

Impact of Differentiated Learning Management on Enhancing Students' Creative Thinking in Mathematics

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ABSTRACT

In the era of globalization, innovation in education is essential, particularly in fostering students' creative thinking abilities. Mathematics, as a core subject, requires teaching strategies that stimulate creativity. This study explores the influence of differentiated learning management in mathematics on students' creative thinking at MIN 1 Sidoarjo. A quasi-experimental design with a quantitative approach was used. The research population included all students at MIN 1 Sidoarjo, with the sample drawn from class VI students. Data were collected using pre-tests, post-tests, and questionnaires and analyzed using t-tests to assess the impact of the differentiated learning approach on creative thinking. The findings reveal that differentiated learning management significantly enhances students' creative thinking in mathematics. The experimental group, which received differentiated instruction, showed greater improvements in creative thinking compared to the control group, which followed a traditional teaching approach. The results highlight the positive influence of differentiated learning strategies in promoting creativity within mathematics education. The experimental group's superior performance underscores the need for more innovative teaching practices to meet the demands of modern education. Differentiated learning management in mathematics has a significant positive effect on students' creative thinking. These findings offer important insights for educators seeking to enhance creativity through tailored instructional methods.

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1. INTRODUCTION

The education industry is one of the many industries that will be greatly impacted by the globalization period. The rise of students' creative thinking and the increased use of learning technology that is more inventive, creative, and valuable for students' development are two ways that globalization has affected and developed the education industry. Likewise, in student development, teachers in the digital era must also emphasize and pay more attention to the characteristics and development potential of students according to their individual personalities (Kahar et al., 2021) . Because every student has different talents and interests. Involving students in creative thinking

activities in mathematics not only improves their understanding of the material, but also forms the basis for problem solving in real-world contexts (Astria & Kusuma, 2023) .

Creative thinking is a learning process that is able to motivate and encourage students' creativity during learning by applying appropriate strategies (Astuti et al., 2023) . Understanding and developing creative thinking is becoming increasingly important in facing global challenges in various fields. One of the problems that arises is a lack of creativity in solving problems. According to Yustina's research results, it was found that around 75% of respondents from various countries considered themselves less creative. This data reflects the priority need to develop creative thinking in various levels of society (Anggraini et al., 2023) . Creative thinking is a thought process where someone creates something new. The indicators for creative thinking include the following: (a) Fluency, (b) Flexibility, (c) Elaboration, (d) Originality (Handayani et al., 2021) .

As stated in the Law of the Republic of Indonesia about the National Education System Number 20 of 2003, article 37 paragraph 1, mathematics is one of the subjects that students in formal education institutions from primary to secondary education levels are required to learn. (Adiwijaya, 2022) . Mathematics is a lesson that can train students to develop creative thinking because thinking is one part that is of concern in learning activities (Erni et al., 2022) . Creative thinking is one of the goals of mathematics learning in schools from primary to secondary education levels. Creative thinking is really needed in mathematics, including in solving math problems. By thinking creatively, students are expected to be able to solve mathematical problems with a variety of new approaches and ideas (Febriani et al., 2021) . According to the findings of the Japan International Cooperation Agency survey titled "IMSTEP-JICA Development Of Science and Mathematics Teaching For Primary And Second Education In Indonesia," student achievement in mathematics is still low at both the primary and secondary levels. This is because the mathematics learning taught by teachers discusses various practice problems, which causes students to not be interested in mathematics, so they do not focus and think that mathematics is difficult (Ariana et al., 2023) . Mathematics learning activities at school have not met expectations. The learning that takes place is teacher-centered, where the teacher uses conventional methods and students record it in their notebooks so that when students learn mathematics, they only memorize the formulas (Astuti et al., 2023) .

According to , differentiated learning is an endeavor to modify classroom activities to meet the unique learning requirements of every student. Since many teachers still treat all of their students equally during the learning process under the false pretense that there is no jealousy among students, it is impossible to separate the role that differentiated learning plays in helping students reach their full potential. Additionally, with relation to the allocation and realization of the same rights for students. They believe that if there is a difference in treatment, it will make other pupils envious since one student will receive preferential treatment. Perhaps just a small number of pupils has the same competencies, despite the fact that every kid has a unique character and potential. Therefore, teachers must identify children's competencies (Aprima & Sari, 2022) . The teacher's role must be optimal in preparing learning that is attended by students with different competencies, ensuring that all students participate in learning optimally.

