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Implementation of Differentiated Learning to Enhance Elementary School Students' Mathematical Critical and Creative Thinking Skills

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ABSTRAK

Kemampuan berpikir kritis dan kreatif siswa masih rendah, potensi pengembangan terbesar terletak pada pendidikan matematika. Penelitian ini bertujuan untuk menganalisis efektivitas penerapan pembelajaran diferensiasi untuk meningkatkan kemampuan berpikir kritis dan kreatif siswa. Penelitian ini menggunakan desain kuantitatif dengan model dua kelompok eksperimen semu, yang terdiri dari kelompok eksperimen dan kelompok kontrol. Partisipan penelitian terdiri dari 21 siswa pada kelompok eksperimen dan 21 siswa pada kelompok kontrol. Instrumen pengumpulan data yang digunakan adalah tes berpikir kritis dan kreatif. Teknik analisis data meliputi uji statistik antara lain uji normalitas, homogenitas, dan uji hipotesis terhadap hasil pre-test dan post-test. Hasil perhitungan N-Gain Score menunjukkan bahwa rata-rata N-Gain Score kemampuan berpikir kritis pada kelompok eksperimen adalah sebesar 61,1% yang masuk dalam kategori cukup efektif. Sebaliknya kelompok kontrol hanya mencapai 29,7% yang masuk dalam kategori tidak efektif. Untuk kemampuan berpikir kreatif, rata-rata N-Gain Score pada kelompok eksperimen sebesar 59,2% termasuk dalam kategori cukup efektif, sedangkan pada kelompok kontrol hanya mencapai 45,3% termasuk dalam kategori kurang efektif. Selain itu, hasil pengelompokan siswa berdasarkan kemampuan belajar menunjukkan bahwa nilai post-test kemampuan berpikir kritis dan kreatif siswa kelompok atas lebih tinggi dibandingkan siswa kelompok menengah dan bawah pada kelompok eksperimen.

ABSTRACT

The critical and creative thinking abilities of students are still low, with the greatest potential for development lying in mathematics education. This research aims to analyze the effectiveness of implementing differentiated instruction to enhance students' critical and creative thinking abilities. The study employs a quantitative design with a quasi-experimental two-group model, comprising an experimental group and a control group. The research participants consisted of 21 students in the experimental group and 21 students in the control group. Data collection instruments used were tests of critical and creative thinking. Data analysis techniques involved statistical tests, including tests for normality, homogeneity, and hypothesis testing on pre-test and post-test results. The outcomes of the N-Gain Score calculations indicate that the average N-Gain Score for critical thinking abilities in the experimental group is 61.1%, which falls into the category of moderately effective. On the other hand, the control group only reaches 29.7%, which falls into the category of ineffective. For creative thinking abilities, the average N-Gain Score in the experimental group is 59.2%, also falling into the moderately effective category, while the control group only achieves 45.3%, falling into the less effective category. Additionally, the results of student grouping based on learning abilities reveal that the post-test scores of critical and creative thinking abilities for students in the upper group are higher compared to students in the middle and lower groups within the experimental group.

1. INTRODUCTION

Education is an effort to prepare a qualified generation capable of facing the challenges of the future. Equipping students with higher-order thinking skills (HOTS) is widely agreed upon by teachers as a means to prepare a competent nation to meet the challenges of the Industry 4.0 era (Jesi Alexander Alim et al., 2020; Singh & Marappan, 2020). The goal of education is to prepare children with the competencies required in the 4.0 era (J A Alim et al., 2020; Astuti et al., 2019; Siswanto & Ratiningsih, 2020). This aligns with previous study viewpoint that education should accommodate 21st-century skills, as it would be a mistake if students lack competencies such as critical thinking, creativity, communication, and collaboration skills (Garba et al., 2015). The importance of creative and critical thinking skills in learners is to enable them to become individuals who can comprehend and thoroughly analyze complex matters or objects, thereby

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generating more mature conclusions and decisions (Aslamiah et al., 2021; Bravo et al., 2021). The ability of creative and critical thinking is an integral aspect of thinking skills that individuals must possess in the 21st century to embrace various opportunities and challenges that will be encountered in an era of rapid and dynamic advancements in information and communication technology (Amran et al., 2019; Parmini et al., 2023). Students require creative and critical thinking skills to confront the 21st century, characterized by rapid global changes across various sectors such as the economy, transportation, technology, communication, information, and more.

