Experimental Study on Eighth Grade Students' Creative and Imitative Reasoning through Resource-Based Learning

Intan Susilawati [1*], Suhendra [2,*]
[1,2] Universitas Pendidikan Indonesia, Bandung, Indonesia
*Corresponding Author: suhendra@upi.edu

ABSTRACT

Creative and imitative reasoning are essential components of mathematics learning that support higher-order thinking skills. This study aims to examine the achievement and improvement of creative and imitative reasoning among eighth-grade students through the implementation of Resource-Based Learning (RBL). The research was conducted using a quasi-experimental method with a one-group pretest-posttest design. The subjects were 43 eighth-grade students from a junior high school in Indonesia, selected using purposive sampling based on prior mathematical ability. The sample was categorized into high (8 students), medium (20 students), and low (15 students) ability groups. Research instruments included a mathematical reasoning test, classroom observation, and interviews. The results showed differences in the achievement of creative and imitative reasoning among the three groups. High-ability students demonstrated better comprehension and problem-solving skills, whereas medium- and low-ability students struggled with complex tasks and abstract concepts. RBL was found to significantly enhance creative reasoning, particularly through active exploration and the use of diverse strategies. However, some students, especially from the low-ability group, continued to exhibit imitative thinking patterns. These findings suggest the need for a more structured and exploratory RBL design to further develop students' independent and innovative thinking in mathematics.

Keywords: creative reasoning; imitative reasoning; mathematics learning; resource-based learning.

INTRODUCTION

Higher-order thinking skills have become a central focus of 21st-century education, particularly in mathematics instruction (Dinni, 2018; Oemolos, 2021). Among the key components of higher-order thinking are creative reasoning and imitative reasoning, which must be developed in a balanced manner (Septian, 2022; Willemsen et al., 2023). According to Palengka et al (2022), reasoning in mathematics can be classified into two main types: creative reasoning and imitative reasoning. Creative reasoning reflects students' ability to generate new, flexible, and innovative solutions to mathematical problems (Fitriyyah et al., 2024). In contrast, imitative reasoning involves the replication of known procedures or examples without meaningful adaptation a pattern frequently observed in traditional mathematics classrooms.

In practice, mathematics instruction in schools still tends to be procedural, emphasizing solution strategies based on given examples (Situngkir et al., 2023; Swasto et al., 2024). As a result, many students develop a strong reliance on imitative thinking and receive limited opportunities to explore or construct creative solutions. This issue is especially noticeable among eighth-grade students, who often depend heavily on teacher-modeled strategies without attempting alternative approaches. Such conditions highlight the

importance of instructional models that encourage active engagement and independent exploration.

One promising learning model is Resource-Based Learning (RBL), which emphasizes the use of diverse learning resources both digital and non-digital to help students build their own understanding. By exploring various information sources, students are encouraged to develop original problem-solving strategies and become more autonomous learners. Although prior studies have shown that RBL can improve academic outcomes, research focusing specifically on its effects on students' creative and imitative reasoning in junior high school mathematics remains limited. Therefore, this study aims to investigate the achievement and improvement of eighth-grade students' creative and imitative reasoning through the implementation of Resource-Based Learning in mathematics.

Based on the background described above, the research questions in this study are as follows:

1. How is the achievement of creative and imitative reasoning among eighth-grade junior high school students after participating in mathematics learning based on Resource-Based Learning?
2. How is the improvement of creative and imitative reasoning across different ability levels (high, medium, low) through Resource-Based Learning?

RESEARCH METHODS

This study employed a quantitative approach using an experimental method. The design used was a pretest-posttest group design, in which students were given tests before and after the treatment to measure changes in creative and imitative reasoning abilities. The study involved only one experimental group without a control group, and the analysis was based on students' initial ability categories (high, medium, low).

The subjects of this study were 43 eighth-grade students from a public junior high school in Bandung Regency. These students represented the sample of the research, selected through purposive sampling based on their availability and suitability for implementing Resource-Based Learning (RBL) in mathematics instruction. The broader population targeted by this study included all eighth-grade students in public junior high schools within Bandung Regency. After administering a pretest and collecting initial data, the sample was further categorized into three ability groups: 8 students in the high-ability group, 20 students in the medium-ability group, and 15 students in the low-ability group.

