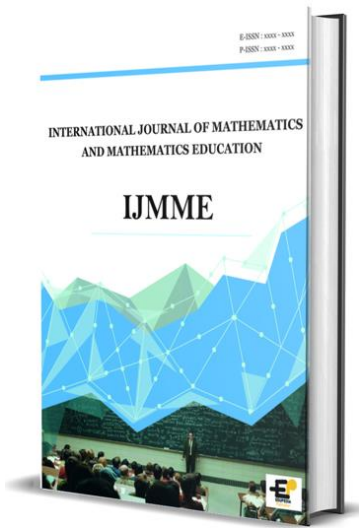

Creativity Increment and GeoGebra Classroom Quality: Impact on Student Learning

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Creativity Increment and GeoGebra Classroom Quality: Impact on Student Learning

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Abstract

Preliminary observation results highlight the importance of utilizing innovative learning media to stimulate students' creativity in both classroom and home-based learning. One interactive learning medium identified for this purpose is GeoGebra Classroom. This research aims to analyze the effect of using the GeoGebra Classroom on the increment of students' creativity, the effect of the increment of students' creativity on students' learning Results, the effect of GeoGebra Classroom quality on students' learning Results, and the interactivity between students' creativity and the quality of GeoGebra Classroom learning media. By analyzing pre- and post-implementation learning processes with GeoGebra Classroom, we collected data on increased student creativity. In conclusion, GeoGebra Classroom effectively fosters increased student creativity. And from the process of analyzing the effect of students' creativity increments, we get the result that the creativity increments give an effect on the learning result of quadratic function materials. Unfortunately, the quality of the learning media GeoGebra Classroom can't give an effect on the learning result. The insights gained pave the way for future research efforts to delve deeper into the optimization of interactive learning media to improve educational outcomes in a variety of academic contexts.

Introduction

The true essence of education, as emphasized by Sugiharti et al. (2017) lies in the cognitive development fostered through dedicated study. In our current era of digital-based learning, the transformation of education into a digital format is not just a trend but a mandate embedded in the curriculum, known as the Sekolah Penggerak Curriculum. But the observation results show that in the mathematics learning activities at SMA Negeri 3 Surakarta, especially in Class X, teachers tend to use the lecture method. The lack of use of innovative and creative learning media places students as individuals who are monotonous and less creative in their learning process. Consequently, the urgent need arises for the integration of innovative learning media to ensure the continuous and enjoyable learning experiences that stimulate students'

creativity both in the classroom and at home. Learning media is a tool that allows two-way communication or more as a process of transferring knowledge both from teacher to student and student to teacher. While interactive learning media means a product or digital service (multimedia) that presents learning content such as text, moving images, audio, and video to video games. Interactive learning media is designed so that users can respond to carry out an activity provided so that interactive learning media is not like passive media such as print media which cannot exercise control over its users. In this case, users (students) interact with learning media containing the studied material. According to Prastowo that the user of this form of instructional media is provided with a controller that allows him to select the next procedure that best suits his needs (Anggraeni et al., 2021).

The role of media as an intermediary in ongoing teaching and learning activities benefits greatly from the use of learning media. Teachers are useful in disseminating course content, and students are useful in comprehending certain course content through the use of media, as successful educators take a methodical approach to developing and implementing course content. The representations of mathematics can be made with concrete objects, manipulative models, tables, diagrams, graphs, drawings, sketches, mathematical models and computer simulations (N, 2017, Novitasari, 2016, Malatista & Sediyono, 2011). The learning activities will be effective if planned and managed well Yuliyanto & Jailani on (Syafitri, 2018). The use of media in the classroom has been shown to improve student engagement and retention of material, leading to better long-term results for education. Teaching media is beneficial for a number of reasons, including (but not limited to) the following: (1) students are more likely to pay attention and become motivated to learn; (2) students will be able to better understand the purpose of lessons and complete them; (3) teachers can employ a wider range of strategies in their lessons; and (4) students are more likely to engage in a variety of learning activities, rather than relying solely on teacher descriptions (Mardhatillah et al., 2020). The one of the interactive learning media for mathematics is learning media based on GeoGebra (Anggraeni et al., 2021). GeoGebra is a page (website) provider of math applications. accessible. via geogebra.org. GeoGebra was developed by Markus Hohenwarter, a professor at Johannes Kepler University Linz starting in 2001 and also an Austrian mathematician. He is chairman of the Mathematics Education Institute which developed it. mathematics education specification software, namely GoeGebra. GeoGebra is a free, dynamic, multi-platform math software. GeoGebra combines algebra, geometry, tables and graphs, statistics, and calculus in one easy package that can be used for all educational networks, according to Hidayat and Tamimuddin in (Anggraeni et al., 2021). GeoGebra can produce interactive math applications via the geogebra.org page. Thus, the geogebra.org page can be used as an alternative to disseminating GeoGebra-based learning media. In addition, on the GeoGebra page, there is a GeoGebra Classroom feature that can be used to display. activities created through the GeoGebra application, so students can access it without having to install the GeoGebra application on their computers. Researchers feel the need to use interactive learning media based on GeoGebra to be able to introduce this graphical mathematics software to students and teachers and guide students to carry out digital-based concept discovery activities using GeoGebra Classroom through the creative activity shown.