Creative thinking skills involve an imaginative activity that manifests the practical intelligence of thinking, aiming to generate a product or solve an issue using innovative methods (Jaarsveld & Lachmann, 2017; Zubaidah et al., 2017). There are five stages in the creative thinking process, including 1) the orientation phase, where the problem is defined and the aspects within it are identified; 2) the preparation phase, involving the collection of relevant information for a comprehensive problem-solving approach; 3) the incubation phase, where obstacles in the problem-solving process are encountered; 4) the illumination phase, where a series of ideas that are believed to solve the problem are formulated and established; 5) the verification phase, which involves testing and critically evaluating the proposed solutions (Fan & Ye, 2022; Wijayati et al., 2019). Critical thinking skills are the ability to think objectively without prejudice, present statements supported by evidence, and draw conclusions based on existing facts in order to solve problems. The interplay between creative and critical thinking enables individuals to generate arguments for problem-solving and to integrate all available information while formulating responses and justifying their positions (Amran et al., 2019; Suryadi et al., 2021). Another connection reveals that critical and creative thinking are complex thinking skills. The development of creative and critical thinking skills in students will not occur by chance, but rather requires contributions from others and a supportive environment. Creative learning doesn't arise by chance, but requires preparation, including creating a classroom environment that encourages children to learn creatively (Qodr et al., 2021; Zubaidah et al., 2017). Critical and creative thinking skills are considered high-order thinking skills (HOTS). Teachers can enhance and develop students' critical thinking skills in decision-making and problem-solving through well-designed learning processes (Afni & Hartono, 2020; Reidelbach et al., 2021). Mathematics provides a significant opportunity for the development of critical and creative thinking skills as the learning process is focused on solving contextual mathematical problems. The lack of emphasis on developing thinking abilities during classroom instruction is a current issue in education. The results of the 2018 PISA assessment indicate that Indonesia scored 379, which is lower than the OECD and ASEAN averages, with approximately 71% of Indonesian students not reaching the minimum competency level (Nold, 2017; Yasinta & Hamsa, 2022). However, the ability to think critically stimulates students to respond and provide systematic and conceptually grounded solutions to contextual problems they encounter (Jesi Alexander Alim et al., 2021; Hutagalung & Purbani, 2021).

In addition to equipping students with skills to face future challenges, teachers should also understand the characteristics and diverse needs of their students in the classroom. Students bring different backgrounds, readiness levels, and learning styles when they enter school (Mavidou & Kakana, 2019; Niemi & Kousa, 2020). Teachers require time, experience, and support from the school community to design and provide differentiated instruction to ensure that students receive support in their learning process (Van Geel et al., 2022; Westbroek et al., 2020). Emphasize the need for a learning model that can accommodate the diverse needs of students. Differentiated learning can be a solution to address diversity, as it involves instruction that allows teachers to achieve learning success in the face of diverse student conditions (Pozas et al., 2020; Smets & Struyven, 2020). Differentiated instruction from teachers can facilitate the heterogeneity of students in the classroom.

Teacher preparation and awareness are necessary for implementing differentiated instruction and transforming it from theory into practice. In mathematics education, teachers play a role in developing students' mathematical abilities by guiding them to gain learning experiences (Hermita et al., 2021; Noviyanti, 2019; Westbroek et al., 2020). Classroom activities should consider the diverse characteristics of students, their readiness to learn, and their varying interests. The implementation of differentiated instruction is considered highly effective in enhancing students' understanding of mathematical concepts and is perceived as engaging by students (Aprima & Sari, 2022; Siregar et al., 2021). This study aims to analyze whether there are differences in the improvement of students' critical and creative thinking skills in mathematics between students in the experimental group receiving differentiated instruction and students in the control group receiving conventional teaching methods. Additionally, this research also aims to investigate whether there are differences in the improvement of critical and creative thinking skills based on the learning abilities of students in the high, medium, and low groups within the experimental group that receives differentiated instruction.

2. METHOD

The research design for this quantitative study is quasi-experimental, where the groups used in the quasi-experiment consist of an experimental group and a control group. However, participants are not randomly assigned to these groups as they are already part of existing intact groups. In this quasi-experimental study, the researcher will use a non-equivalent control group design with pre-tests and post-tests, consisting of two groups: the experimental group (Group A) and the control group (Group B). Both groups will receive pre-tests and post-tests, but the treatment will only be given to the experimental group (Group A). The population for this study consists of all students from SDN 07 in the Mandau sub-district, Bengkalis regency, Riau. The target population for this research is fifth-grade students of SDN 07 Mandau, including both male and female students. The research data will be obtained through a test instrument designed based on indicators of critical and creative thinking skills related to the topic of volume of cubes and rectangular prisms. The data collection instruments to be used in this research consist of tests of critical and creative thinking, observation formats during learning, questionnaires, and interviews. To measure Critical Thinking Abilities, an essay test is used, which is designed to measure critical thinking abilities in the form of problem-solving questions, and student responses are scored based on the indicators of critical thinking abilities presented in Table 1.