Three main instruments were used in this study. First, a test of creative and imitative reasoning consisting of mathematics problems based on AKM-style problem-solving, developed using reasoning indicators from Lithner (2008), was used to assess students' ability to solve problems both creatively and imitatively. Second, a classroom observation guide was used to monitor the implementation of Resource-Based Learning (RBL) and student engagement during the learning process. Third, an interview guide was designed to explore students' learning experiences and teachers' perspectives on the effectiveness of RBL in enhancing students' reasoning abilities.

The research procedure involved several systematic stages. First, a pretest was administered to all subjects to assess their initial creative and imitative reasoning abilities. Then, mathematics instruction using the Resource-Based Learning (RBL) approach was conducted over 4 to 6 sessions. Following the treatment, a posttest was administered to

evaluate improvements in reasoning abilities. To analyze the quantitative data from the pretest and posttest, descriptive statistics (mean, standard deviation) and inferential statistics (paired sample t-test) were used to determine the significance of improvement. In addition, qualitative data from classroom observations and interviews with students and teachers were analyzed using thematic analysis to gain deeper insights into the learning experience and the effectiveness of the RBL implementation.

RESULTS AND DISCUSSION

The results of the study show that most students experienced an improvement in creative reasoning after participating in mathematics instruction based on Resource-Based Learning (RBL). A number of students, however, continued to demonstrate imitative reasoning when completing the assigned tasks. These findings indicate variation in the development of reasoning skills among the students following the RBL implementation.

Achievement of Creative and Imitative Reasoning Abilities

To examine the post-test results of the high-ability group of students, refer to Figure 1 below:
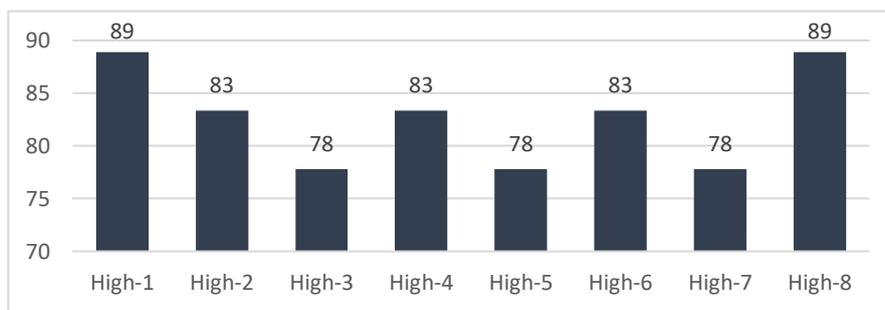

Figure 1. Bar Chart of Posttest Scores of High-Ability Group Students

Analysis of the posttest responses showed that students with higher scores demonstrated greater accuracy in solving algorithm-based problems and applying mathematical strategies (Ndiung et al., 2020; Sanusi et al., 2020; Septian et al., 2022). Meanwhile, lower-scoring students struggled with tasks requiring flexible thinking and novel problem-solving, as reflected in frequent errors on questions 5, 6, 10, 11, and 12. These items targeted flexible reasoning, the ability to analyze modifications, and prediction skills within mathematical contexts.

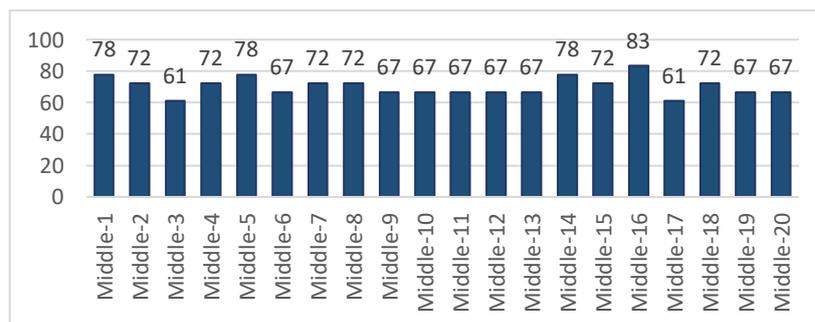To examine the posttest results of students in the medium-ability group, refer to Figure 2.

