Prisma Sains: Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA IKIP Mataram
https://e-journal.undikma.ac.id/index.php/prismasains/index
e-mail: prismasains.pkpsm@gmail.com

July 2023. Vol. 11, No. 3
p-ISSN: 2338-4530
e-ISSN: 2540-7899
pp. 805-815

The Effect of the GeoGebra-Based Project Based Learning (PjBL) Model on the Creative Thinking Ability of Junior High School Students

Adella Irma Wiyanti, *Windia Hadi
Mathematics Education Study Program, Faculty of Teacher Training and Education, Universitas Muhammadiyah Prof. Dr. HAMKA. Jl. Tanah Merdeka No.20, Jakarta 13830, Indonesia.

*Corresponding Author e-mail: windia.hadi@uhamka.ac.id

Received: May 2023; Revised: June 2023; Published: July 2023

Abstract

The PjBL model provides opportunities for individuals to work freely, which fosters genuine individual creativity and the ability to think creatively using media such as GeoGebra. GeoGebra media is able to visualize in a realistic manner, allowing individuals to understand it effectively. This study aims to determine the effect of the GeoGebra-based Project Based Learning (PjBL) model on the creative thinking skills of junior high school students. This is quantitative research using a quasi-experimental approach with a posttest-only control design. The sample of this study are 70 seventh-grade students, particularly 35 students for the ability to think creatively in the GeoGebra-based PjBL model and 35 for the Non-GeoGebra-based PjBL model. The instrument employed consisted of a 5-question essay test on the ability to think creatively, with earlier phases of the validation of expert and from the eighth-grade students in various schools. The results of data analysis using the Mann Whitey Non-Parametric test were obtained at 0.118 (P Value > 0.05 significant level). According to the findings of the analysis, the GeoGebra-based PjBL model does not significantly convert the creative thinking abilities of the students, despite it gives an impact of the influence of junior high school students' abilities.

Keywords: PjBL, GeoGebra, Creative Thinking Skills

How to Cite: Wiyanti, A., & Hadi, W. (2023). The Effect of the GeoGebra-Based Project Based Learning (PjBL) Model on the Creative Thinking Ability of Junior High School Students. *Prisma Sains : Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA IKIP Mataram, 11*(3), 805-815. doi:https://doi.org/10.33394/j-ps.v11i3.7992

https://doi.org/10.33394/j-ps.v11i3.7992

INTRODUCTION

The independent learning curriculum is a curriculum design that provides freedom of learning of the students, this independence allows students free to explore the knowledge that can be obtained both in academic and non-academic education, therefore there are no restrictions in the curriculum (Manalu et al., 2022; Pantiwati et al., 2023). The absence of limits in the independent study curriculum might stimulate student's ability to think. According to Piaget (in Suparno, 2001) the ability to think of students from the age of eleven to fifteen years has reached the formal stage, students do not only think concretely but ideally, logically and abstractly. (Noor & Hidayati, 2017). The existence of abstract thinking can build students' creative thinking abilities (Santrock, 2008; Noor & Hidayati, 2017).

Creative thinking is an exploration of one's creativity with several domains including: creative people, creative press, creative processes, and creative products. (Garcês et al., 2016; Jumadi et al., 2021). Creative people are individual habits of a person in doing a creation, the creative press is more towards a person's attitude in producing something in the form of creativity, the creative process is a person's steps in combining ideas and information into creative products, and creative products are the creative results of a person generated from ideas and information (Silvia et al., 2014; Jumadi et al., 2021). So, the ability with the aim of

finding, creating, and producing real, not ordinary, and precise new ideas is the ability to think creatively. (Andiyana et al., 2022; Dalilan & Sofyan, 2022; Sari & Afriansyah, 2022).

However, in fact the inability of individuals to think creatively is still relatively high. The results of the 2018 International Student Assessment Program (PISA) survey, Indonesia reached 379 points in Mathematics (Masfufah & Afriansyah, 2021). In the same year, the results of the International Trends Survey in Mathematics and Science (TIMSS) Indonesia earned 397 points out of 500 international (Sari et al., 2022). The results of the survey above agree with the results of other studies which provide information about the percentage of students' creative thinking abilities at 44.67%. (Fardah, 2012; Putra et al., 2018). Then explained in detail according to the creative thinking index, namely: 34.22% (fluency), 40.96% (flexibility), 35.45% (originality), and 34.33% (elaboration) (Hakim et al., 2017; Jumadi et al., 2021). Based on observation in class VII at one of the State Junior High School in East Jakarta, it was found the same case of the low Mathematics test results on daily tests of 35%. This is caused by the fact that during the learning process, it only provides practice questions from book guidelines from the school without any other variations of questions that are able to encourage the individuals to think creatively so that it triggers less effective learning.

