-5 with heterogeneous academic abilities (the original groups). Each member of the original group is given a different subtopic to study. The names of the original groups are listed in Table 1 below:

Table 1. List of Names of Students by Origin Group

No.	GROUP 1	GROUP 2	GROUP 3	GROUP 4
1.	AS	NOT	BY	OF
2.	FR	on	AND	ID
3.	YS	YF	EY	JB
4.	WR	IS	MJ	EARLY

Expert Group Phase (Formation of Expert Group)

Then, each member of the original group gathers with the same ability/responsibility to master the same material (homogeneous) as the other members of the original group to form an expert group. The list of expert group names is in Table 2 below:

Table 2. List of Names of Expert Group Students

No.	TUBE 1	CONE 1	IT WAS 1	IT WAS 2
1.	AS	FR	YS	WR
2.	NOT	on	YF	IS
3.	BY	AND	EY	MJ
4	OF	ID	JB	HM

In expert groups, they work on the LKPD. However, the teacher will first provide instructions for completing the expert group's LKPD. Then, the teacher will distribute the LKPD and expert group teaching materials to the students who have sat in their groups.

Figure 2. Delivering Instructions for Working on the Expert Group's LKPD

Figure 3. Distributing the Expert Group's LKPD

The student worksheets (LKPD) are compiled based on the chosen learning method, namely guided discovery. With the LKPD, students independently discover the surface area formula for curved solid shapes. Thus, students understand the origin of the formula and construct the concept well. This is in line with the research results of Anjarwati et al. (2022) which found moderate to large effects on learning outcomes and critical thinking skills after the GDL intervention.

To facilitate students in proving (constructing curved-sided geometric shapes), teaching aids are provided. This is in line with research by Ahmad & Siller (2024) that teaching aids facilitate the transition from concrete to pictorial and then symbolic representations (Concrete-Pictorial-Symbolic), thereby reducing abstractions that hinder the understanding of mathematical concepts and strengthening the formation of students' cognitive structures. The following teaching aids are used.

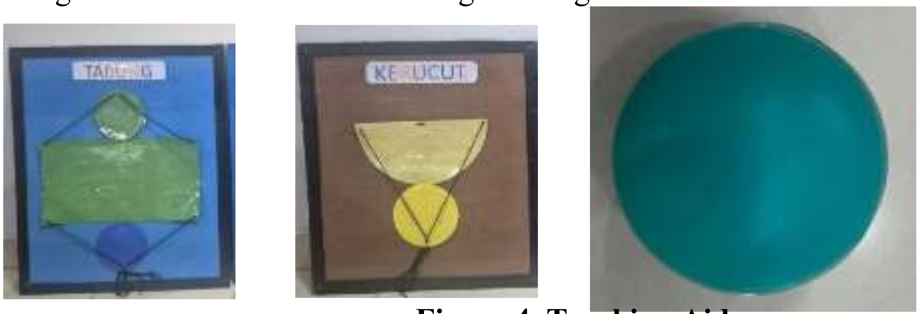

Figure 4. Teaching Aids

The teacher guides and directs students in working on the expert group LKPD and monitors the progress of group discussions.

Figure 5. Guiding and Directing Students in Working on LKPD

Sharing Phase (Expert Team Returns to the Original Group to Share Knowledge)

After students have finished working on the expert group's LKPD, students return to their original groups to exchange knowledge that they have obtained while working on the expert group's LKPD.

Figure 6. Students Return to Their Original Groups

Next, the teacher distributes the original group's LKPD to students who have sat in their original groups and discusses completing the Original Group's LKPD, which contains all subtopics.

Figure 7. Distributing the Original Group's LKPD

The teacher guides and directs students in working on the original group's LKPD and monitors the progress of the group discussion.

Evaluation Phase (Evaluation)

After completing the Home Group Worksheet distributed by the teacher, the teacher asks a representative from each group to present the results of their discussion to the class. The teacher will then evaluate the students' answers.