Figure 2. Bar Chart of Posttest Scores of Medium-Ability Group Students

The posttest results of the medium-ability group showed a strong alignment with the blueprint measuring mathematical reasoning. Scores ranged from 60 to 85, reflecting varying abilities. Analysis of responses across 18 items revealed patterns in five reasoning aspects: algorithmic (items 1, 2, 3, 10), memory-based (items 4, 11, 12, 13), flexible thinking (items 5, 14), novelty (items 8, 17), and general reasoning (items 6, 7, 9, 15, 16, 18). Higher-scoring students excelled in algorithmic and conceptual tasks, while lower-scoring students struggled with memory, flexibility, and novelty-based items. Overall, students were more comfortable with procedural tasks but found creative and flexible reasoning challenging. Future instruction should therefore emphasize developing critical and creative thinking skills.Examine the posttest results of students in the low-ability group, refer to Figure 3.
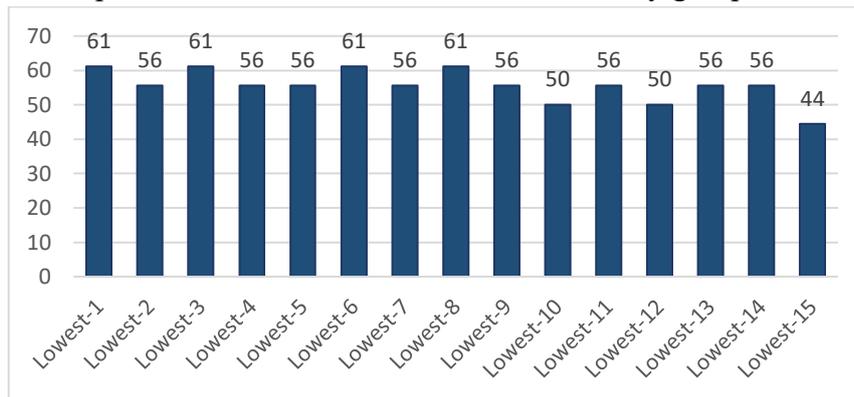

Figure 3. Bar Chart of Posttest Scores of Low-Ability Group Students

Figure 3 and the student response table reveal variation in mathematical reasoning among the low-ability group, with most scores ranging from 50 to 61 and one outlier at 44. Each item was scored 1 for correct and 0 for incorrect answers, highlighting performance across reasoning indicators. The posttest was based on a blueprint covering algorithmic (items 1, 2, 3), memory-based (items 4, 11, 12), and flexible/novel reasoning (items 7, 8, 16, 17). Students generally performed well on algorithmic items involving surface area and volume but struggled with memory-based and visual tasks, as well as problems requiring creative and flexible thinking (Rahmi et al., 2023). These results suggest a need to strengthen instruction in critical, exploratory, and creative reasoning skills (Badi'ah et al., 2024).

The overall class results showed that the average posttest score for the high-ability group was 83, the medium-ability group was 70, and the low-ability group was 56. A clearer depiction is shown in Figure 4.
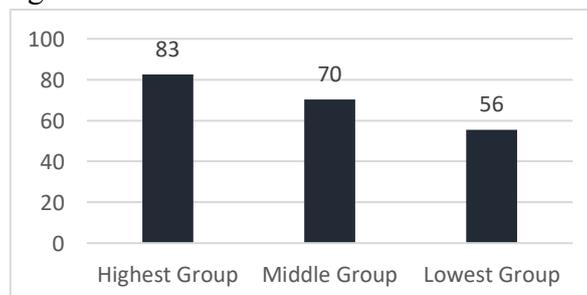

Figure 4. Bar Chart of Average Posttest Scores by Student Group

Figure 4 compares average posttest scores across high-, medium-, and low-ability groups, showing clear differences in learning outcomes. High-ability students achieved the highest scores, demonstrating strong problem-solving and conceptual understanding. Medium-ability students performed fairly well but faced challenges with complex, analytical tasks. Low-ability students struggled most, particularly with abstract concepts and strategy application. These results highlight the need for adaptive instruction: high-ability students benefit from exploratory tasks, while medium and low groups require structured support to build reasoning skills. Table 1 summarizes the percentage achievement for each reasoning indicator by ability group.

Table 1. Average Scores of Creative and Imitative Reasoning Skills

No	Indicator	Percentage of Achievement	Average value
High Group			
1	CR	78.75%	7,875 years
2	IR	84.38%	6.75
Middle Group			
1	CR	70.5%	7.05
2	IR	75%	6
Low Group			
1	CR	61.3%	6.13
2	IR	65.83%	5.27

Based on Table 1, there are noticeable differences in Creative Reasoning (CR) and Imitative Reasoning (IR) abilities across the student groups. The high-ability group demonstrated the highest achievements, with CR at 78.75% and IR at 84.38%. The medium group recorded a CR of 70.5% and an IR of 75%, while the low-ability group had the lowest performance, with CR at 61.3% and IR at 65.83%.