Students who are able to think creatively are better able to adapt to new situations, see things from a variety of angles, and come up with novel solutions to problems of all sizes. Further, the ability to "view a product

or an idea with various perspectives or a holistic approach; to develop and enrich detailed ideas; to come up with one's own unique solutions to problems; and to bring out such ideas and solutions" A report by the (Ministry of Education) is "the phenomenon in which a person communicates a new concept (product) obtained as a Result of a mental process in generating ideas that is an attempt to fulfil a need" (press) (Özdas & Batdi, 2017). influenced by environmental stressors. Four components make up the creative process: the artist, the process, the media, and the final product. Most researchers settle on the definition of creativity offered by Stenberg, Kaufman, and Pretz: the capacity to create novel, contextually appropriate, and aesthetically pleasing products. New research suggests that creativity needs to be nurtured in the context of Basadur's real world (Munandar, 2018), and this can be seen in how people attach importance to a process in problem solving. An individual's creative capacity, as defined by (Munandar, 2018), is their "intellectual ability to create and develop something new from a collection of experiences, knowledge, and concepts." Those who are able to think creatively are those who are willing to keep an open mind. The authors draw on the views of Mel Rhodes, Stenberg, Kaufman, Pretz, and Munandar to define creativity as the capacity to produce novel results from the application of one's mind to the solution of problems in one's immediate environment.

The characteristics of a creative product according to Guilford in (Munandar, 2018) are 1) fluency, or the ability to produce a large number of ideas in a short time, and 2) flexibility, or the ability to adapt one's ideas. think for different circumstances. It takes a flexible mind, for example to create many categories of ideas that have been raised, or to create new ideas; (3) Uniqueness, or the quality of being the first to have an idea. According to (Munandar, 2018), original works exhibit the following qualities: The ability to quickly and easily switch between different solutions to a problem is called 1) fluency and 2) fluency. To know a person well is to be fluent in their language; to be able to think creatively is to be flexible. Being adaptable-means you can look at a problem from different angles and employ a wide variety of solutions; 3) Elaboration, elaboration is the process of refining an idea by providing more information about it. Provide more information to help readers engage with and grasp the subject at hand; 4). Originality, authenticity means creating something that has not been done before. Authenticity also requires you to present ideas in novel ways. The authors draw upon these considerations to arrive at the conclusion that creativity is comprised of four main characteristics: fluency, flexibility, elaboration, and originality. According to Schoevers et al. (2022) researchers studying the connection between creativity and mathematical performance should account for the influence of other variables that might help explain the observed connection.

Information visualisation in the digital realm facilitates the grasp of abstract ideas without resorting to literal representation. Science education initiatives several researchers that create or implement digital tools for educational consumption highlight engagement and improved learner outcomes (Ernst, 2014). Researchers are eager to test the hypothesis that the high-quality GeoGebra Classroom media used to teach quadratic functions increases both student creativity and retention of the material. In Indonesia, research on the use of GeoGebra Classroom is still rarely carried out, several studies have been carried out including research from (Pianda & Rahmiati, 2020) about "*Peningkatan Kreativitas Siswa Dalam Pembelajaran Matematika Dengan Google Classroom Sebagai Kelas Digital Berbantuan Aplikasi Geogebra The*

students of SMK Negeri 6 Lhokseumawe's Class X-NKPI" have shown increased mathematical imagination after being exposed to the Google Classroom method as a Digital Class with Geogebra Applications. Research from (Kemala Sari et al., 2021) about "*Pengaruh Kemampuan Berfikir Kreatif Matematis Siswa Terhadap Hasil Belajar Siswa SMA Negeri 1 Banda Aceh*" show that the ability to think creatively in mathematics has a positive influence on mathematics learning outcomes, (2) the creative thinking skills of students in mathematics at SMA Negeri 1 Banda Aceh point to a significant connection between the two. These studies provide results that GeoGebra Classroom is able to support improved mathematics learning outcomes, but to date there has been no research that examines the development of GeoGebra Classroom on quadratic function material with the aim of increasing students' creative thinking abilities. Based on the introductory material, this study investigates how students' creativity grows as a result of using the GeoGebra Classroom, how that growth affects the students' learning outcomes, how the quality of the GeoGebra Classroom affects the students' learning outcomes, and how students' creativity and the quality of the GeoGebra Classroom learning media interact.