Realizing effective, meaningful, and fun learning is one of the other efforts to train and improve individual abilities in creative thinking. In reality, there are still educators who carry out conventional learning which involves educators taking more leadership in learning (Sari et al., 2019). Learning merely led by the educators in schools is not appropriate, because this leads in limitations for students in training and increasing the development of thinking skills, especially creative thinking skills (Sari et al., 2019). Therefore, a learning model is needed so that individuals are able to train and improve their creative thinking skills. According to Stripling (in Sani R, 2014) the learning model is Project Based Learning (PjBL). Because, one of the peculiarities of the PjBL model is that it uses the ability to think creatively (Sari et al., 2019). In the implementation of the independent learning curriculum, the PjBL model is part of the recommendeded learning model to use in class (Mulyana et al., 2022). The PjBL model is a model related to a generative learning scheme that allows students to construct their own meaningful knowledge. (Siwa et al., 2013; Utami et al., 2015).

Learning with the PjBL model can train and even improve creative thinking skills by enabling each individual to participate in simulations and become independent learners (Suhirman & Ghazali, 2022). Students will train and even improve their ability to think creatively with the four indices of creative thinking; fluency, flexibility, originality and elaboration (Biazus & Mahtari, 2022). Fluency is the fluency of thinking in solving problems, flexibility is the flexibility of thinking to generate ideas so that they can solve problems, originality is thinking creatively to offer a variety of other ideas, elaboration is detail when thinking to generate ideas (Munandar, 2009; Utami et al., 2015).

In addition to learning models, educators also need media to improve the continuity of learning, especially when learning Mathematics (Nurhayati et al., 2022). Utilizing current technological developments is very useful in the learning process and from this, a person will be more active when the learning process takes place (Hanifah et al., 2019;Widia hadi, 2022). GeoGebra is one of the other applications created for learning media in Mathematics (Eviliasani et al., 2018; Purba & Harahap, 2021;Noviana & Hadi, 2021). The GeoGebra program is suitable as a media for learning Mathematics, as the visualization in GeoGebra is displayed in an attractive way, able to be moved and changed in terms of both size and shape, and is able to provide opportunities for easy exploration and observation in building mathematical concepts. (Japa et al., 2017; Supriadi, 2019).

Many studies discuss GeoGebra-assisted PjBL with various abilities, including problem solving skills, learning outcomes, understanding of mathematical concepts in the development of Digital Pocket Books, ethnomathematics-based creative thinking skills, Higher Order Thinking Skills (HOTS) (Suriani et al., 2018; Nurhayati et al., 2022; Anjarwati et al., 2022; Irfan, 2022; Suherman et al., 2020).

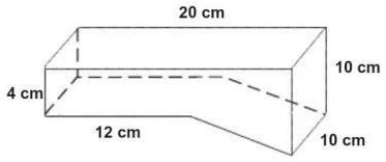
In this study, there is no other relevant observation which expands on the PjBL model, GeoGebra, or creative thinking skills. The PjBL model is one that emphasizes the use of creative thinking skills along with a learning tool like GeoGebra that may demonstrate more in-depth and fascinating mathematical concepts. Therefore, in-depth research is required to determine the impact of the GeoGebra-based Project Based Learning model on critical thinking abilities. skills. Thus, the novelty of this study is that researchers use GeoGebra media. The purpose of this study is to determine the effect of the GeoGebra-based Project Based Learning (PjBL) model on the creative thinking abilities of junior high school students

METHOD

This research is a quantitative research with quasi-experimental method. Studies using this method have a control group to regulate external variables that affect the implementation of experiments with imperfect work systems (Arikunto, 2013). The research design uses a posttest-only control design. The sample for this research consisted of two classes with 35 individuals per class representing the entire class VII population at one of the State Junior High School in East Jakarta for the 2022/2023 academic year. The first group of individual abilities in creative thinking was selected as the experimental class (the PjBL model with GeoGebra) and the second group (the PjBL model without GeoGebra).

The sampling technique for this study was a cluster random sampling technique. Individual ability to think creatively is measured through a test in the form of a description (essay) totaling 5 questions about geometric shapes based on the ability index to think creatively. The previous instrument was tested on students who had studied the material beforehand, the eighth-grade students in different schools from the previous stage, the expert validation test so that validation and reliability results were obtained. Analysis can be carried out from the results of individual ability description tests in creative thinking given in the experimental class and the control class. The following items on the instrument are shown in Table 1.

Table 1. Instrument Question Items

Capability Index	Question Item
Flexibility	Mr. Irvan wants to make a water storage tank with a maximum volume of 15.300 cm^3. What possible room structures can be formed and how is their volume? Do the answers in at least 2 ways.
Elaboration	A geometric shape has a volume between $1 - 249\ cm^3$. Determine the block that can be formed and calculate the surface area. Make a detailed answer!
Originality	Look at the picture below. Ghina's mother wants to put ceramics on the inside of her swimming pool. Determine the surface area of the ceramic installed in the swimming pool using your own language. 
Fluency	Riko has a pyramid-shaped Rubik's toy that is completely filled when put in a cube-shaped box with a cube edge length of 30 cm. How is the volume of the cube outside the toy?
Originality	Nana and Nani buy dumplings for their uncle. The dumplings have different sizes, 2 cm dan 5 cm and want to be packed into a block-shaped box with a size of45 cm × 15 cm × 12 cm. How many possible dumplings will fill the box provided that the contents are not much different? Explain!