These data indicate that students in the higher-ability group tend to possess stronger creative and imitative reasoning compared to the other groups. This difference suggests that a higher level of understanding and richer learning experiences contribute significantly to the enhancement of students' reasoning abilities. A more detailed breakdown of achievement for each indicator is presented in Table 2.

Table 2. Average Mathematical Reasoning Abilities by Indicator

No	Types of Reasoning	Indicator	Percentage of Achievement	Average value
High Group				
1	Creative Reasoning	Novelty	100%	2
2		Flexibility	81.25%	1.625
3		Makes sense	87.5%	1.75
4		Based on Mathematics	75%	4.5
5	Imitative Reasoning	Memory Reasoning	87.5%	1.75
6		Algorithmic Reasoning	83.3%	5
Middle Group				

1	Creative Reasoning	Novelty	62.5%	1.25
2		Flexibility	90%	1.8
3		Makes sense	75%	1.5
4		Based on Mathematics	64.17%	3.85
5	Imitative Reasoning	Memory Reasoning	75%	1.5
6		Algorithmic Reasoning	75%	4.5
Low Group				
1	Creative Reasoning	Novelty	10%	0.2
2		Flexibility	66.67%	1.33
3		Makes sense	43.33%	0.867
4		Based on Mathematics	64.4%	3.87
5	Imitative Reasoning	Memory Reasoning	43.33%	0.87
6		Algorithmic Reasoning	73.3%	4.4

Table 2 shows that the high-ability group achieved the highest scores across all creative and imitative reasoning indicators. In creative reasoning, the high group reached 100% on the novelty indicator, outperforming the medium (62.5%) and low (10%) groups. Although the medium group scored slightly higher in flexibility (90% vs. 81.25%), both outperformed the low group (66.67%). For plausibility and mathematical basis, the high group also led with 87.5% and 75%, respectively. In imitative reasoning, the high group again scored highest—87.5% for memory and 83.3% for algorithmic reasoning—surpassing the medium and low groups. Overall, performance improved with ability level, with the high group excelling in nearly all areas. Average scores for each indicator are illustrated in Figure 5.
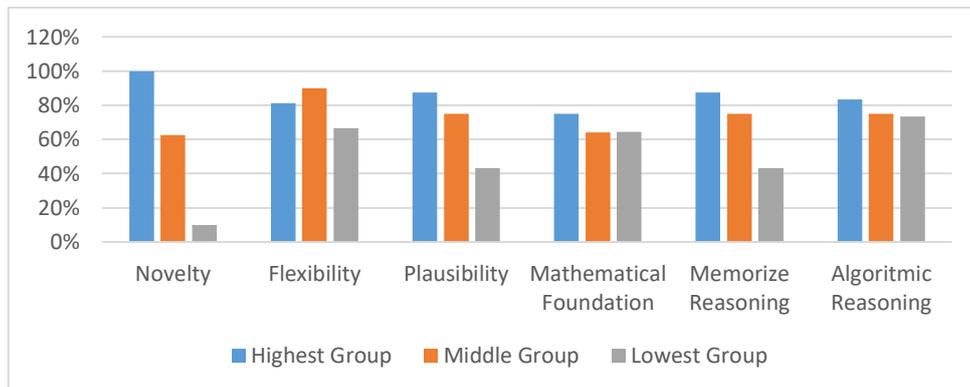

Figure 5. Average Achievement of Reasoning Indicators or Types

Figure 5 presents the average scores for each mathematical reasoning indicator across high-, medium-, and low-ability groups. The high group consistently outperformed others, achieving 100% on novelty and leading in plausibility (87.5%), mathematical basis (75%), memory (87.5%), and algorithmic reasoning (83.3%). Interestingly, the medium group scored highest in flexibility (90%), slightly above the high group (81.25%). The low group showed the weakest performance, especially in novelty (10%) and plausibility (43.33%).

These results highlight the high group's stronger reasoning skills and the need for targeted support for the low group to develop both creative and imitative reasoning.

Improvement of Creative and Imitative Reasoning Skills

The improvement in students' mathematical reasoning abilities through Resource-Based Learning based on Prior Mathematical Knowledge (PAM) can be identified by analyzing the gain scores, i.e., the pretest and posttest scores for creative and imitative reasoning abilities. The average scores from the students' reasoning ability tests can be found in the appendix and are presented descriptively in Table 3 and Figure 6 below.