Table 1. The Indicators of Critical Thinking Abilities

The Assessed Creative Abilities	Response to Questions/Problems	Score
Identifying/Justifying Concepts	1) Does not provide the expected concept to solve the problem.	1
	2) Provides a concept that is not relevant to problem solving.	2
	3) Provides a concept but the solution is incorrect.	3
	4) Provides the correct concept and solution.	4
Problem-solving.	1) Does not understand the problem/ no response.	0
	2) Does not pay attention to the problem requirements/ lacks accurate interpretation of the problem.	1
	3) Plans a solution but the concept is not appropriate.	2
	4) Formulates the problem/ constructs a mathematical model effectively.	3

To measure Creative Thinking Abilities, an essay test is used, which is designed to measure creative thinking abilities in the form of problem-solving questions, and student responses are scored based on indicators of creative thinking abilities. The indicators of creative thinking abilities can be seen in Table 2.

Table 2. Indicator of Creative Thinking Abilities

The Assessed Creative Abilities	Response to Questions/Problems	Skor
Fluency	1) Does not provide the expected ideas to solve the problem.	0
	2) Provides ideas that are not relevant to problem solving.	1
	3) Provides ideas but the solution is incorrect.	2
	4) Provides ideas and the solution is correct.	3
	5) Provides a detailed answer and the result is correct.	4
Elaboration	1) Does not provide an answer.	0
	2) Provides an answer that is not detailed and incorrect.	1
	3) Provides an answer that is not detailed but correct.	2
	4) Provides a detailed answer but incorrect result.	3
	5) Provides a detailed answer and correct result.	4
Originality	1) Does not provide an answer.	0
	2) Does not depict ideas in providing an answer and leads to an incorrect response.	1
	3) Does not depict ideas in providing an answer but leads to a correct response.	2
	4) Depicts ideas in providing an answer but leads to an incorrect response.	3
	5) Depicts ideas in providing an answer and the response is correct.	4

The Assessed Creative Abilities	Response to Questions/Problems	Skor
Flexibility	1) Does not provide an answer.	0
	2) Provides answers that are not diverse and incorrect.	1
	3) Provides answers that are not diverse but correct.	2
	4) Provides diverse answers but incorrect.	3
	5) Provides diverse and correct answers.	4

Due to the quasi-experimental design used in this quantitative research, quantitative analysis with statistical methods is employed for data analysis. After obtaining the data, prerequisite analysis tests are conducted, including tests for normality and homogeneity, to determine the appropriate sample for analysis. The data analysis also involves calculating the t-test, where if the calculated t-test result yields a significance value greater than 0.05, the null hypothesis (H_0) is accepted and the alternative hypothesis (Hα) is rejected.

3. RESULT AND DISCUSSION

Result

The results of the improvement in critical and creative thinking abilities, which are the objectives of this research, will be presented in the form of a comparison between the pre-test and post-test scores for the experimental and control groups in the topic of Cube and Rectangular Prism Volume in Grade V at SDN 07 Mandau. Further tests were conducted to examine the hypothesis using One-Way ANOVA, and it was found that there was no significant difference in the average pre-test scores of critical thinking abilities between the experimental group and the control group. Table 3 shows the results of the pre-test scores for critical and creative thinking abilities of the students.

Table 3. Pretest Results of Students' Critical and Creative Thinking Abilities

Thinking Ability	Max Score	Experiment Class				Control Class			
		X_{min}	X_{maxs}	$\bar{X}$	s	X_{min}	X_{maxs}	$\bar{X}$	s
Critical	100	30	55	41.43	7.27	30	55	41.90	7.16
Creative	100	17	58	36.90	10.72	17	58	35.71	11.2

Based on Table 3, it can be concluded that in this study, students' initial abilities in critical and creative thinking in mathematics, specifically in the topic of cubes and rectangular prisms, were similar between the experimental group and the control group, both falling below average and categorized as low. Subsequently, after the pretest assessment, the experimental class would receive treatment through the implementation of differentiated learning, while the control class would continue using the conventional teaching model, which is teacher-centered. The purpose of this is to examine the effectiveness of the differentiated learning model in mathematics education in enhancing students' critical thinking and creative thinking abilities. The application of the differentiated learning model in the experimental class will involve grouping students based on their learning styles and thinking abilities. Student mapping based on learning styles was designed to group students according to visual, auditory, and kinesthetics learning styles. The results of the student mapping were used to design differentiated learning activities. The mapping result is show in Figure 1.