Afterwards, the normality test, homogeneity test, and hypothesis test were carried out using the parametric test or t-test and the Mann Whitney Non-parametric test if the abnormality in the normality test was through the SPSS 26.0 application for windows.

RESULTS AND DISCUSSION

This study discusses whether there is influence or not on the GeoGebra-based Project Based Learning (PjBL) model on the creative thinking abilities of junior high school students. The data from the results will be described in detail so that at the end of the discussion a conclusion will be obtained from this study.

Results of Data Analysis

The results of testing the research instrument through the validation test and reliability test showed that the research results were obtained from the calculated correlation coefficient for each item. Then, to find out whether the question is valid or not the biserial point correlation value is compared to the $f_{table}$with $n = 36$ at a significant level of 0,05, namely 0,339. With the provision that the items are valid if calculated $f_{count} > f_{table}$. From the 5 essay questions that have been tested, it turns out that all are valid or feasible to use for research. Furthermore, the results of calculating the reliability of the description questions on the ability of individuals to think creatively are obtained $r_{11} = 0{,}70751$ and the reliability calculation value from $f_{table} = 0{,}339$ then $r_{11} > r_{table}$. Thus, it can be concluded that the description questions on the ability to think creatively are reliable and appropriate to be used as a research instrument.

After going through the validation test in the validity of the questions and reliability with the results feasible to use in research instruments conducted in different schools. This research was conducted at one of the State Junior High School in East Jakarta, in an experimental class with data on creative thinking abilities using the Geogebra-based PjBL model and the control class using the Non-GeoGebra-based PjBL model. The following is a calculation assisted by SPSS 26.0 for windows software on data analysis.

Table 2. Data Description on Creative Thinking Skill

Experiment Class	Highest Score	19
	Lowest Score	10
	Average (Mean)	14.31
	Median (Me)	14.00
	Standard Deviation (st)	2.610
Control Class	Highest Score	19
	Lowest Score	10
	Average (Mean)	13.66
	Median (Me)	14.00
	Standard Deviation (st)	2.155

The table above shows that the highest score is 19 and the lowest score is 10 from the two classes data containing the same value, then the mean and standard deviation of the two classes are not much different. the average value (mean) of the experimental class is 14.31 and that of the control class s 14.00. Standard deviation (standard deviation) 2.610 and 2.155. Furthermore, the normality test results are shown in Table 3.

Table 3. Display of Normality Test

Competency	**Class**	$\boldsymbol{\alpha}$	**N**	$\boldsymbol{t_{count}}$	**Conclusion**
Creative Thinking Skills	Experiment Class	0.05	35	0.076	Normal
	Control Class	0.05	35	0.043	Abnormal

This study used the Kolmogorov Sminov test. The results of the post-test data normality test for the class' ability to think creatively given the GeoGebra-based PjBL model in the table above reveal that the experimental class obtained a t_{count} of 0.076. Therefore it is stated that this sample is from a normally distributed population because the $t_{count} >$ significant level is 0.05 . Then in the post-test of the ability to think creatively given the Non-GeoGebra-based PjBL model in the table above, it shows that the control class obtained a t_{count} of 0.043 and it is concluded that the sample came from a population with an abnormal distribution because the $t_{count} \leq$ significant level.

In the normality test in the table above it is known that one of the data is not normally distributed, namely t_{count} ≤significant level, thus it is no longer a homogeneity test but a Mann Whitney Non-Parametric test. Following are the results of the Mann Whitney Non-Parametric test which will be explained in more detail in Table 4.

Table 4. Class Data Rating Display

Competency	Class	N	Average Means
Creative Thinking Skills	Experiment Class	35	38.63
	Control Class	35	32.64

The table above directs the subjects from the same number of classes, namely 35 people. The mean rank or average rating is 38.36 higher than the experimental class and the control class is 32.64. A summary of the results of hypothesis testing using the Mann Whitney Non-Parametric test is shown in Table 5.

Table 5. Display of the Mann Whitney Statistical Test

Mann-Whitney U	512.500
Wilcoxon W	11142.500
Z	-1.184
Asymp. Sig. (2-tailed)	0.236

In the next stage, on the Mann Whitney Non-Parametric Test, it shows a U value of 512,500 and a W value of 1142,500. If it is changed to a Z value, it is -1.184. The sig (2-tailed) value is 0.236, as it is still (2-tailed) to get (1-tailed) the data must be divided by two so you get 0.118. significant value or P Value > significant level of 0.05, therefore it can be concluded that there is no significant difference in the ability to think creatively between the experimental class, namely the GeoGebra-based PjBL model and the control class, the Non-GeoGebra-based PjBL model.