Table 3. Improvement of Creative Reasoning (CR) and Imitative Reasoning (IR)

Class		Ideal Score	Mathematical Reasoning			Presentation Gains
			Pre-Test Average	Post Test Average	Average Gain	
High Group	CR	10	5	7,875 years	0.57	57%
	IR	8	2.75	6.75	0.843	84.3%
Medium Group	CR	10	3.45	7.05	0.5455	54.55%
	IR	8	3	6	0.6	60%
Low Group	CR	10	2	6,133 people	0.5166	51.67%
	IR	8	2.4	5,267 people	0.5022	50.22%

Table 3 shows improvement in mathematical reasoning across all groups based on pretest and posttest scores, though the extent varies. In the high group, creative reasoning (CR) rose from 5 to 7.875 (57%), and imitative reasoning (IR) saw the highest gain—from 2.75 to 6.75 (84.3%). The medium group improved CR from 3.45 to 7.05 (54.55%) and IR from 3 to 6 (60%). The low group also progressed, with CR rising from 2 to 6.133 (51.67%) and IR from 2.4 to 5.267 (50.22%). The most notable improvement was in the IR of the high group, while the smallest gain occurred in the low group's IR. Figure 6 illustrates these average scores.
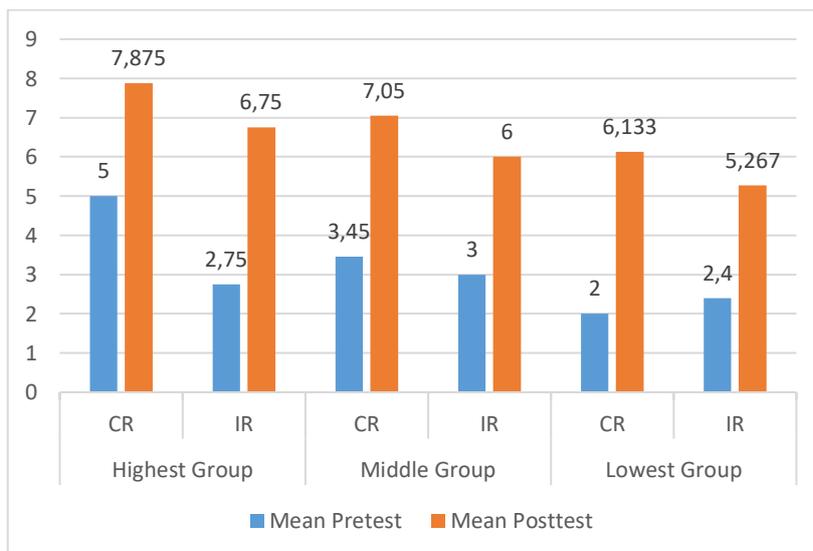

Figure 6. Average Pretest and Posttest Scores of Students' Creative and Imitative Mathematical Reasoning Abilities in Each Class

A more detailed view of the reasoning improvements in the high, medium, and low groups can be seen in Figure 7.
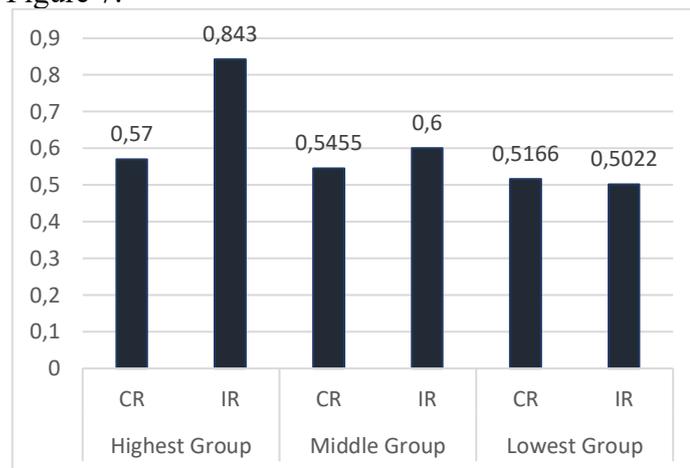

Figure 7. Average Improvement in Students' Mathematical Reasoning Abilities in Each Class

These findings support Vygotsky and Cole (1978) Zone of Proximal Development, highlighting how tailored support and varied resources can enhance cognitive growth. They also align with Lithner (2008)) reasoning framework, showing that RBL can reduce reliance on imitative thinking and promote creative reasoning. Thus, RBL is effective in developing mathematical reasoning when adapted to students' needs.