Figure 8. Each Group Presents the Results of Their Discussion

Closing Activities

The teacher gives individual tests to students to see how well they understand after the lesson (Figure 8). Next, ask about whether the students have understood the material. And the students answer that they understand, the teacher ensures this by asking questions, and the students can answer. Next, together with the students, conclude the lesson that has been learned. The teacher conveys the material that will be taught in the next meeting, namely, the Volume of curved-sided solid shapes. So that students can prepare themselves. At the end of the lesson, the teacher points to the students to close with a prayer, and after that says hello.

Figure 9. Distributing Individual Tests

Attitude Assessment Results

Table 3. Assessment of Attitudes of Class IX B Students

No.	Student Name	Indicator				Total Score	Category
		Cooperate	Responsibility	Self-Confidence	Thorough		
1.	ASR	4	4	3	4	3,75	Very good
2.	LIVE	3	4	2	3	3,0	Good
3.	YES	3	4	3	4	3,5	Very good

4.	DAB	3	3	3	2	2,75	Good
5.	EY	4	4	4	3	3,75	Very good
6.	FFFD	3	3	4	2	3,0	Good
7.	FRR	3	3	3	2	2,75	Good
8.	HMD	4	3	4	3	3,5	Very good
9.	IDR	4	4	3	4	3,75	Very good
10.	JBA	3	3	2	2	2,5	Good
11.	MJMS	3	3	3	3	3,0	Good
12.	SAP	4	4	3	3	3,5	Very good
13.	WAS	3	3	2	3	2,75	Good
14.	WRS	4	3	4	4	3,75	Very good
15.	YSAM	3	2	3	3	2,75	Good
16.	YWAS	3	3	2	3	2,75	Good
17.	YFS	4	4	3	3	3,5	Very good
Amount		**58**	57	51	51	54,25	
Presentation		85,29%	83,82%	75%	75%	79,78%	

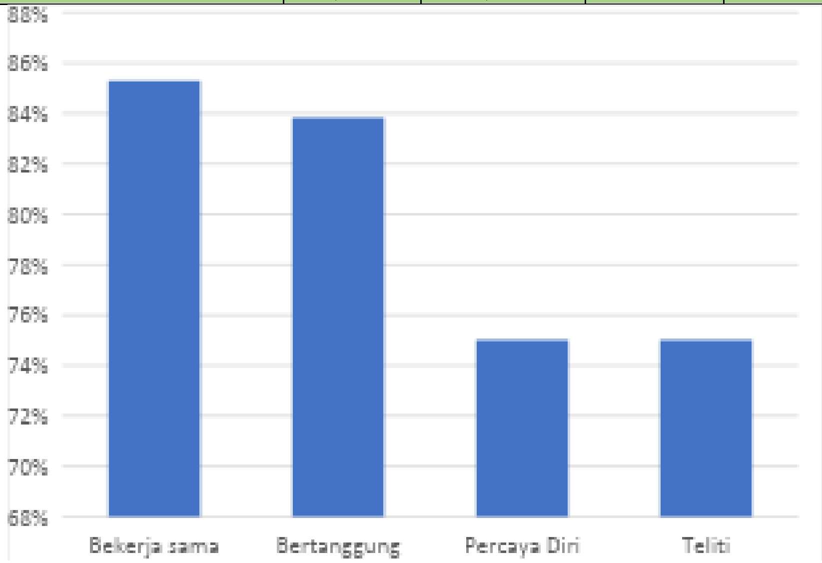

Figure 9. Percentage Diagram of Attitude Assessment of Class IX B Students

The data obtained from Table 3.1 are:

a) The number of students who have very good attitudes is8 people.
b) Students have good attitudes as many as9people.
c) Students have a fairly non-existent attitude.
d) Students have a lack of attitude.

Based on Figure 2.25, the results of the percentage of the assessment of the attitudes of class IX B students are as follows:

a) The percentage of cooperative attitudes is85,29%.
b) The percentage of a responsible attitude is83,82%.
c) The percentage of self-confidence is75%.
d) The percentage of conscientious attitude is75%.