Discussion

This study used two classes for creative thinking skills including an experimental class (PjBL model based on GeoGebra) and a control class (PjBL model based on Non-GeoGebra). Learning in the experimental class with the GeoGebra-based PjBL model has increased. This is evidenced by the acquisition of the ability to think creatively in geometric teaching materials, class experiments with an average value (mean) of 14.31 and class control is 13.66.

Learning activities show differences in the experimental and control classes, in which being in teaching assisted by the GeoGebra application. Based on the results of the data hypothesis testing using the Mann Whitney Non-Parametric test, it was found that the use of the GeoGebra-based PjBL model does not significantly affect the ability to think creatively with a P Value > 0.05 significant level. But the use of the PjBL model has influenced the learning process in the ability to think creatively. PjBL is a model with individual contextual learning that is capable of playing a role in problem solving, decision making, research, presentation, and writing. (Guo & Yang, 2012; Daniel, 2017). The following stages in Project Based Learning (PjBL) are as follows: (1) Identification of Presentation Projects, (2) Plan steps to complete the project, (3) Prepare Schedules in Project Implementation, (4) Project Completion and Supervision, (5)) Writing reports and Presenting/publicizing Project Results, (6) Project Results and Assessing Project Results (Anggraini & Wulandari, 2020). Picture 1. shows the results of the project.

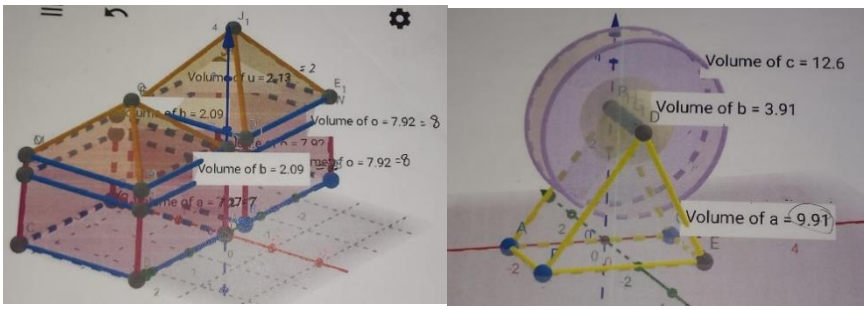


Figure 1. Project results in GeoGebra Media

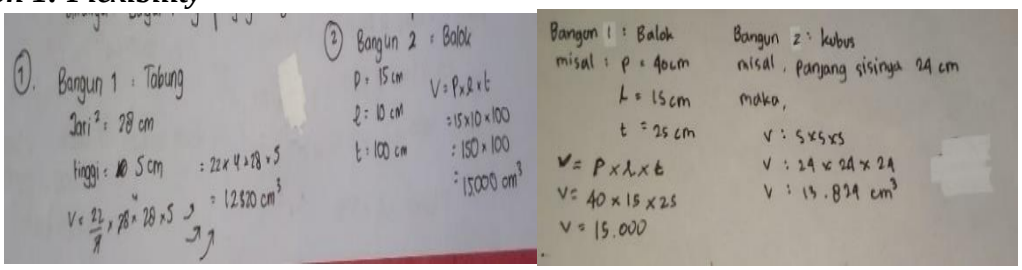
The image is the result of a project generated from the geogebra-based PjBL model, namely the experimental class. Then for the resulting project control class, which captures the results of images of buildings around the community environment in which there are various combinations of spatial shapes, such as houses, mosques, schools, and many others. From these projects, it is revealed that the PjBL model is able to ecourage the students to be able to think creatively. The results of individual abilities in creative thinking which will be detailed from the indicators are shown in Table 6.

Table 6. Comparison of creative thinking abilities

No	Indicator	Ideal score	Experiment		Control	
			Total Score	Mean	Total Score	Mean
1	*Flexibility*	4	123	3,51	108	3,09
2	*Elaboration*	4	117	3,34	107	3,06
3	*Originality*	4	107	3,06	104	2,97
4	*Fluency*	4	88	2,51	92	2,63
5	*Originality*	4	66	1,89	67	1,91

Creative thinking is defined as the ability to obtain various concepts, (1) the ability to obtain various ideas (fluency), (2) flexible thinking (flexibility) to generate changes in ideas, answers, or questions, (3) creative thinking (originality) generates ideas and new expressions are also unique. (4) elaboration (elaboration) to construct other ideas (Purwaningrum, 2016). Table 6. shows the ratio of the number of scores and the mean (mean) of the predictors is not extremely different in the experimental class and the control class. From the flexibility, elaboration, and originality of the experimental class is much higher, but for the smooth control of the class it is higher than the experimental class. Even this is clarified by the results of individual answers from both the experimental class and the control class. The following are the results of the answers to the individual description questions.

