Project-Based Learning in Elementary School: Influence on Students' Creative Thinking Ability

Muhammad Rizky Pratama
Institut Agama Islam Negeri Kudus, Indonesia
Email: Rizkyprat0025@gmail.com

Ulya Fawaida*
Institut Agama Islam Negeri Kudus, Indonesia
Email: ulyafawaida@iainkudus.ac.id

Rica Mae Guarin
MSU – Iligan Institute of Technology, Philippines
Email: ricamae.guarin@g.msuiit.edu.ph

*Corresponding Author
Copyright © 2023 Muhammad Rizky Pratama, Ulya Fawaida, Rica Mae Guarin

This work is licensed under a Creative Commons Attribution 4.0 International License.

Abstract
This research is experimental research with a quantitative approach that aims to determine the effect of a project-based learning model on students' creative thinking skills by making a herbarium. In this study, the sample used was 51 students. The data collection techniques used in this study were tests and documentation. The results showed that the experimental class had an average posttest score of 72.47 and the control class had a posttest average score of 57.53. The results of the creative thinking skills of the experimental class for indicators of fluency were 79%, flexibility 71%, originality 73%, and elaboration 56%; the control class had an average value for each indicator which was lower than the experimental class. This study's results indicate an influence in the use of the project-based learning model through making a herbarium on the creative thinking skills of students in grade 4 MI NU Miftahul Ulum Loram Kulon. The effect of the project-based learning model on students' creative thinking skills is

evidenced by the regression equation Y=18.802 + 0.933X. The existence of this project-based learning model has a positive and significant relationship of 0.877 which is included in the very strong category and can contribute to students in improving students' creative thinking skills by 76.9%.

Keywords: project-based learning, creative thinking, elementary school

INTRODUCTION

The skill of creative thinking is needed in thematic learning. Thematic learning itself is an education system that allows students, individually and in groups, to actively seek, explore, and discover scientific concepts and principles in a holistic, meaningful, and authentic way (Kadir & Asrohah, 2015). Thematic learning is integrated learning that prioritizes student participation in learning, involves students actively in the learning process, and creates problem-solving situations based on student needs (Nurmawati & Yulisetiani, 2022). Thematic learning allows students to learn and play with high creativity. Based on this, developing creative thinking skills in" thematic learning " is very important (Budhi & Fawaida, 2021).

Thinking creatively is seen as a form of thinking that receives less attention in the world of education, especially in learning in schools which still focuses on acquiring knowledge, memory, and reasoning (Febrianingsih, 2022) In the current learning process, most have not shown satisfactory results, the teacher's efforts to improve the quality of the teaching and learning process are not optimal, the methods, approaches, and assessments mastered by the teacher have not changed

traditional patterns, and this has a negative impact on students' absorption of knowledge. Learning activities that involve creative thinking skills can produce something new, both in the form of ideas and real learning works (Lubis, 2018).

One of the important influences on learning depends on the learning model used. The chosen learning model must be able to involve students and allow students to build their meaningful knowledge through real-world experiences by the nature of thematic learning that produces 21st-century learning known as 4C (Communication, Collaboration, Critical Thinking, and Problem-Solving, Creativity, and Innovation) (Khoiri et al., 2021). However, students have received so much pressure regarding orders to do something in their learning process, so they have lost the opportunity to develop creative thinking skills. Until now, educators (teachers) in Indonesia have not understood creative thinking skills and how to develop them in students.

This is consistent with the results of pre-research at MI NU Miftahul Ulum Loram Kulon Jati Kudus. Based on the interview results, the class VI A teacher explained that students' creative thinking abilities had not been trained, and there had been no specific evaluation of students' creative thinking abilities. The teacher also said in interviews that in giving material, the teacher used a direct teaching model, held discussions, carried out demonstrations, and carried out exercises replaced with pictures. From this description, we can see that the learning methods and models applied by teachers are very diverse. Still, they have not maximized students' creative thinking abilities.