Based on the observation results, it can be seen that class IX B students have good attitudes.

a. Knowledge Assessment

Table 4. List of Individual Test Score Results

No.	Student Initials	Mark	Criteria	Information
1.	ASR	75	B	Good
2.	LIVE	75	B	Good
3.	YES	70	B	Good
4.	DAB	70	B	Good
5.	EY	80	B	Good
6.	FFFD	70	B	Good
7.	FRR	65	C	Enough
8.	HMD	65	B	Good
9.	IDR	75	B	Good
10.	JBA	65	C	Enough
11.	MJMS	60	C	Enough
12.	SAP	75	B	Good
13.	WAS	60	C	Enough
14.	WRS	75	B	Good
15.	YSAM	70	B	Good
16	YWAS	60	C	Enough
17.	YFS	70	B	Good

From the data above, the following data was obtained:

1. There were no students who obtained very good (A) criteria.
2. Students who obtain good grades (B) are the12 people.
3. Students who obtained sufficient criteria (C) are those 5 people.
4. There were no students who obtained a grade of less than (D).
5. There were no students who obtained very poor (E) criteria.

Based on the data above, it can be seen that the learning outcomes of students are that out of 17 students, there are...12students who have fulfilled the KKM (Complete) in the individual test, and there are5Students who have not met the KKM (Not Completed) set by the school, namely70.This means that 71% of students meet the KKM

By using the results of the knowledge assessment of class IX B students from Permendikbud No. 81A of 2013 (M. Pendidikan et al., 2013)

Thus, the results of the individual test assessment show that the average student score is:

$$\frac{Total\ scores\ of\ all\ students}{Number\ of\ students} = \frac{1.180}{17} = 69{,}41$$

So, the knowledge assessment criteria are good.

The jigsaw cooperative learning model encourages positive interdependence, as each student holds a piece of information that must be understood and taught to their group members, thus increasing individual and collaborative responsibility (Slavin, 2019). Furthermore, this model has been shown to improve conceptual understanding, communication skills, and social skills, as the discussion process within expert and home groups allows students to construct knowledge more deeply (Aronson & Patnoe, 2011). Recent research also shows that Jigsaw can increase learning motivation, active participation, and learning outcomes in various subjects, especially when combined with appropriate media or learning strategies (Nurhayati & Hakim, 2022).

4. CONCLUSION AND SUGGESTIONS

Conclusion

1. Based on the results of observations of student attitude assessments, it was found that the percentage of cooperative attitudes was85,29%, a responsible attitude of83,82%, a self-confident attitude of75%, and a meticulous attitude of75% . It can be seen that the student attitude that has the highest percentage is the attitude of responsibility, and the lowest percentage is the attitude of self-confidence and thoroughness.
2. Based on the results of the individual test assessment, it can be seen that the average student score is69,41 in the good category, and 71% meet the KKM.

Suggestion

Based on the research results, it is recommended that teachers continue to optimize the application of the Jigsaw model by providing proportional guidance at each stage of discovery, so that students can build concepts independently but still in a directed manner. The use of teaching aids should be more varied and adapted to the characteristics of spatial figures to help students visualize concepts concretely. In addition, it is important for teachers to carry out effective group management so that each member plays an active role in expert discussions and home group discussions. For future researchers, it is recommended to test the effectiveness of this model and method on other geometry materials or at different educational levels to broaden the generalizability of the research results. Further research can also integrate digital technology as a visualization tool to see its effect on improving students' conceptual understanding.

5. REFERENCE LIST

Adilah, N., Husnah, N., & Sari, M. 2025. *Analisis Kesalahan Siswa dalam Menyelesaikan Soal Bangun Ruang Sisi Lengkung Menggunakan Prosedur Newman*. *5*(1), 61–76.

Ahmad, S., & Siller, H. 2024. *Investigating the effect of manipulatives on mathematics achievement : The role of concrete and virtual manipulatives for diverse achievement level groups*. *15*(3), 979–1002.

Anjarwati, D., Juandi, D., Nurlaelah, E., & Hasanah, A. 2022. *Studi Meta-Analisis : Pengaruh Model Discovery Learning Berbantuan Geogebra Terhadap Kemampuan Berpikir Kritis Matematis Siswa*. *06*(03), 2417–2427.

Aprilia, R. D., Haninah, S., Salmaa, Y. M., & Arifin, F. 2024. *STUDENTS ' DIFFICULTIES IN LEARNING THE CONCEPT OF CURVED-SIDED SPACES : A LITERATURE REVIEW*. *9*(2), 147–160.