Method

Research Types and Approaches

This article mostly shows how statistics work to define the connectivity of each variable which has been a concern in this research. The role of statistics in research is very significant, especially in terms of data processing (Sundayana, 2012). Given the importance of the role of statistics especially in research, almost each university with various levels as well as study programs make subjects Statistics a compulsory subject taken by all students. The research adopts a quantitative and formal study design to systematically evaluate existing literature from Haidich (2010) to (Özdas & Batdi, 2017). This study employs a quantitative and formal study design. In order to draw a broad conclusion, researchers often re-analyze and combine the findings of multiple studies on the same topic that were conducted at different times and by different researchers (Glass, 1976; Özdas & Batdi, 2017). The primary objective of this research is to investigate the correlation between student creativity and the quality of learning media within the GeoGebra Classroom. Additionally, the study aims to explore how the utilization of GeoGebra Classroom impacts students' creativity and learning abilities.

Research Procedure

The first step in this research was to create an interactive activity for teaching and learning mathematics with GeoGebra Classroom. After a series of expert validation processes, the GeoGebra Classroom media is deemed valid if there are no comments or suggestions for improvement from the experts. Media expert validators include Riki Andriatna, S.Pd., who is a lecturer in Mathematics Education at Sebelas Maret University and Fakhi Rahmasari, S.Pd. who is a mathematics subject teacher at SMA Negeri 3 Surakarta. The basis for media validation is carried out by distributing questionnaires to validators. Before the questionnaire is distributed, the questionnaire is first consulted with the supervisor and then validated by the main validator, namely Riki Andriatna, S.Pd., M.Pd. The questionnaire evaluation by media experts and content experts found that the GeoGebra Classroom-based interactive learning media fulfilled the

validity criteria. Experts in the media have given it an average score of 0.889, which meets the "very good" standard of evaluation. The average score for the evaluation of subject matter experts was 0.872, with the very good evaluation criterion included. It follows that GeoGebra Classroom-based interactive learning materials are appropriate for teaching and learning about quadratic functions. The next step is to administer creativity assessments to students both before and after they have used the media produced in this way. We analyse the results of the creativity test alongside those from a questionnaire designed to gauge the quality of the GeoGebra Classroom media students have used and a learning achievement test for all of the tested material. The gain normality test, the user response test on the quality of GeoGebra Classroom, and the analysis of variance (ANOVA) will be used as the statistical tests.

For example, "Analysis of variance (ANOVA) is a statistical tool used to detect differences between experimental group means" (Sawyer, 2009). Analysis of variance (ANOVA) is the most commonly used statistical test because it allows researchers to compare the means of several groups or conditions to see if there are any significant differences (Lehmann et al., n.d.). The analysis of variance (ANOVA) method is useful for spotting trends and patterns in complex data by comparing means across multiple groups. Researchers in this study used SPSS 22 to perform ANOVA tests; results indicated a significant relationship between variables when sig. > alpha and no relationship when sig. alpha.

The increase in student creativity was taken from the pretest scores (before using GeoGebra Classroom learning media) and posttest (after using GeoGebra Classroom learning media). The results of the assessment obtained both before (pre) and after (post) tests are calculated using the normalized gain or N-Gain test. (Guntara, 2021) stated that N-gain or based on the original source of the article written by Hake (1998), introduces the term Average normalized gain or the average N-gain of a treatment/learning/lecturing is a rough measure/estimate of the effectiveness of a treatment/learning/lecturing in encouraging understanding draft. The normalized gain test was carried out to determine the increase in student learning creativity after being given treatment as stated by Richard in (Adawiyah et al., 2019).

$$N - Gain = \frac{Score\ Post\ Test - Score\ Pre\ Test}{Ideal\ Score - Score\ Pre\ Test}$$