From the researcher's experience of teaching at MIN 1 Sidoarjo, there are still many students who experience difficulties in learning mathematics delivered by teachers, so teachers need to apply learning methods that are appropriate to the material being taught. Learning methods are very important to improve at every level of school, because from the reality found in the field the learning models applied by teachers have not helped improve students' creative thinking. Therefore, initiatives to enhance the learning process are required. According to current circumstances, innovation in the educational process is necessary to facilitate students' development of their creative thinking skills. Using a differentiation learning approach is one method of creating and implementing a learning process based on the characteristics of the students. (Aprima & Sari, 2022) .

According to Efendi, differentiated learning is considered a learning process that has great possibilities for students to learn and is adapted to their abilities, preferences and needs. (Faiz et al., 2022). Teachers who implement differentiated learning need to understand the different characteristics of each student and develop student potential according to pedagogical competence (Marlina 2020). According to Ausubel, cited by Ruseffendi, it is also advised that when learning, an approach that makes use of inquiry, problem-solving techniques, and learning strategies that can stimulate creative thinking be employed. As a result, one endeavor that may be undertaken to provide pupils with meaningful learning is learning innovation. Effective learning management is essential to fostering innovation in education. Three key components interact in learning management: students, teachers, and instructional materials. Other elements such as learning planning, execution, and evaluation, are all a part of this interaction (Mumthaza et al., 2021).

The important role of teachers in learning management is to support the success of the learning process in the classroom. Teachers must have the skills to identify student learning styles, develop differentiated learning plans, and provide the necessary support to create an inclusive and responsive learning environment (Turnbull et al., 2019). Before conducting learning, teachers must prepare learning tools which include implementation and evaluation based on learning management. As for the steps in learning management, the first is planning, planning is the initial activity carried out by the teacher before holding teaching and learning activities in the form of preparing learning tools, whether syllabus, lesson plans or teaching modules. Second, organizing is an activity carried out by the teacher to group themes and sub-themes in learning activities and distribute them according to the time allocation and lesson schedule that has been determined. Third, actuating, namely the teacher's efforts to mobilize all teaching and learning activity programs and students, so that they are focused and ready to accept mathematics lessons happily. Fourth, evaluation is the final step carried out by the teacher to find out the extent to which teaching and learning activities are carried out in accordance with expectations (Istikomah, 2022).

In carrying out learning activities, teachers must prepare learning tools, starting with preparing the syllabus and Learning Implementation Plan (RPP). These activities have a significant impact on the quality of teaching and learning carried out by teachers in the classroom (Istikomah, Dzulfikar Akbar Romadlon, 2023). Scientific studies highlight several key factors that teachers need to consider to ensure the preparation of syllabi and lesson plans that are effective and oriented toward optimal learning outcomes. First, research conducted by Sakinah shows that a deep understanding of student needs and diversity is an essential basis for teaching preparation. Teachers need to identify students' learning styles, their level of understanding, and various individual needs to design appropriate learning experiences (Enramika, 2022). Implementing appropriate teaching methods with clear steps can increase the effectiveness of mathematics teaching. The learning implementation plan is prepared by the teacher to support the learning process, for this reason the learning plan has been prepared in such a way that the teacher carries out the learning steps clearly depicted in the RPP. The learning steps in the RPP can actually be used as guidelines and learning scenarios that provide a real picture of the actions that must be carried out by teachers and students, as well as the results that will be achieved, which are measured using predetermined instruments, while still referring to the curriculum. Teachers need to design evaluation instruments that are appropriate to learning objectives and are able to provide information that can be used to improve teaching in the future, especially in the field of mathematics studies (Enramika, 2022).