Question 1: Flexibility

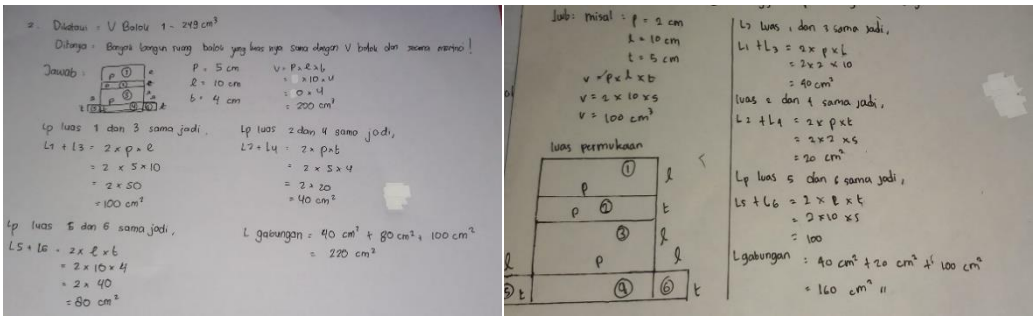


(Experimental Class) (Control Class)

Figure 2. Display of individual answers in questions of flexibility

This question contains indicators of flexibility (flexibility). As in the answers given by the students, it is revealed that there are differences in the results of the answers, however it was found similarities in the answers as they both responded with the results of the answers in at least 2 ways. This is the point of the flexibility indicator, answering the correct result in at least 2 ways.

Question 2: Elaboration

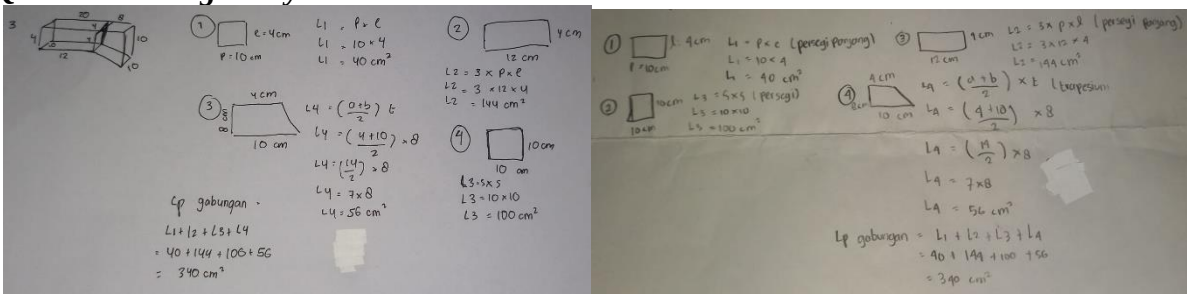


(Experimental Class) (Control Class)

Figure 3. Display of individual answers in elaboration questions

This question contains elaboration indicators (elaboration). Students answer with detailed results, such as the answers given individually in the picture above. This indicator is required to answer as clearly as possible step by step correctly and in the end get the correct result.

Question 3: Originality

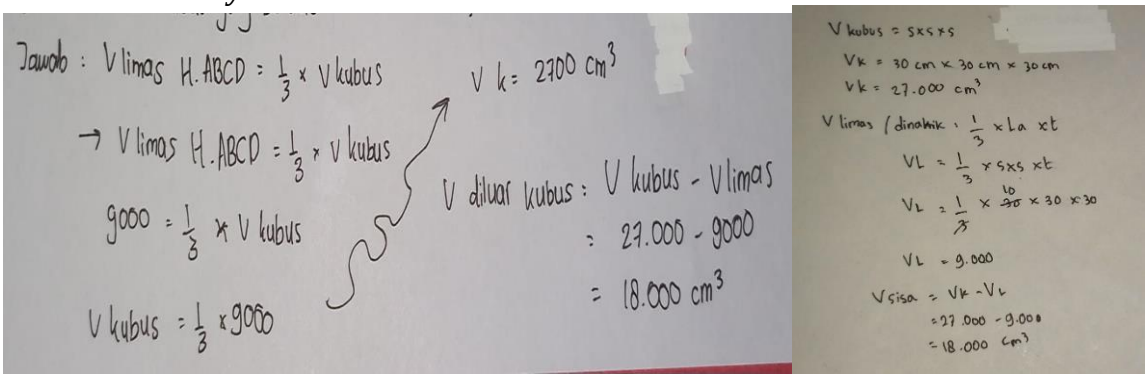


(Experimental Class) (Control Class)

FIgure 4. Display of individual answers in originality questions

This question contains an indicator of originality. Student answers are shown from how to answer with genuine answers or with individual mindsets. As the picture above reveals how to answer with different stages from each individual.