In this regard, the author tries to apply a learning model that can develop students' creative thinking abilities that are still weak. The author attempts to develop students' creative thinking skills by making a herbarium using an alternative learning model, namely the project-based learning (PjBL) model. Herbariums are preserved plant specimens consisting of dry and wet herbariums. (Hafida et al., 2020) This model was chosen because it has the advantage that students are actively involved in projects that help solve community and environmental problems. Learners are trained to analyze problems, explore, collect and interpret information, and evaluate working on projects related to the problems investigated (Boss & Krauss, 2022).

The Project Based Learning (PjBL) learning model is designed to develop students' creative thinking skills so that learning objectives can be fulfilled (Nurhidayah et al., 2021). By applying this model, students' creative thinking processes can be developed by giving them project assignments in the form of herbarium using plants found around their homes or schools. The plant parts then identify the plant. Student identification results are stored as a herbarium as a learning medium that can be used to facilitate the learning process.

In this regard, the author tries to apply a learning model that can develop students' creative thinking skills, which are still not optimal. The author attempts to develop students' creative thinking skills by making a herbarium using an alternative learning model, namely the project-based learning (PjBL) model. The herbarium is a preserved plant specimen consisting of dry and wet herbarium (Hafida et al., 2020). This model was

chosen because it has the advantage that students are actively involved in projects that help solve community and environmental problems. Learners are trained to analyze problems, explore, collect, interpret information, and evaluate working on projects related to the issues investigated.

METHODS

The type of research used by researchers is a direct field. Researchers used two groups, namely the control and experimental groups, as a Non-Equivalent Control Group. The design of this study used an experimental group and a control group with an initial test (pretest) given to both groups, then given treatment (treatment) (Tersiana, 2018). The study ended with a final test (posttest) given to both groups.

The researcher conducted the research in classes IV A and IV B with 33 students in class IVA and 26 in IVB MI NU Miftahul Ulum Loram Kulon, whose address is Jl. At-Taqwa Mosque Jalan, Kauman, Loram Kulon, Kec. Jati, Kudus Regency, Central Java 59344. Time The research was carried out in the even semester of January-March 2023 for the 2022/2023 academic year. This study's population was all fourth-grade students at MI NU Miftahul Ulum Loram Kulon, totaling 59 students.

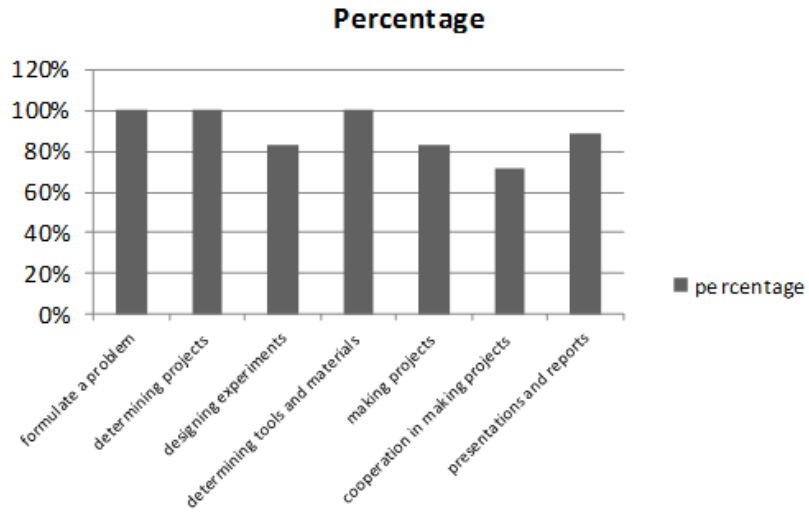
The sample used in this study was 51 students from class IVA and class IVB, where 26 students from class IVA as the experimental class and 25 from class IVB as the control class. Data collection techniques are the most important step in research because the main purpose is to obtain data. The following are ways to collect data: test and documentation methods. The form of the test given is a description test with 8 questions.