Ardiyanti, N., & Sutopo, A. (2022). *Analisis kesulitan siswa dalam menyelesaikan soal bangun ruang sisi lengkung di SMP*. Jurnal Pendidikan Matematika, 14(2), 115–128.

Fitri, U., Mochammad, H., Arif, B., & Herman, R. 2024. *LITERATURE REVIEW : Efektivitas Alat Peraga Matematika Pada Pembelajaran di Sekolah Menengah*. *2*(1). https://doi.org/10.60041/ijisl

Kartika, D. 2024. *PENGARUH PENGGUNAAN ALAT PERAGA TERHADAP HASIL BELAJAR MATA PELAJARAN MATEMATIKA SISWA KELAS IV*.

Kusumah, Y. S., Kustiawati, D., & Herman, T. 2020. The effect of geogebra in three-dimensional geometry learning on students' mathematical communication ability. *International Journal of Instruction*, *13*(2), 895–908. https://doi.org/10.29333/iji.2020.13260a

Nasution, S. S., Muhammad, K. M. S., & Fauzi, A. 2025. *Efektifitas Blended Learning*

Berbasis Meningkatkan Kemampuan Berpikir Kritis Guided Discovery Learning Untuk The Effectiveness of Blended Learning Based on Guided Discovery Learning to Improve Critical Thinking Skills. *16*(2), 112–124.

Navianto, A. 2023. *UPAYA MENINGKATKAN HASIL BELAJAR BANGUN RUANG SISI LENGKUNG MELALUI PEMBELAJARAN KOOPERATIF BERMAKNA MENGGUNAKAN BENDA NYATA*. *5*(2), 221–232.

Nia Pratama Ristiani, Bakti Mulyani, S. 2025. *Pengaruh Model Pembelajaran Inkuiri Terbimbing terhadap Keterampilan Proses Sains Siswa Kelas VII Materi Pesawat Sederhana*. *14*(1), 25–35.

Oudat, M. A., Al-luwaici, N. M., & Mahmoud, H. 2025. *The Impact of the Guided Discovery Strategy on Developing Creative Thinking among Sports Students*. *14*.

Pendidikan, K., & Teknologi, D. A. N. 2022. *Matematika*.

Pendidikan, M., Kebudayaan, D. A. N., & Indonesia, R. 2013. *BERITA NEGARA*. *972*.

Rahmawati, L., Pramudita, D., & Nugroho, S. (2021). *Miskonsepsi siswa pada materi tabung, kerucut, dan bola ditinjau dari kemampuan visual-spasial*. Jurnal Riset Pendidikan Matematika, 8(1), 45–59.

Rahmawati, D., & Setiawan, A. (2022). *Pengaruh apersepsi dan motivasi belajar terhadap hasil belajar siswa pada pembelajaran tematik*. Jurnal Pendidikan Dasar, 13(2), 115–124.

Sanjaya, W. (2019). *Strategi Pembelajaran Berorientasi Standar Proses Pendidikan*.
Kencana.

Sari, M., & Hidayat, R. (2023). *Pengaruh kemampuan spasial dan penggunaan media konkret terhadap pemahaman bangun ruang sisi lengkung*. Jurnal Inovasi Pembelajaran Matematika, 5(3), 210–222.

Stefan, H., & Sagheer, S. 2024. The Effect of Concrete and Virtual Manipulative Blended Instruction on Mathematical Achievement for Elementary School Students. In *Canadian Journal of Science, Mathematics and Technology Education* (Vol. 24, Nomor 2). Springer International Publishing. https://doi.org/10.1007/s42330-024-00336-y

Uno, H. B. (2021). *Teori Motivasi dan Pengukurannya: Analisis di Bidang Pendidikan*.
Bumi Aksara.

Xu, T., & Sun, S. 2025. *Spatial Reasoning and Its Contribution to Mathematical Performance Across Different Content Domains : Evidence from Chinese Students*.

Zhang, Q. 2021. *Opportunities to Learn Three-Dimensional Shapes in Primary Mathematics : The Case of Content Analysis of Primary Mathematics Textbooks in Hong Kong*. *17*(6).