Question 4: Fluency

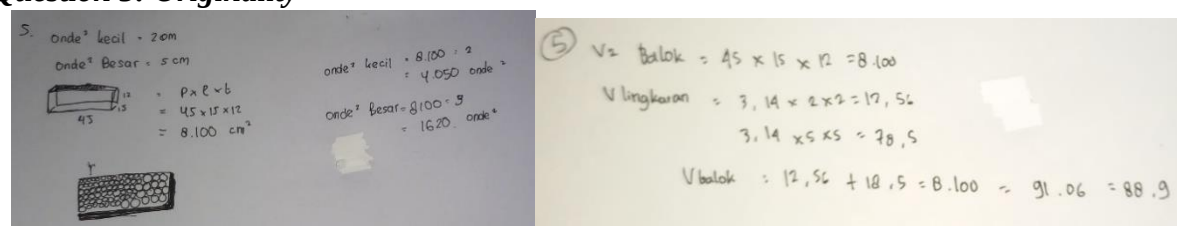


(Experimental Class) (Control Class)

Figure 5. Display of individual answers in fluency questions

This question contains indicators of fluency. Students answer with the fluency of students in answering so as to produce correct and complete answers at the end.

Question 5: Originality



(Experimental Class) (Control Class)

Figure 6. Display of individual answers in originality questions

This question contains an indicator of originality. The same as in question number 3 which is to produce original answers from individuals with different processing steps from each individual. From the answers of the students above, it shows that individuals are able to provide answers according to the creative thinking ability index. Hence, this proves that there is the influence of the PjBL model without GeoGebra media, even though students are able to think creatively. This is in line with the results of research (Irfan, 2022), which revealed that the ability to think creatively can influence training and increase using the PjBL model

CONCLUSION

Based on the results and discussion of this study, the normality test for the experimental class is 0.076 and the control class is 0.043. From the two normality test data, there are data that are not normally distributed because the $t_{count} \leq$ significant level is 0.05, then it is continued with the Mann Whitney Non-Parametric test which is obtained at 0.118, which is a significant value or P Value > significant level of 0.05, it is concluded that there is significant difference between the experimental class, in which the GeoGebra-based PjBL model on the creative thinking abilities of junior high school students and the control class using the Non-GeoGebra-based PjBL model**.**

RECOMMENDATION

Based on the conclusions of research with this title. The advice given is to use other learning media, such as PjBL with AR-based media, Cabri, Sketchpad, or other learning media and it is suggested to compare the PjBL model with other models.

REFERENCES

Andiyana, M., Maya, R., & Hidayat, W. (2022). Analisis Kemampuan Berpikir Kreatif Matematis Siswa Smp Pada Materi Bangun Datar. *Jurnal Edukasi Dan Sains Matematika (JES-MAT)*, *8*(2), 117–132. https://doi.org/10.25134/jes-mat.v8i2.5609

Anggraini, P. D., & Wulandari, S. S. (2020). Analisis Penggunaan Model Pembelajaran Project Based Learning Dalam Peningkatan Keaktifan Siswa. *Jurnal Pendidikan Administrasi Perkantoran (JPAP)*, *9*(2), 292–299. https://doi.org/10.26740/jpap.v9n2.p292-299

Anjarwati, S., Pujiastuti, H., & Ihsanudin, I. (2022). Pengembangan Pocket Book Digital Berbasis Project Based Learning Menggunakan GeoGebra untuk Meningkatkan Pemahaman Konsep Matematis Siswa SMP. *Wilangan: Jurnal Inovasi Dan Riset Pendidikan Matematika*, *3*(2), 111. https://doi.org/10.56704/jirpm.v3i2.13414

Arikunto, S. (2013). *Prosedur Penelitian Suatu Pendekatan Praktik*. PT. Rineka Cipta.

Biazus, M. de O., & Mahtari, S. (2022). The Impact of Project-Based Learning (PjBL) Model on Secondary Students' Creative Thinking Skills. *International Journal of Essential Competencies in Education*, *1*(1), 38–48. https://doi.org/10.36312/ijece.v1i1.752

Dalilan, R., & Sofyan, D. (2022). Kemampuan Berpikir Kreatif Matematis Siswa SMP ditinjau dari Self Confidence. *Plusminus: Jurnal Pendidikan Matematika*, *2*(1), 141–150. https://doi.org/10.31980/plusminus.v2i1.1585

Daniel, F. (2017). Kemampuan Berpikir Kritis Siswa Pada Implementasi Project Based

Learning (PJBL) Berpendekatan Saintifik. *JPMI (Jurnal Pendidikan Matematika Indonesia)*, *1*(1), 7. https://doi.org/10.26737/jpmi.v1i1.76