As for these questions, it is indicated by aspects of creative thinking, fluency which has indicators; Having many ideas, flexibility with indicators; Providing various interpretations of an image, story, or problem; originality with indicators; Providing new ways/ideas and elaboration with indicators Performing the following steps detailed steps. In addition to project-based learning worksheet instrument questions, they also participate in data collection and make it easier for students to use as a guide in completing projects later.

This method is used to obtain data about the general description of the madrasa, the condition of students and taking photos of research results as support and at the same time evidence that research has been carried out (Sukardi, 2021). Data analysis is done after collecting data from all respondents or other data sources. To find out how much influence the project-based learning model through making a herbarium has on the creative thinking skills of students in grade IV MI NU Miftahul Ulum Loram Kulon, researchers analyzed the data to answer the problem formulation. They tested the hypotheses that had been proposed, in this case, this study used data analysis from the normality test using the Liliefors test with the Kolmogorov-Smirnov technique. Then test for homogeneity using the Homogeneity of Variance (Lavene statistic). Calculating whether or not there is an influence of the project-based learning model through making a herbarium on the creative thinking skills of fourth-grade students can be used in the two-sample t-test formula. The proposed hypothesis is then tested with the help of SPSS version 25 software through a simple regression test.

RESULT AND DISCUSSION

In learning the Project Based Learning model that has been implemented in the experimental class with six stages, starting from determining the project, designing steps, compiling a project schedule, and completing the project with the teacher. Prepare reports and presentations and evaluate project results. From the findings after the PjBL model was applied through the making of a Herbarium, all students in class IV A, totaling 26 students, can obtain a recapitulation of student scores in the Project Based Learning assessment rubric as a whole can be seen in graph one as follows:

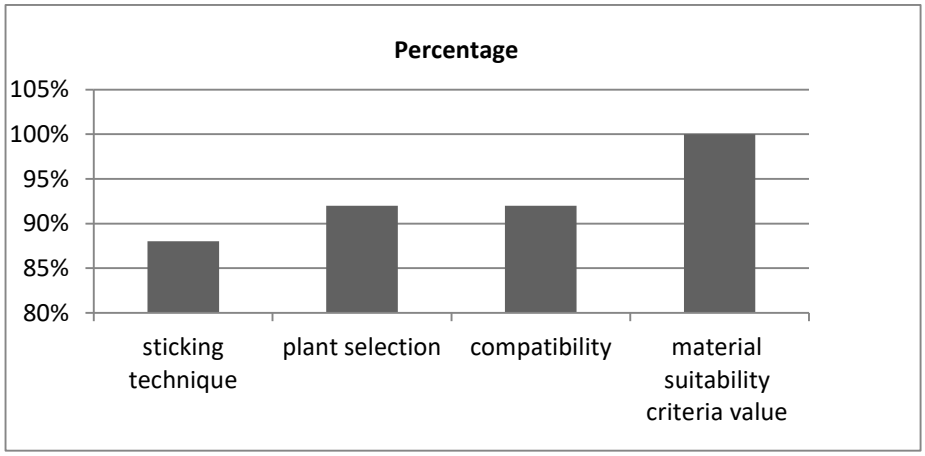


Graph 1. PjBL Learning Percentage Results

From graph 1, it is known that the percentage values of all groups show that the criteria for formulating problems, determining projects and determining tools and materials are 100% and for designing experiments

83%, making projects 83% and cooperation in doing projects is 72% while for presentations and reports by 89%, in terms of project-based learning with six steps carried out in learning it looks good and students are very enthusiastic in participating in learning.

In terms of product assessment results produced by students can be seen in the following herbarium-making project assessment recapitulation diagram.