The study titled "Differentiated Learning in Mathematics Learning in the Independent Curriculum" (Gusteti & Neviyarni, 2022) explores the implementation of differentiated learning strategies in the Indonesian language program for Grade IX students at SMPIT Khairunnas, Bengkulu City. The research utilized a classroom action research approach, focusing on how personalized learning strategies impact students' engagement and outcomes. According to Manggalastawa (2023),

differentiated learning management significantly increases students' interest, particularly in language acquisition, by providing innovative, personalized, and engaging learning experiences that cater to individual student needs.

Another study, conducted by Aprima and Sari (2022), examines the application of differentiated learning within the independent curriculum in elementary mathematics lessons. This research employed *ex post facto*, or causal-comparative methodology, using multiple linear regression, correlation, and descriptive statistics to analyze data collected from students at Pelita Rantepao High School. The findings highlight that individualized learning management enables students to reach their full potential by adapting both curriculum content and teaching strategies to their unique needs and abilities (Fatimah & Mashar, 2023).

Similarly, research by Siringoringo et al. (2023) titled "Differentiated Learning Strategy: Acceleration Increases Students' Potential" employed a systematic literature review of articles published between 2018 and 2023. The study concludes that differentiated learning strategies are effective in addressing diverse learning needs by aligning instruction with students' readiness, interests, and preferences. Another related study, conducted by Astria and Kusuma (2023), titled "Analysis of Differentiated Learning to Improve Mathematical Creative Thinking Ability," applied a quantitative experimental design. This study used a One Group Pretest-Posttest Design to analyze data from Class VIII-C students at Tri Sakti 2 Catholic Middle School in Medan. The results, analyzed through a t-test, show that differentiated learning models significantly enhance students' mathematical creative thinking abilities (Kusuma et al., 2023).

While prior studies have focused on language acquisition, acceleration strategies, and mathematical creative thinking in middle and high school settings, our research addresses a key gap by focusing on the management of differentiated learning in basic education. Specifically, this study was conducted at Madrasah Ibtidaiyah, an elementary-level Islamic educational institution, where students require greater teacher support and guidance in developing foundational skills. The novelty of our research lies in exploring differentiated learning in the early stages of education, particularly within mathematics, which is often perceived as challenging for young learners at this level.

This study aims to answer two main research questions: (1) How is differentiated learning managed in the mathematics program at MIN 1 Sidoarjo? (2) How does the management of differentiated learning impact students' creative thinking abilities? The significance of this research lies in identifying effective management practices for differentiated learning and assessing their impact on improving students' creative thinking. The findings are expected to provide valuable insights into how differentiated learning strategies can be optimized in early education, particularly in mathematics, where students often struggle. This research can serve as a model for other institutions seeking to enhance student engagement and foster creative thinking through tailored instructional strategies.

2. METHODS

This kind of study uses a quasi-experimental methodology and quantitative research design to examine the direct impact of one variable on other variables (Sari & Hafandi, 2022). In this study, critical thinking is the dependent variable, and differentiated learning management is the independent variable. All MIN 1 Sidoarjo students, including a selection of class VI students, made up the research population. When employing a purposive sampling strategy to obtain research samples, consider the features of the population that are relevant to the study. (Sugiyono, 2017).

Pre- and post-tests as well as questionnaires, were employed as data gathering methods. Following data collection, the researcher used the SPSS t-test to examine the data. In this case, a statistical technique called the two-sample t-test is employed to compare two distinct groups and determine whether there are any meaningful differences between them (Tellur et al., 2017).

Measurement of Creative Thinking Mathematics in class VI at MIN 1 Sidoarjo is based on:

1. Understanding Mathematical Concepts (understanding problems/questions)
Ensure a strong understanding of the basic mathematical concepts relevant to the problem. A solid understanding provides the basis for formulating a creative approach.
2. Alternative View (choosing a concept/formula)
Consider alternative solutions to math problems. Think about whether there is another way to approach the problem.
3. Problem Solving Steps (carrying out the stages of problem solving)
Use a systematic problem-solving approach. Identify the information provided, determine what is requested, and think of steps to reach a solution.
4. Analogy
Use analogies or metaphors to connect math problems to other, more familiar situations or concepts. This can help generate new ideas.
5. Results construction
Answer questions appropriately according to procedures.