Fithriyah & As'ari in (Setiawati et al., 2017) explained how to measure the level of quality of learning media, using the following analytical techniques:

$$P = \frac{\sum Xi}{\sum Xj} \times 100\%$$

Explanation:

P = Presentage

$\sum Xi$ = The sum of score

$\sum Xj$ = The sum of maximum score

Participants

In this research, the technique used for selecting subjects which was carried out at the stage of testing the practicality and effectiveness of learning media was probability sampling, namely a sampling technique that provides equal opportunities or opportunities for each element or member of the population to be selected as a sample (Sugiyono, 2017). Cluster random sampling is simple random sampling that is applied successively to units or sub-populations which are then referred to as clusters (Budiyono, 2017). This determination was made during teacher interviews and observations at school by taking final semester 1 assessment score data. The population used in this research were all class X students at SMA Negeri 3 Surakarta consisting of accelerated classes (X E1 and X E3, X E4, X E5, X E6, X E7, the research sample was determined by dividing the student population based on clusters consisting of accelerated classes and regular classes. Based on the research time, a regular class was chosen to be used as a research sample, then clustering was carried out again to determine the research sample in the form of a control class and an experimental class. The sample in this study was class X E3 students as the experimental class and class X E8 students as the control class. The selection of these two classes was based on the same curriculum, the same material delivery times, the same teachers, and the average learning outcomes for the final semester 1 assessment which were not much different.

Instruments

To get data that represented students' creativity, the quality of GeoGebra Classroom learning media, and students' learning results of quadratic function materials, there are some instruments: students' creativity instruments test, the quality of GeoGebra Classroom instruments test, student learning result instruments test, explained more fully as follows:

Students' Creativity Instruments Test

The purpose of this assessment is to compare students' levels of inventiveness in learning about quadratic functions before and after they have been exposed to the material via media. Rizki Arifani Nur 'Aini's 2013 thesis, titled "Profile of the Wallas Model Guided Creative Thinking Process and the Level of Students' Creative Thinking in Solving Problems on the Subject of Quadratic Functions Viewed from the Perspective of Gender and Mathematical Ability (Research Conducted in SMA Negeri 1 Klaten Academic Year 2010/2011)," used student learning creativity tests.

The Quality of GeoGebra Classroom Instruments Test

To evaluate the efficacy and excellence of GeoGebra Classroom as an educational tool for pupils, three fundamental enquiries might be employed. Begin by inquiring with students about the platform's level of intuitiveness and ease of usage. The content provided by GeoGebra Classroom may not encompass all subjects and concepts that are part of the curriculum. Assess the platform's interactivity and engagement components to see if students are actively acquiring knowledge through interactive tools and activities. In

order to ensure equitable access for all students, it is necessary to conduct comprehensive testing of GeoGebra Classroom on various devices and operating systems. Queries on the platform's capacity to enhance cooperative learning and communication among students and teachers also shed light on its educational setting. Feedback regarding the platform's performance and dependability, including loading times, responsiveness, and technical issues, is essential for addressing any learning concerns. By utilising these indicators and including student feedback, educators may evaluate the quality and effectiveness of GeoGebra Classroom as an educational tool. They can then make improvements and optimisations to better cater to the needs of students.

Table 1. Instrument of Quality Media

Assessment Criteria	Indicator	
Aspects of Learning	1)	Ease of understanding
	2)	Suitability of purpose
	3)	The accuracy of the material
	4)	Variation of problems in each activity
	5)	Quality problems in each activity
Aspect of Media Quality	6)	Easy of use
	7)	Language suitability
	8)	Ease of following the flow of media with instructions for use
	9)	Compatibility of website with the device owned by user
	10)	The accuracy of website selection
Aspek Media Display	11)	Display quality
	12)	Color variations in the media
	13)	Media typography
	14)	Media design
Aspect of Media Function	15)	Clarify understanding
	16)	Help active and fun learning
	17)	Ease of storing student work
	18)	Improving student learning creativity related to identifying the characteristics of quadratic functions
	19)	Increase student learning creativity related to constructing graphs of quadratic functions
	20)	Increase student learning creativity related to solving problems in everyday life with quadratic functions

Adapted from (Hafizhah et al., 2022; Irawan & Hakim, 2021; Islamyati & Manuaba, 2021)

Student Learning Result Instruments Test

After getting the result of the student's creativity, then a thorough quadratic function material test was carried out in the form of ten multiple choice questions to get student learning results on quadratic function material.

Results

After those instruments are already tested, the data that has been collected should be analyzed. To find the answer to the question research, there are some analyzed that must be done, including the following below.