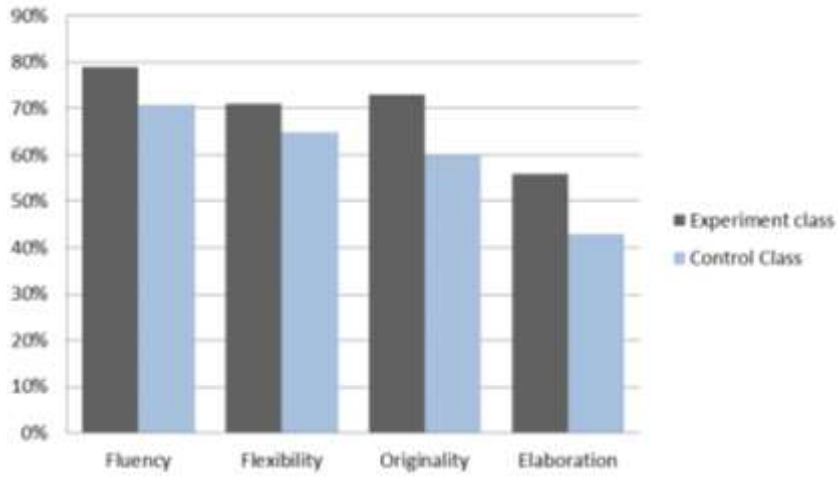


Graph 2. Results of the Herbarium-Making Project Assessment

From Graph 2, the making of the herbarium is good; it can be seen from the material suitability criteria value of 100%, the selection of plants, and 92% compatibility only in the part of the sticking technique, which is not good and the lack of precision between the plants and the paper is 88%.

The value of the student's creative thinking skills in the experimental and control classes showed differences according to the post-test scores in the experimental and control classes in the results obtained

between the project-based learning (PjBL) learning model through making herbarium and scientific learning models on students' creative thinking skills in each indicator; the data is tabulated and displayed in diagrams the following:



Graph 3. Results of Students' Creative Thinking Skills in the Control and Experiment Classes

Based on Graph 3, in the experimental class, the average value of each indicator has higher scoring criteria, namely the indicator of fluency (fluency) 79%, flexibility (Dexterity) 71%, originality (originality) 73%, and the elaboration indicator (Detailing) of 56% while in the control class, the average value for each indicator is lower than the experimental class, namely the indicator of fluency (fluency) 71%, flexibility (Dexterity) 65%, originality (Originality) 60% and the elaboration indicator (Detailing) of 43 %.

The fluency indicator "is responding with several answers if there are questions and having many ideas about a problem. The ability to think

fluently can be developed by applying a project-based learning model. At the stage of determining the basic questions, students are expected to be able to come up with many ideas or answers to the questions presented (Candra et al., 2019).

On the flexibility indicator, the measured sub-indicator thinks of different ways to solve a problem. Students are guided to carry out project assignments in the herbarium and then think of various ways to complete project activities, such as suggesting the best ways to find out the parts of the plant being observed. By thinking of various ways of solving problems and putting forward arguments that are solutions, it is hoped that students will be able to develop indicators of flexibility.

On the originality indicator, the measured sub-indicator is working to find a new solution. Through the project assignments given, students are asked to work to solve the problems they face, such as compiling reports on project results that are presented systematically. They are the result of their thinking, not other people's. So that through these activities, it is expected to develop indicators of originality (authenticity).

On the elaboration indicator (detailing), the measured sub-indicator is problem-solving by carrying out detailed steps. In this sub-indicator, students are asked to detail the process of the observations made so that students creative thinking skills can be developed.