Eviliasani, K., Hendriana, H., & Senjayawati, E. (2018). Analisis Kemampuan Berfikir Kreatif Matematis Ditinjau Dari Pada Materi Bangun Datar Segi Empat. *Jurnal Pembelajaran Matematika Inovatif (JPMI)*, *1*(3), 333–346. https://doi.org/10.22460/jpmi.v1i3.333-346

Fardah, D. K. (2012). Analisis Proses dan Kemampuan Berpikir Kreatif Siswa Dalam Matematika Melalui Tugas Open-Ended. Semarang: Universitas Negeri Semarang. *Jurnal Kreano*, *3*(2), 1–10. https://journal.unnes.ac.id/nju/index.php/kreano/article/view/2616

Garcês, S., Pocinho, M., De Jesus, S. N., & Viseu, J. (2016). The impact of the creative environment on the creative person, process, and product. *Avaliacao Psicologica*, *15*(2), 169–176. https://doi.org/10.15689/ap.2016.1502.05

Guo, S., & Yang, Y. (2012). Project-Based Learning: an Effective Approach to Link Teacher Professional Development and Students Learning. *Journal of Educational Technology Development and Exchange*, *5*(2). https://doi.org/10.18785/jetde.0502.04

Hakim, A., Liliasari, L., Setiawan, A., & Saptawati, G. A. P. (2017). Interactive Multimedia Thermodynamics To Improve Creative Thinking Skill of Physics Prospective Teachers. *Jurnal Pendidikan Fisika Indonesia*, *13*(1), 33–40. https://doi.org/10.15294/jpfi.v13i1.8447

Hanifah, H., Supriadi, N., & Widyastuti, R. (2019). Pengaruh Model Pembelajaran E-learning Berbantuan Media Pembelajaran Edmodo Terhadap Kemampuan Pemecahan Masalah Matematis Peserta Didik. *NUMERICAL: Jurnal Matematika Dan Pendidikan Matematika*, *3*(1), 31–42. https://doi.org/10.25217/numerical.v3i1.453

Irfan, M. (2022). Pengaruh Model Pembelajaran Project Based Learning (PjBL) Berbasis Etnomatematika Terhadap Kemampuan Berpikir Kreatif Siswa. *Proximal: Jurnal Penelitian Matematika Dan Pendidikan Matematika*, *5*, 1–7. https://www.e-journal.my.id/proximal/article/view/1779%0Ahttps://www.e-journal.my.id/proximal/article/download/1779/1435%0Afile:///C:/Users/acer/Downloads/1779-Article Text-4991-1-10-20220609.pdf

Japa, N., Suarjana, I. M., & Widiana, W. (2017). Media Geogebra Dalam Pembelajaran Matematika. *International Journal of Natural Science and Engineering*, *1*(2), 40. https://doi.org/10.23887/ijnse.v1i2.12467

Jumadi, J., Perdana, R., Hariadi, M. H., Warsono, W., & Wahyudi, A. (2021). The impact of collaborative model assisted by Google Classroom to improve students' creative thinking skills. *International Journal of Evaluation and Research in Education*, *10*(2), 396–403. https://doi.org/10.11591/ijere.v10i2.20987

Manalu, J. B., Sitohang, P., Heriwati, N., & Turnip, H. (2022). Prosiding Pendidikan Dasar Pengembangan Perangkat Pembelajaran Kurikulum Merdeka Belajar. *Mahesa Centre Research*, *1*(1), 80–86. https://doi.org/10.34007/ppd.v1i1.174

Masfufah, R., & Afriansyah, E. A. (2021). Analisis Kemampuan Literasi Matematis Siswa melalui Soal PISA. *Mosharafa: Jurnal Pendidikan Matematika*, *10*(2), 291–300. https://doi.org/10.31980/mosharafa.v10i2.825

Mulyana, E., Juariah, J., Suherman, A., Widyanti, T., & Supriyatna, A. (2022). Implementasi Model Project Based Learning Dalam Rangka Meningkatkan Kemampuan Berpikir Kreatif. *Sosial Khatulistiwa: Jurnal Pendidikan IPS*, *2*(1), 25. https://doi.org/10.26418/skjpi.v2i1.54119

Noor, I., & Hidayati, N. (2017). Kelas Vii Berdasarkan Teori Piaget Ditinjau Dari. *JPPM (Jurnal Penelitian Dan Pembelajaran Matematika)*, *10*(2), 2–7.