Analyze The Effect of Quality Media on Students' Creativity Increcement

Performing One Way ANOVA analysis using statistical software such as SPSS 22 provides valuable insights into the associations among variables in a dataset. This analytical methodology enables researchers to compare averages across various groups in order to ascertain the presence of statistically significant disparities among them. By utilising SPSS 22 to input data and execute the One-Way ANOVA test, researchers can acquire vital insights into the disparity between groups and within groups. This allows them to make informed inferences about the impact of various factors on the desired outcome. The outcomes generated by SPSS 22 offer significant insights that inform decision-making processes in diverse domains, encompassing psychology, sociology, economics, and more.Table 2. Test Normality of Quality Media

N		36
Normal Parameters[a,b]	Mean	.0000
	Std. Deviation	.82808
Most Extreme Differences	Absolute	.139
	Positive	.139
	Negative	-.106
Test Statistic		.139
Asymp. Sig. (2-tailed)		.077[c]
Exact Sig. (2-tailed)		.451
Point Probability		.000

a. Test distribution is Normal.
b. Calculated from data.
c. Lilliefors Significance Correction.

The significance level (α) in statistical analysis serves as a critical threshold for determining whether to accept or reject hypotheses. The data can be inferred to follow a normal distribution based on the significance level (0.05) and the asymptotic significance (Sig Asymp.) value (0.077). The significance level is the probability of observing a result as extreme as the one obtained, assuming that the null hypothesis is correct. If the significance asymptotic score is higher than the predefined α level, it implies that there is not enough evidence to reject the null hypothesis, which suggests that the distribution is normal. This discovery is essential for accurate inferential testing and dependable data discoveries in statistical analysis. By establishing the normality of the distribution, researchers can reliably employ parametric statistical methods, which rely on the assumption of normality, to generate precise and pertinent analyses of the dataset.

Table 3. Test Homogenity of Quality Media

Dependent Variable: CreativityIncrecement			
F	df1	df2	Sig.
1.458	11	24	.212

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + MediaQuality

Because of Sig. $= 0.212 \geq 0.05 = \alpha$, so the data are homogenous. The two sets of samples are representative of the same population, as their characteristics are similar. All data are normally distributed, as

demonstrated by the necessary tests. As a result, a parametric statistical test was carried out. The purpose of this study was to compare the effects of the independent variable on the dependent variable, so a one-way variance analysis was conducted. Table 4 displays the outcomes of the statistical analysis.

Table 4. One Way ANOVA

Dependent Variable: CreativityIncrecement					
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1.953[a]	11	.178	3.256	.008
Intercept	6.107	1	6.107	112.016	.000
MediaQuality	1.953	11	.178	3.256	.008
Error	1.308	24	.055		
Total	13.289	36			
Corrected Total	3.261	35			

a. R Squared = .599 (Adjusted R Squared = .415)

Pay attention to the value of Sig. from MediaQuality. Because of $\text{Sig.} = 0.008 < 0.05 = \alpha$ then can be concluded that the quality of GeoGebra learning media has an effect on increments students' creativity.

Analyze The Effect of Students' Creativity Increcement and Quality Media on Learning Results

We will do the analysis simultaneously by using Two Way ANOVA in SPSS 22, with variable learning result as the dependent variable, variable independent is taking place by variable creativity increments and media quality.

Table 5. Test Normality

N		36
Normal Parameters[a,b]	Mean	.0000
	Std. Deviation	.95618
Most Extreme Differences	Absolute	.117
	Positive	.113
	Negative	-.117
Test Statistic		.117
Asymp. Sig. (2-tailed)		.200[c,d]
Exact Sig. (2-tailed)		.663
Point Probability		.000
a. Test distribution is Normal.		
b. Calculated from data.		
c. Lilliefors Significance Correction.		
d. This is a lower bound of the true significance.		

Because of Sig Asymp. $= 0.200 \geq 0.05 = \alpha$, so the data having normal distributions.

Table 6. Test Homogenity

Dependent Variable: LearningResults			
F	df1	df2	Sig.
1.803	26	9	.179
Tests the null hypothesis that the error variance of the dependent variable is equal across groups.			

Because of Sig. $= 0.179 \geq 0.05 = \alpha$, so, the data are homogenous.