Researchers used the Kolmogrov-Sminov normality test with a significance level of 5% and with the help of Windows Release Version 25 SPSS data. The results of the pretest and posttest data normality test for the experimental class and control class can be seen in Table 1:

Table 1. Normality Test Results for Pretest and Posttest Class Experiment and Control Class with Kolmogorov Smirnov

Tests of Normality

Class		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Creative Thinking Skills	*Pre-Test* Experiment (PjBL)	,105	26	,200*	,981	26	,885
	Post-Test Experiment (PjBl)	,144	26	,177	,958	26	,354
	Pre-Test Control (Saintifik Learning)	,111	25	,200*	,975	25	,774
	Post-Test Control (Saintifik Learning)	,153	25	,134	,961	25	,431

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

The results of the normality test (Table 1) with the Kolmogrov-Sminov test show that the significance is > 0.05. With details of the experimental pretest sig value of 0.200, the observed posttest sig value of 0.177, the control pretest sig value of 0.200, and the control post-test sig value of 0.134. This means that the significance value of the four data has a sig value > 0.05. It can be concluded that the data is normally distributed

This study used the homogeneity test to determine whether the variance of the pretest data for the experimental class (Project Based Learning) and the pretest data for the control class (Scientific Learning) was homogeneous or heterogeneous. Homogeneity testing in this study uses the Homogeneity of Variance (Lavene statistic) formula with the help of SPPS Windows Release 25. The following are the test criteria; If the sig value > α (0.05), the two variances are the same. If the sig value < α (0.05), then the two variances are not the same

Table 2. Homogeneity Test Results for Control Class and Experiment Class Pretest Values

Test of Homogeneity of Variance			
Levene Statistic	df1	df2	Sig.
2,055	1	49	,158

Based on the results of the homogeneity test (Table 2) on the pretest values of the control and experimental classes, as can be seen in Table 2, a significance value of 0.158 is obtained. It means that sig > α is 0.158 > 0.05. So, it can be said that the two data have the same variance (homogeneous).

The analysis used a hypothesis test to find out the results of student's creative thinking skills in the experimental class. In this study, the formula t-test (simple regression test) was used with the help of SPSS Windows Release 25.0 data processing.

Table 3. Data Analysis Test Results (simple regression test)

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	18,802	5,880		3,198	,004
Model Project-Based Learning	,933	,107	,877	8,749	,000

a. Dependent Variable: Creative Thinking Skills

Based on Table 3, the results of calculating the simple regression coefficient show that the constant coefficient value is 18.802 while the value of the pro-project-baserunning method is the regression coefficient of 0.933 so that the regression equation is written: Ý = 18.802 + 0.933X

The correlation coefficient (r) is a value used to measure the degree of closeness of the relationship between two variables.

Table 4. Results of data processing
(correlation coefficient and determination)

Model	R	R Square	Adjusted R Square	Std. The error in the Estimate
1	,877[a]	,769	,759	5,31671

a. Predictors: (Constant), Project-Based Learning Model

Based on the calculation above, the r count is 0.877. the correlation coefficient between users of the Project Based Learning Model on the Creative Thinking Skills of Class IV MI NU Miftahul Ulum students is included in the robust category. This means that it has a positive and significant relationship. Meanwhile, the coefficient of determination is 0.769. This means that the implementation variable of the Project Based Learning Model influences students' creative thinking skills by 76.9%.

Creative thinking has so far received little attention in education, especially in school learning which is still focused on acquiring knowledge, memory, and reasoning; with the implementation of the PjBL model through making a herbarium; students are involved in analyzing problems, then exploring, collecting information, interpretation, and assessment of working on projects related to the problems studied (Elvianasti & Kartikawati, 2022) so that this learning allows students to develop their creativity in designing and making projects that can be used to solve problems (Fauzia & Kelana, 2020).