CONCLUSION

This study found that students' creative and imitative reasoning varied by group, with high achievers excelling across most indicators, especially flexibility and plausibility, while low achievers struggled, particularly in novelty. All groups improved after the Resource-Based Learning (RBL) intervention, with the high group showing the greatest gains.

These findings support Vygotsky and Cole (1978) Zone of Proximal Development, highlighting how tailored support and varied resources can enhance cognitive growth. They also align with Lithner (2008)) reasoning framework, showing that RBL can reduce reliance on imitative thinking and promote creative reasoning. Thus, RBL is effective in developing mathematical reasoning when adapted to students' needs.

REFERENCES

Badi'ah, S., As'ari, A. R., & Hidayah, I. N. (2024). Interpreting Skills to The Student's Mathematical Problem-Solving Process. *PRISMA*, *13*(1), 123–130. https://doi.org/10.35194/jp.v13i1.3941

Dinni, H. N. (2018). HOTS (High Order Thinking Skills) dan Kaitannya dengan Kemampuan Literasi Matematika. *Prisma*, *1*, 170–176.

Fitriyyah, A., Anwar, L., & Hafiizh, M. (2024). Assessment of Creative Thinking Skills through Imitation, Modification, and Construction of Creative Thinking Models. *PRISMA*, *13*(2), 175–186. https://doi.org/10.35194/jp.v13i2.4342

Lithner, J. (2008). A Research Framework for Creative and Imitative Reasoning. *Educational Studies in Mathematics*, *67*(3), 255–276. https://doi.org/10.1007/s10649-007-9104-2

Ndiung, S., Sennen, E., Helmon, A., & Jediut, M. (2020). Efektivitas Model Pembelajaran Treffinger dalam Menumbuhkan Keterampilan Berpikir Kreatif Peserta Didik Sekolah

Dasar. *PRISMA*, *9*(2), 167–178.

Oemolos, M. S. (2021). Profil Higher Order Thinking Skill Siswa Dalam Menyelesaiakan Masalah Aritmatika Sosial. *AdMathEdu : Jurnal Ilmiah Pendidikan Matematika, Ilmu Matematika Dan Matematika Terapan*, *10*(2), 111. https://doi.org/10.12928/admathedu.v10i2.13009

Palengka, I., Juniati, D., & Abadi. (2022). Mathematical Reasoning of Prospective Mathematics Teachers in Solving Problems Based on Working Memory Capacity Differences. *Eurasia Journal of Mathematics, Science and Technology Education*, *18*(12), 1–12. https://doi.org/10.29333/ejmste/12670

Rahmi, D. F., Satrio, M. T. J., Azmy, D. S., & Septian, A. (2023). Penerapan Model ICARE Berbasis Media Powtoon untuk Meningkatkan Kemampuan Berpikir Kritis Matematis Siswa. *PRISMA*, *12*(2), 486–493. https://doi.org/10.35194/jp.v12i2.3758

Sanusi, A. M., Septian, A., & Inayah, S. (2020). Kemampuan Berpikir Kreatif Matematis dengan Menggunakan Education Game Berbantuan Android pada Barisan dan Deret. *Mosharafa: Jurnal Pendidikan Matematika*, *9*(September), 511–520.

Septian, A. (2022). Student's mathematical connection ability through GeoGebra assisted project-based learning model. *Jurnal Elemen*, *8*(1), 89–98. https://doi.org/10.29408/jel.v8i1.4323

Septian, A., Inayah, S., & Monika Putri, M. (2022). Peningkatan Kemampuan Pemahaman Konsep Matematika Siswa melalui Model Pembelajaran Flipped Classroom. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *11*(4), 2787–2798.

Situngkir, F. L., Saragih, S., & Napitupulu, E. E. (2023). Penilaian Dinamis pada Kemampuan Berpikir Kritis. *PRISMA*, *12*(2), 587–596. https://doi.org/10.35194/jp.v12i2.3263

Swasto, W., Suanto, E., & Saragih, S. (2024). Analysis of Computational Thinking Ability of High School Students in Solving Statistics problems. *PRISMA*, *13*(2), 269–277. https://doi.org/10.35194/jp.v13i2.4373

Vygotsky, L. S., & Cole, M. (1978). *Mind in Society: Development of Higher Psychological Processes*. Harvard University Press.

Willemsen, R. H., de Vink, I. C., Kroesbergen, E. H., & Lazonder, A. W. (2023). The role of creative thinking in children's scientific reasoning. *Thinking Skills and Creativity*, *49*(March), 101375. https://doi.org/10.1016/j.tsc.2023.101375