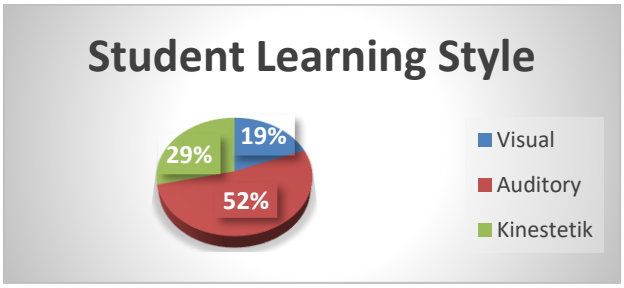

Figure 1. Student Learning Style Mapping

Base on Figure 1, students were grouped based on their learning styles in two consecutive sessions, they were then given a set of questions as a post-test to assess the improvement of students' critical and creative thinking abilities in the topic of cube and rectangular prism geometry. The data in this study is

derived from the average scores of post-tests measuring critical thinking and creative thinking skills after the implementation of differentiated instruction in the experimental class and conventional instruction in the control class. A summary of the descriptive data analysis, including the minimum score (Xmin), maximum score (Xmax), mean score ($\bar{X}$), and standard deviation (s), is presented in Table 4.

Table 4. Descriptive Statistical Analysis Results of Post-Tests in The Experimental Class and Control Class

Thinking skills	Max Score	Experiment Class				Control Class			
		X_{min}	X_{maks}	$\bar{X}$	s	X_{min}	X_{maks}	$\bar{X}$	s
Critical	100	60	95	76.90	8.871	45	75	59.29	8.409
Creative	100	58	92	74.62	10.740	42	92	65.10	12.292

Data from Descriptive Statistical Analysis Results of Post-Tests in the Experimental Class and Control Class is presented in Table 4, it can be observed that the average scores in the experimental class, which received differentiated instruction, are higher compared to the control class, which received conventional instruction, for both post-tests measuring critical thinking and creative thinking skills. Based on the results of hypothesis testing, it can be concluded that there is a significant influence of differentiated instruction in the experimental class on the improvement of critical thinking and creative thinking skills in elementary school mathematics. Due to the significant difference in the average post-test scores, an N-Gain Score test was conducted. The N-Gain Score test is used to determine the effectiveness of a treatment, in this case, the impact of differentiated instruction. Table 5 presents the N-Gain Score calculations along with their respective categories.

Table 5. N-Gain Score Test Results for The Experimental Class and Control Class

Thinking skills	Experiment Class		Control Class	
	Mean N-Gain	Category	Mean N-Gain	Category
Critical	61.08	Moderately effective	29.65	Not effective
Creative	59.20	Moderately effective	45.30	Less effective

Based on Table 5, it can be observed that the utilization of the differentiated model in the experimental class yields fairly effective outcomes, categorized as "moderate," in enhancing students' critical and creative thinking abilities. On the other hand, the control class, which employs conventional teaching methods, demonstrates ineffective results in improving critical thinking skills and less effectiveness in enhancing students' creative thinking abilities. Based on the above results, an independent samples t-test will be conducted for the N-Gain Score to determine the significance of the differences in effectiveness. After conducting the prerequisite tests and obtaining results indicating homogeneity and normal distribution of the data, the testing results is show in Table 6.

Table 6. Independent Samples T-Test for N-Gain Score

Independent Samples Test								
		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Thinking skills	Critical	1.224	0.275	7.76	40	0.000	31.43	4.05
	Creative	0.105	0.748	2.47	40	0.018	13.91	5.63

From Table 6, it can be concluded that there is a significant difference in effectiveness between the implementation of differentiated learning in the experimental group and conventional learning in the control group. This means that the implementation of differentiated learning is more effective than conventional learning. Further testing is conducted to determine the average improvement in critical and creative thinking skills among students in the high, medium, and low ability groups with differentiated learning in the experimental group. To understand the extent of the influence of differentiated learning on the improvement of critical and creative thinking skills among students grouped based on their learning abilities, we can refer to the N-Gain scores presented in Table 7.