This project-based learning model has several first stages in the PJBL learning process, namely determining the first stage project process in

determining that this project is included in the fluency category because students are given several stimulus questions to determine the project for the second stage of designing project steps. In this stage, the aspect of creative thinking that is stimulated is the ability of students to think flexibly and bring out original traits. In the third stage of the preparation of the schedule, the ability to detail is needed in the process of preparing the project completion schedule. The fourth stage of project completion is teacher monitoring. In this stage, originality ability is needed to complete the project. The fifth step is elaboration and assessment, where students present the results of their products and project work for a week, reveal the advantages and disadvantages of the product, and assess according to their views about the product and its relation to the material of plant parts. The sixth step still in line with the fifth step. The sixth step is evaluation, in which students evaluate the results of the project and reflect on the material content of the plant parts in their projects (Saad & Zainudin, 2022)

This study found that there is an influence of the PjBL model through making a herbarium on students' creative thinking skills in the material of plant parts. The influence of the PjBL model through making herbarium occurs because the PjBL model can facilitate students in practicing their creative thinking skills by giving systematic project assignments (Zulyusri et al., 2023). After the implementation of learning in the experimental and control classes, the posttest results obtained from both classes experienced an increase. Based on the results of the t-test post-test data, the average experimental class was 72.47 and 57.53 in the

control class. It can be seen that there is a difference between the two classes, namely the results of the experimental class are higher than the control class, where the average of the experimental class is in the moderate category, while the average in control class is in the less category.

This is because the ability of students to understand all the concepts of plant parts and work on creative thinking questions is not fully maximized. The factor of not being used to working on creative thinking questions also underlies the low average scores in both classes, even though there was still an increase in both classes after being given treatment on plant parts material. The components of creative thinking, according to Harisuddin, include creative component aspects, namely fluency or fluency, flexibility or flexibility, originality or originality, elaboration or detailing (Harisuddin & ST, 2019).

The component aspects are calculated to determine the achievement of each indicator. Based on the results of the posttest, in the first aspect of creative thinking for both classes, namely fluency or fluency, the two classes look different. Namely, the percentage of fluency in the experimental class is higher, with an acquisition of 79% compared to the control class, 71%. This is because the application of project learning emphasizes the stimulus of questions and discovery of problems so that students are encouraged to seek answers and think of solutions. In contrast, control class students were only given a question stimulus based on the 2013 curriculum provisions in the "asking" syntax without being involved in a problem. As for the criteria for the fluency aspect, that is,

submitting lots of ideas, and answers, solving problems and questions, also providing many ways, and thinking of more than one answer (Lince, 2016)

In addition to applying the project learning model, the experimental class also applied project learning worksheets according to the steps in the model (Sari et al., 2017). At the same time, students in the control class applied observation or experimental worksheets. Based on the results of the percentage of creative value acquisition in the experimental class LKPD for aspects of fluent thinking, it is included in the "moderate" category.

This is because the evaluation or assessment is not only on the content of the lesson but also on the project, namely the product that is made and then repaired if something is lacking, the product functions to facilitate students' understanding of the subject matter. But because of the nature of the project, which is complex and takes a long time, not all students can quickly improve and understand the conclusions of the material, causing some students to find still it difficult to assess according to their views due to a lack of deepening of the material and affirmation of the core of the material (Chen et al., 2022). It is different from the control class; students are not emphasized by doing projects so that they can focus more on theory and then prove it by observing, seeking information, and communicating material for a longer time (Banawi, 2019).

In the revised thinking taxonomy, the evaluation stage is the highest stage. As Febriana stated regarding evaluation, the emphasis that should be the subject of evaluation is mostly on theory, rather than following an empirical view (Febriana, 2021). The aspect of assessing, according to

Harissudin, is, giving rational and justifiable reasons for the truth and giving consideration or judgment his views (Harisuddin & ST, 2019)

Based on the results of the posttest in the experimental class, the highest component achievement is the Fluency aspect, and the lowest is Elaboration. The highest and lowest components in the control class are the same as in the experimental class. This can also be seen from the results of the average acquisition of the elaboration component in the PjBL worksheet, which shows lower results compared to other components. James states that students tend to be more creative in choosing topics or methodologies (Supena et al., 2021). Whereas for the evaluating stage, not all students can construct all the knowledge well obtained. In line with this, based on Didi's research results on the evaluation aspect, the experimental class is lower than the control class, and the project should be given some stimulus that encourages the process of evaluating phenomena (Nurhadiyati et al., 2021)

In project implementation, it should be better applied to certain units or specific material. The point is to make it easier for students to focus on thinking about projects and understanding their knowledge. This is as stated by William in his book, "The teacher must determine which instructional standards from one or several contiguous units might be best addressed in the context of the PBL assignment"(Bender, 2012). To be able to carry out projects and understand them optimally, the units used for project implementation are specific.