Noviana, W., & Hadi, W. (2021). The Effect of Van Hiele Learning Model Based Geogebra on Students' Spatial Ability. *Proceedings of the 1st Annual International Conference on Natural and Social Science Education (ICNSSE 2020)*, *547*(Icnsse 2020), 14–19. https://doi.org/10.2991/assehr.k.210430.003

Nurhayati, N., Zuhra, F., & Salehha, O. P. (2022). Penerapan Model Pembelajaran Project

Based Learning Berbantuan Geogebra Untuk Meningkatkan Hasil Belajar Siswa. *Jurnal Pendidikan Matematika (Jupitek)*, *4*(2), 73–78. https://doi.org/10.30598/jupitekvol4iss2pp73-78

Pantiwati, Y., Chamisijatin, L., Zaenab, S., & Aldya, R. F. (2023). Characteristics of Learning Assessment Towards Implementation of Merdeka Learning Curriculum. *Jurnal Penelitian Dan Pengkajian Ilmu Pendidikan: E-Saintika*, *7*(1), 115–128. https://doi.org/10.36312/esaintika.v7i1.1125

Purba, M. C., & Harahap, N. A. (2021). Kemampuan Berpikir Kreatif Matematis Menggunakan Model Pembelajaran Cooperative Script Berbantuan Aplikasi Geogebra di SMA Negeri 1 Rantau Utara. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *5*(2), 2115–2122. https://doi.org/10.31004/cendekia.v5i2.661

Purwaningrum, J. P. (2016). Mengembangkan Kemampuan Berpikir Kreatif Matematis Melalui Discovery Learning Berbasis Scientific Approach. *Refleksi Edukatika*, *6*(2), 145–157. https://doi.org/10.24176/re.v6i2.613

Putra, H. D., Akhdiyat, A. M., Setiany, E. P., & Andiarani, M. (2018). Kemampuan Berpikir Kreatif Matematik Siswa SMP di Cimahi. *Jurnal Matematika Kreano (Kreatif-Inovatif)*, *9*(1), 47–53.

Sani R, A. (2014). *Pembelajaran Saintifik untuk Kurikulum*. Bumi Aksara.

Santrock, J. W. (2008). *Psikologi Pendidikan*. Kencana.

Sari, Fauziah, R., Afriansyah, & Aldila, E. (2022). Kemampuan Berpikir Kreatif Matematis dan Belief Siswa pada Materi Persamaan dan Pertidaksamaan Linear. *Plusminus: Jurnal Pendidikan Matematika*, *2*(2), 275–288. https://doi.org/10.31980/plusminus.v2i2.1755

Sari, S. P., Manzilatusifa, U., & Handoko, S. (2019). Penerapan Model Project Based Learning (PjBL) Untuk Meningkatkan Kemampuan Berfikir Kreatif Peserta Didik. *Jurnal Pendidikan Dan Pembelajaran Ekonomi Akuntansi*, *5*(2), 119–131. http://jurnal.fkip.unla.ac.id/index.php/jp2ea/article/view/329

Silvia, P. J., Beaty, R. E., Nusbaum, E. C., Eddington, K. M., Levin-Aspenson, H., & Kwapil, T. R. (2014). Everyday creativity in daily life: An experience-sampling study of "little c" creativity. *Psychology of Aesthetics, Creativity, and the Arts*, *8*(2), 183–188. https://doi.org/10.1037/a0035722

Siwa, I. B., Muderawan, I. W., & Tika, I. N. (2013). Pengaruh Pembelajaran Berbasis Proyek dalam Pemebalajaran Kimia terhadap Keterampilan Proses Sains ditinjau dari Gaya Kognitif Siswa. *E-Journal Program Pascasarjana Universitas Pendidikan Ganesha*, *3*(3), 1–13.

Suherman, Prananda, M. R., Proboningrum, D. I., Pratama, E. R., Laksono, P., & Amiruddin. (2020). Improving Higher Order Thinking Skills (HOTS) with Project Based Learning (PjBL) Model Assisted by Geogebra. *Journal of Physics: Conference Series*, *1467*(1). https://doi.org/10.1088/1742-6596/1467/1/012027

Suhirman, S., & Ghazali, I. (2022). Exploring Students' Critical Thinking and Curiosity: A Study on Problem-Based Learning with Character Development and Naturalist Intelligence. *International Journal of Essential Competencies in Education*, *1*(2), 95–107. https://doi.org/10.36312/ijece.v1i2.1317

Suparno, P. (2001). *Teori Perkembangan Kognitif Jean Piaget.* Kanisus.

Supriadi, N. (2019). *Pembelajaran Geometri Berbasis Geogebra Sebagai Upaya Meningkatkan Kemampuan Komunikasi Matematis*. *6*(2), 99–109.

Suriani, N. K., Santyasa, I. W., & Parwati, N. (2018). Pengaruh Model Pembelajaran Berbasis Proyek. *Jurnal Pendidikan Dan Pembelajaran IPA Indonesia*, *4*(1), 25–29.

Utami, R. P., Probosari, R. M., & Fatmawati, U. (2015). Pengaruh Model Pembelajaran Project Based Learning Berbantu Instagram Terhadap Kemampuan Berpikir Kreatif Siswa Kelas X SMA Negeri 8. *Bio-Pedagogi*, *4*(1), 47–52.

Widia hadi, ayu faradila. (2022). *Implementation of Geogebra Online Based on Guided*. *11*(2), 882–890.