Table 7. Descriptive Results of N-Gain Scores

Thinking Skills	Group	Minimum	Maximum	N-Gain Score	Category
Critical	High	56	91	72.26	High
	Medium	50	70	57.87	Medium
	Low	38	69	54.70	Medium
Creative	High	57	88	75.99	High
	Medium	28	75	52.52	Medium
	Low	37	75	51.47	Medium

Data from the results of N-Gain scores based on learning ability for critical and creative thinking skills is presented in Table 7, show differences in the average improvement of critical thinking skills among students with different learning abilities: high, medium, and low. Looking at the N-Gain percentage, there is an influence of differentiated learning on the improvement of critical thinking skills: 72.26% in the high-ability group (categorized as high), 57.76% in the medium-ability group (categorized as moderate), and 54.70% in the low-ability group (categorized as moderate). For the improvement of creative thinking skills, the N-Gain Score values are as follows: high-ability group with a high category at 75.99%, medium-ability group with a moderate category at 52.52%, and low-ability group with a moderate category at 51.47%. Therefore, descriptively, it can be concluded that the average improvement of critical thinking skills is better in the high-ability group. This research aimed to examine the improvement of students' critical and creative thinking abilities in the topic of Cubes and Rectangular Prisms in Grade V at SDN 07 Mandau through the implementation of differentiated learning. The research results have been analyzed, and it was found that the Initial Student Abilities from the pretest results showed no significant difference in the initial critical and creative thinking abilities in mathematics, particularly in the topic of cubes and rectangular prisms, between the experimental group (receiving differentiated learning) and the control group (continuing with conventional teaching methods). The pretest results indicated that these abilities, in general, were still below average and categorized as low.

Discussion

The Implementation of Differentiated Learning in the experimental group received differentiated learning, taking into account students' learning styles and thinking abilities. Student grouping based on their learning styles revealed that various learning styles such as visual, auditory, and kinesthetics were used to group students. Improvement in Critical and Creative Thinking Abilities After the implementation of differentiated learning, a post-test was conducted to assess the improvement in students' critical and creative thinking abilities (Dalila et al., 2022; Sahril et al., 2021; Zubaidah et al., 2017). The post-test results showed that the experimental group, which received differentiated learning, achieved higher average scores compared to the control group, which received conventional teaching methods. This applied to both critical and creative thinking abilities.

Significance testing to test the significance of the results, the N-Gain Score test was conducted to measure the effectiveness of the learning. The results indicated that the implementation of differentiated learning in the experimental class had a significant impact on improving students' critical and creative thinking abilities compared to conventional teaching in the control class. Furthermore, the research examined how differentiated learning affected the improvement of students' critical and creative thinking abilities based on their ability levels. The results showed that the group of students with high abilities experienced a greater improvement in critical and creative thinking abilities compared to the moderate and low-ability groups (Fitrianawati et al., 2020; Insyasiska et al., 2015). Based on this research, it also demonstrated the extent of the effectiveness of differentiated learning compared to conventional teaching. Differentiated learning proved to be more effective in enhancing students' critical and creative thinking abilities compared to conventional teaching, which is more teacher-dominated.

Based on interviews with the teacher from SD Negeri 07 Mandau, it is known that the teacher's measure of successful learning is based on students being able to complete assignments correctly and having a calm classroom environment for focused learning. Consequently, the teacher enforces strict rules to ensure students are serious and pay close attention during learning. The teacher dominates the teaching process by providing strict rules for students to follow and maintaining a calm classroom environment. The teacher teaches in their preferred way based on their own abilities, without considering how students learn according to their individual needs. Moreover, the dominance of the teacher in the classroom hinders students' opportunities to develop their thinking skills and broaden their knowledge (Fitriani et al., 2020; Saragih & Zuhri, 2019), It is also in line with research conducted which reveals that teacher-dominated learning tends to make students passive in their learning, thus hindering their thinking abilities (Keiler, 2018). Therefore, the selection of an appropriate learning model/approach that aligns with students'

characteristics is necessary, one of which is differentiated learning that adapts to students' learning styles. As indicated by the study state differentiated learning is currently receiving attention as it is considered to enhance the quality of education without neglecting the diversity among (Mulyawati et al., 2022).