Even so, the project-based learning model in this study has quite an influence on students' creative thinking. This learning model is able to

make students accustomed to thinking, namely training and exploring knowledge to find answers with creative ideas and make a product at the end of learning (Mursid et al., 2022). Yaumi argues about projects and creativity, namely resource space activities often involve students in independent projects, aiming to increase creative thinking and problem-solving. Project-based learning is the right approach to measure students' creative and innovative thinking, but if students are not able to think creatively and innovatively, then project-based learning will be difficult to do (Yaumi, 2017)

Supported by Susanti's research, the ability to think creatively in the control class and the experimental class concluded that the increase in the creative thinking ability of students who received project-based learning (experiment) was significantly different from the increase in the ability to think creatively of students who received practicum-based learning (control) (Susanti, 2013) And also reinforced in other studies, that to foster creative thinking can be trained through learning strategies, one of which is Project-Based Learning, (Ismuwardani et al., 2019) in research by Satria Mihardi et al., "PJBL is a learning model that Students can demonstrate creative thinking to solve a problem. Moreover, the results obtained in this model a work or project as a result of Students creativity"(Mihardi et al., 2013)

So the habit of thinking with the initial stages of having problems (in this case, the application of project learning) that arise repeatedly and problems that have not arisen before is an opportunity to bring up creative ideas or creative thinking processes, which are expected to make students

accustomed to facing a problem in his life so that learning is not only at school but habituation in learning that can be useful for the future (Krajcik & Czerniak, 2018). This aligns with Julie's statement in her journal, i.e., "Education should focus not only on core skills and knowledge but also on teaching and practicing creative and critical. Thinking skills, because these are the skills that will encourage life-long learning and personal development" (Fatmawati et al., 2019)

In line with this opinion, Muhammad Fathrurrohman also argued that project-based learning could increase student confidence, motivation, creativity, and self-esteem (Sumarni & Kadarwati, 2020). "Although students' creative thinking skills can be said to be not optimal, students' responses to the application of the PjBL model through making herbarium obtain good criteria. Thus the PjBL model through making herbarium can be used as a variation of the learning model to develop students' creative thinking skills." (Mulyandari et al., 2022)

Based on the results of the author's observations, the application of the PjBL model through making herbarium can increase students' creative thinking skills in studying plant parts, besides that project-based learning also encourages the growth of creativity and responsibility in completing project assignments given, through student project activities guided to solve problems and be able to make a herbarium that can be used as a medium to make it easier for students to understand the material of plant parts so that students can develop creative thinking skills (Aulia, 2023)

According to Anisa et al. (2018), applying PjBL-based learning has developed students' creative and critical thinking abilities. Because at each

stage of learning, students need cooperation, peer-to-peer communication, and problem-solving and accountability skills (Annisa et al., 2018)