Using the independent t-test and a significance level of 0.05 (5%), the hypothesis was tested using the SPSS program.

- The following criteria are used to make decisions: if the significant value is less than 0.05, then differentiated learning management has an impact on students' creative thinking in the study of mathematics.
- Differentiated learning management has no effect on students' creative thinking in the study of mathematics if the significant value is more than 0.05.

This supports the reasonable hypothesis of this study, which is as follows:

Ha: Differentiated learning management has an impact on pupils' creative thinking when it comes to studying mathematics.

Ho: Differentiated learning management has little effect on pupils' creative thinking when it comes to studying mathematics.

3. FINDINGS AND DISCUSSION

3.1 Normality Test Results

The purpose of the normality test is to determine if the sample data is derived from a normally distributed population. For this research, data with a normal distribution is considered appropriate and useful. The researchers utilized the Shapiro-Wilk normality test with the help of the SPSS software (Scientists & Suryaningtyas, 2022) . The Shapiro-Wilk test was selected due to the class sample size being less than 50.

The decision-making criteria are as follows:

1. The residuals are regularly distributed if a significance value larger than 0.05 is obtained using the Shapiro-Wilk test.
2. If a significance value less than 0.05 is obtained from the Shapiro-Wilk test, the residuals are not normally distributed.

Table 1. Tests of Normality

	Class	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistics	Df	Sig.	Statistics	df	Sig.
Creative Thinking	Class A	.132	30	,193	,930	30	,050
	Class B	.131	30	,197	,962	30	,358

a. Lilliefors Significance Correction

Based on the test results, it is known that each variable data is declared to be normally distributed with a Shapiro-Wilk score >0.05 .

3.2 Homogeneity Test

A homogeneity test is used to determine whether the variance of the data from the experimental and control classes is equal. If the significance level is less than 0.05, the data is considered to have unequal or different variances (non-homogeneous). Conversely, if the significance level is 0.05 or higher, the data is regarded as having equal variances (homogeneous) (Fahrunnisa et al., 2023). The results of the homogeneity test are presented in the table below.

Table 2. Test of Homogeneity of Variances

		Levene			
		Statistics	df1	df2	Sig.
Creative Thinking	Based on Mean	1,580	1	58	,214
	Based on Median	1,223	1	58	,273
	Based on Median and with adjusted df	1,223	1	51,808	,274
	Based on trimmed mean	1,614	1	58	,209

3.3 Hypothesis testing

After the two classes are normally distributed and have homogeneous variances, a test of equality of two means is then carried out using a two-tailed t-test using the SPSS 23.0 for Windows program with a significance level of 0.05. The decision-making criteria, according to (Mufarrikoh, 2019), are as follows:

- A. The probability value is > 0.05 , then H_0 is accepted
- B. The probability value is < 0.05 , then H_0 is rejected

Table 3. Descriptive Statistics

		Mean	N	Minimum	Std. Error	
					Mean	Std. Deviation
Creative Thinkings	Class A PreTest	72,0000	30	55.00	1.58296	8.67020
	Class A PostTest	81.6667	30	70.00	1.42501	7.80510
	Class B PreTest	70.1667	30	45.00	2.02688	11.10167
	Class B PostTest	72.3333	30	50.00	1.88359	10.31682

Figure 3 presents a description of the pairs of creative thinking scores that were analyzed, which includes the average (mean) before being given treatment. Before treatment, the experimental group, namely class A, had an average of 72.0000, and the control group, namely class B, had a smaller average

than the experimental group, namely 70.1667. After being given treatment, the experimental group showed better creative thinking, with an average of 81.6667, and the control group had a lower increase than the experimental group, with an average of 72.3333.

Table 4. 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	95% Confidence Interval of the Difference	
									Lower	Upper
Creative Thinking	Equal variances assumed	1,580	,214	3,952	58	,000	9,333	2,362	4,605	14,061
	Equal variances not assumed			3,952	54,005	,000	9,333	2,362	4,598	14,069

Based on the test results, it is known that the sig. The result obtained was <0.05 , so it can be concluded that the creative thinking posttest scores for the two groups were significantly different.