Until now, teachers have regarded the existing differences in students' abilities as a problem and a challenge for them to address the diversity within the classroom. State that there are pros and cons to grouping students based on academic abilities (Papachristou et al., 2022; Sahril et al., 2021). This is because it is believed that students will be motivated to improve their abilities, but at the same time, there can be a gap in expectations between teachers and students with different abilities (Gultom et al., 2020; Marlina, 2019; Smets & Struyven, 2020). Based on interviews with teachers, it was found that only a few students have high mathematical abilities, while the majority struggle and find it difficult to learn mathematics.

Grouping students based on their learning styles will enable them to process received information more easily. As stated by previous study grouping students based on learning styles facilitates the processing of received information (Rais & Aryani, 2017). The purpose of grouping is to enable students to collaborate in understanding and completing tasks based on their similar learning styles. Initially, students may experience confusion when they are grouped according to their learning styles. However, as the learning process continues, students seem to enjoy the lessons, although they still face challenges in working together because they are preoccupied with understanding the material in their own ways.

Differentiated learning strategies, which include a focus on critical thinking, help align the varying abilities of students in comprehending lesson materials and developing their interests and diverse talents (Haelermans, 2022; Weiss et al., 2018). This means that students with different learning abilities, as determined through grouping, have equal opportunities to develop their interests and learning styles in understanding the lesson content (Fen & Poh, 2015; Zamecnik et al., 2022). However, the above research findings indicate that differentiated learning has not yet influenced student grouping based on their learning abilities. Students with higher learning abilities in the top group still achieved higher average post-test scores compared to those in the middle and bottom groups.

The research findings indicate that the implementation of differentiated learning in the experimental class can enhance critical thinking skills to a greater extent compared to the control class, which utilizes conventional teaching methods, based on the average post-test scores. Differentiated learning provides students with the opportunity to develop critical thinking skills in understanding problems, evaluating information, drawing conclusions, and making generalizations (Benedicto & Andrade, 2022; Magableh & Abdullah, 2020). Differentiated learning is considered as a solution to meet the diverse learning needs of students and their potentials. The differentiated learning strategy directs teachers to avoid imposing their will and provides opportunities for students to develop their own potentials

The implementation of differentiated learning is quite effective in enhancing students' critical and creative thinking skills in mathematics, specifically in the topics of Rectangular Prisms and Cubes for 5th-grade students at SDN 07 Mandau. Based on the presented research findings, it is evident that the application of differentiated learning is quite effective in improving students' critical and creative thinking skills in the volume of rectangular prisms and cubes compared to conventional teaching methods. This finding is consistent with previous study where their study found that the implementation of differentiated learning can improving students' learning outcomes (Hidayati & Sujarwati, 2023). Similarly, research conducted after the implementation of differentiated learning for students found that this method can improve students' creativity and critical thinking skills. Furthermore, a study conducted revealed that the implementation of differentiated learning can enhance the potential of elementary school students (Mulyawati et al., 2022). Another study conducted also indicated that the implementation of differentiated learning can improve students' critical reading abilities (Sahril et al., 2021). Based on these findings, it can be concluded that differentiated learning can be applied to students to enhance their critical and creative thinking abilities. Overall, this research supports the implementation of differentiated learning as an effective method to enhance students' critical and creative thinking abilities in elementary school mathematics education.

4. CONCLUSION

In conclusion, the research findings indicate that differentiated learning, particularly in the context of teaching rectangular prisms and cubes to 5th-grade students at SDN 07 Mandau, is quite effective in enhancing critical and creative thinking abilities. The N-Gain scores show varying levels of improvement in critical thinking abilities among students with different learning abilities, with the high-ability group showing the highest improvement. Similarly, creative thinking abilities also improved, with the high-ability group exhibiting the highest improvement. The observed traditional teaching approach in the control group, where the teacher dominated the learning process and enforced strict rules, seems to hinder

students' opportunities to develop their thinking skills and expand their knowledge. In contrast, differentiated learning, which focuses on critical thinking, provides equal opportunities for students with diverse abilities to understand the subject matter and develop their interests and learning styles. Overall, these findings demonstrate that differentiated learning is a valuable approach for enhancing critical and creative thinking abilities in mathematics education. Teachers should have a better understanding and mastery of implementing differentiated learning, not only based on content, process, and product but also by adapting the learning to the mapped learning needs, rather than solely focusing on grouping based on learning styles. The implementation of differentiated learning as part of the independent curriculum requires sufficient time for adaptation and teacher preparation.

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