Table 7. Two Way ANOVA

Dependent Variable: LearningResults					
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	10480.556[a]	26	403.098	6.596	.003
Intercept	137058.324	1	137058.324	2242.773	.000
MediaQuality	951.294	11	86.481	1.415	.306
CreativityIncrecement	2441.482	6	406.914	6.659	.006
MediaQuality * CreativityIncrecement	177.230	9	19.692	.322	.947
Error	550.000	9	61.111		
Total	206100.000	36			
Corrected Total	11030.556	35			

a. R Squared = .950 (Adjusted R Squared = .806)

Pay attention to the value of Sig. from CreativityIncrecement. Because of Sig. $= 0.006 < 0.05 = \alpha$ then can be concluded that the increcement of students' creativity has an effect on students' learning results. The value of Sig. from MediaQuality $= 0.306 \geq 0.05 = \alpha$ then can be concluded that the quality of learning media GeoGebra Classroom has no effect on students' learning results. And because of sig. value of MediaQuality*CreativityIncrecement $= 0.947 \geq 0.05 = \alpha$, so the conclusion is there are no interaction between students' creativity increcement and the quality of GeoGebra Classroom learning media.

From the learning process before and after using learning media GeoGebra Classroom we get data on students' creativity increments and by the students' response to the quality media, we can imply that actually that media giving a significant effect on the creativity increments, so we can conclude that learning media GeoGebra Classroom can increase students' creativity. And from the process of analyzing the effect of students' creativity increments, we get the result that the creativity increments give an effect on the learning result of quadratic function materials. Unfortunately, the quality of the learning media GeoGebra Classroom can't give an effect on the learning result. From that results we can conclude that the learning

activity that researchers give on GeoGebra Classroom can increase students' creativity on learning quadratic function materials, but can't give an effect on the learning result. And so on we can accept the result that there is no interaction of students' creativity and the quality of learning media GeoGebra Classroom on the learning result.

Discussion

The results stated that the quality of GeoGebra Classroom learning media had no effect on student learning outcomes, maybe because of the deficiencies that existed in GeoGebra which at that time had an effect on student learning processes. According to Kusuma & Utami (2017) in (Aprillia & Zainil, 2020) disadvantages of using GeoGebra in learning mathematics is as following : (1) not all students have computers or laptops, so the use of GeoGebra is not optimal. (2) not all schools in Indonesia have laboratories computer, so the application of GeoGebra not much effect on the increase student activity in exploring and experimenting with materials geometry for not practicing it directly. This theory is supported by facts in the field where data collection was carried out in early 2021 where learning was still online due to the Covid-19 pandemic so that students were not directly monitored for carrying out the learning activities that the researchers had given to the GeoGebra Classroom, increased creativity could occur because the assessment was carried out twice, before and after using the media so it is natural that there is an increase in score because students finally understand the material through activities in the GeoGebra Classroom, but the effect on learning results cannot be ascertained because there is material that is not given an approach to activities in the media, problems based learning questions of quadratic function materials. If teachers want to increase students' creativity in studying quadratic functions, then they can use GeoGebra Classroom learning media to deliver the materials, and by that increments it can be shown that students can understand the materials better so it can give effect on their learning results. Teacher can't use the media just for better learning result because the result of our research say that the quality of learning media GeoGebra Classroom can't give an effect on students' learning result.

Conclusion

The research outcomes indicate that the utilization of the interactive learning media GeoGebra Classroom has a positive impact on enhancing students' creativity. Furthermore, the increased creativity of students correlates with improved learning outcomes. However, it is noteworthy that the GeoGebra Classroom, as a learning medium, does not directly influence students' learning results. Additionally, there is no observed interaction between the increased creativity of students and the quality of the GeoGebra Classroom learning media concerning its impact on students' learning results in quadratic functions materials. These findings underscore the importance of interactive learning tools, such as GeoGebra Classroom, in fostering creativity among students. While the tool contributes positively to creativity development, its direct influence on academic performance appears limited. Educators and stakeholders should consider these nuanced relationships when implementing technology-based learning strategies, understanding that the enhancement of creativity might not uniformly translate into improved academic outcomes in all contexts.

Further exploration and adaptation of teaching approaches may be warranted to maximize the benefits of both creativity development and effective learning outcomes.

Recommendations

This research just shows the effect of using GeoGebra Classroom and students' creativity increcements on learning result of quadratic function materials. There are so many mathematical ability that should be analyzed on learning quadratic functions, especially by using learning media GeoGebra Classroom, so our recommendation for further research is going to analyze the effect of the other competencies like critical thinking, mathematical communication, and etc on students learning result by using GeoGebra Classroom.

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