Discussion

In the world of education, the differentiation approach has been recognized as an effective way to accommodate students' individual learning needs. Especially in the field of mathematics studies, this approach can facilitate various learning styles and different student understanding (Rahmah et al., 2022). In a study conducted to evaluate the effect of differentiated learning management on students' creative thinking, the results showed significant differences between the experimental group and the control group.

Before being given treatment or differentiation approach treatment, the experimental group had an average creative thinking score of 72.0000. Meanwhile, the control group showed a slightly lower average, namely 70.1667. However, after the treatment was implemented, there was a significant increase in the performance of the experimental group. Their average creative thinking score increased to 81.6667. On the other hand, the control group also experienced an increase, but at a lower level, reaching an average of 72.3333. This shows that the application of a differentiation approach in mathematics learning can have a greater positive impact on students' creative thinking compared to conventional methods.

Other research that supports these findings was conducted by (Rahmah et al., 2022) (Manggalastawa, 2023), which found that students who studied with a differentiation approach had better problem-solving abilities and were more able to think creatively compared to those who studied with a conventional approach. These findings emphasize the importance of adapting learning approaches according to students' needs and characteristics to increase students' creative potential. Differentiated learning management recognizes that each student has different learning styles, backgrounds and needs. In the study of mathematics, differentiation allows teachers to adapt teaching methods, materials, and resources to suit student characteristics and needs. In this way, students who

may have difficulty understanding certain concepts can be given additional help or alternative teaching methods that better suit their learning style (Istikomah & Haryanto, 2021).

The importance of this adequate approach lies in the fact that mathematical understanding is not only based on one's numerical strength, but also on one's ability to think critically, analyze, and relate those concepts to real-world situations. Therefore, with a differentiation approach, students are not only given the opportunity to understand the material in depth but also to develop their creative thinking.

In the long term, students who have strong creative thinking will be better able to face future challenges, both in academic and professional environments. The ability to think creatively allows them to find innovative solutions to problems, adapt to change, and have a broader view of the world around them. Thus, differentiated learning management in the field of mathematics study not only improves students' academic understanding but also equips them with the skills and competencies necessary for success in the future.

Apart from that, the differentiation approach in mathematics learning also creates an inclusive environment in the classroom. By accommodating diverse learning needs, teachers recognize each student as an individual with unique potential. This can increase students' motivation and self-confidence because they feel valued and supported in their learning process.

Furthermore, with a differentiation approach, students are invited to become lifelong learners. They are trained to become more independent, learn how to learn best for themselves, and value diversity in thought and approach. It's not just about understanding mathematics, but also about preparing students to face a rapidly changing world, where adaptation skills and creative thinking are becoming increasingly important.

The benefits of the differentiation approach are not only felt by students who may have difficulty understanding mathematical concepts. Even students who already have a strong understanding can be given additional challenges or more in-depth material according to their needs, so that they remain motivated and driven to reach their peak potential.

Finally, it is important to note that implementing a differentiation approach requires appropriate support and training for teachers. By ensuring that teachers have the tools, resources, and understanding necessary to implement this approach effectively, the positive potential of differentiated learning management in the mathematics subject area can be fully realized.

Overall, differentiated learning management in the field of mathematics studies plays a crucial role in improving students' creative thinking. By providing an approach that is adequate and appropriate to students' learning needs, their creative potential can be optimized, which will ultimately make a positive contribution to their future development.

4. CONCLUSION

The research findings indicate that differentiated learning management in mathematics has a significant positive impact on students' creative thinking. Students who received instruction through a differentiated approach demonstrated greater improvements in creative thinking compared to those taught with conventional methods, confirming that tailoring learning approaches to meet students' individual needs and characteristics enhances their creative potential. As a result, the adoption of differentiated learning strategies in mathematics is strongly recommended to foster students' creative development. However, the study has limitations, including a focus on a specific subject and educational context, which may restrict the generalizability of the findings to other subjects or school environments. Future research should explore the long-term effects of differentiated learning on creative thinking across different disciplines and educational levels. Additionally, further studies could investigate the role of teacher training and instructional design in optimizing the effectiveness of

differentiated learning, as well as how collaboration between educators, students, and parents can support its successful implementation.

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