CONCLUSION

The skills of creative thinking of students in the experimental class with the application of the project-based learning model, the average value for each indicator has higher scoring criteria, namely the indicator of fluency (fluency) 79%, flexibility (flexibility) 71%, originality (authenticity) 73 % and the elaboration indicator (detailing) is 56% while in the control class, the average value for each indicator is lower than the experimental class, namely the indicator of fluency (fluency) 71%, flexibility (dexterity) 65%, originality (authenticity) 60% and elaboration indicators (detailing) by 43%. The effect of the project-based learning model on students' creative thinking skills is evidenced by the regression equation Y=18.802 + 0.933X. This project-based learning model has a positive and significant relationship of 0.877 which is included in the powerful category and can improve students' creative thinking skills by 76.9%. This was obtained because the average pretest score in the experimental class was 53.78, and the average pretest value in the control class was 44.39. The posttest average score for the practical class was 72.47, and the posttest average score for the control class was 57.53. There is a positive and significant influence in the use of the Project Based Learning model through the making of a herbarium on the creative thinking skills of students in grade 4 MI NU Miftahul Ulum Loram Kulon.

REFERENCES

Annisa, R., Effendi, M. H., & Damris, M. (2018). Peningkatan kemampuan berpikir kreatif siswa dengan menggunakan model Project Based Learning berbasis STEAM (Science, Technology, Engineering, Arts Dan Mathematic) pada materi asam dan basa di SMAN 11 Kota Jambi. *Journal of The Indonesian Society of Integrated Chemistry (On Progress)*, *10*(2), 42–46.

Aulia, N. (2023). Penerapan Model Project Based Learning untuk Meningkatkan Kemampuan Berpikir Kreatif Siswa di Sekolah Dasar. *Jurnal Riset Madrasah Ibtidaiyah*, *3*(1), 284–290.

Banawi, A. (2019). Implementasi pendekatan saintifik pada sintaks discovery/inquiry learning, based learning, project based learning. *BIOSEL (Biology Science and Education): Jurnal Penelitian Science Dan Pendidikan*, *8*(1), 90–100.

Bender, W. N. (2012). *Project-based learning: Differentiating instruction for the 21st century*. California: Corwin Press.

Boss, S., & Krauss, J. (2022). *Reinventing project-based learning: Your field guide to real-world projects in the digital age*. Washington: International Society for Technology in Education.

Budhi, H. S., & Fawaida, U. (2021). Pengembangan Perangkat Dan Model Pembelajaran Berbasis Proyek Mata Kuliah Ipa Terpadu Melalui Pendekatan Stem (Science, Technology, Engineering and Mathematics). *Jurnal Ilmiah Edukasia*, *1*(1), 99–111. https://doi.org/10.26877/jie.v1i1.7969

Candra, R. A., Prasetya, A. T., & Hartati, R. (2019). Analisis kemampuan berpikir kreatif peserta didik melalui penerapan blended project based learning. *Jurnal Inovasi Pendidikan Kimia*, *13*(2), 2437–2446.

Chen, S.-Y., Lai, C.-F., Lai, Y.-H., & Su, Y.-S. (2022). Effect of project-based learning on development of students' creative thinking. *The*

International Journal of Electrical Engineering & Education, *59*(3), 232–250.

Elvianasti, M., & Kartikawati, E. (2022). Research Trends in PjBL (Project-Based Learning) at Indonesian Journal of Biology Education. *Jurnal Iqra': Kajian Ilmu Pendidikan*, *7*(2), 105–119.

Fatmawati, A., Zubaidah, S., & Mahanal, S. (2019). Critical thinking, creative thinking, and learning achievement: How they are related. *Journal of Physics: Conference Series*, *1417*(1), 12070.

Fauzia, N. L. U., & Kelana, J. B. (2020). Natural Science Problem Solving in Elementary School Students Using the Project Based Learning (PjBL) Model. *Jurnal Ilmiah Sekolah Dasar*, *4*(4), 596–603.

Febriana, R. (2021). *Evaluasi pembelajaran*. Jakarta: Bumi Aksara.

Febrianingsih, F. (2022). Kemampuan Berpikir Kreatif Siswa dalam Memecahkan Masalah Matematis. *Mosharafa: Jurnal Pendidikan Matematika*, *11*(1), 119–130.

Hafida, S. H. N., Ariandi, A. P., Ismiyatin, L., Wulandari, D. A., Reygina, N., Setyaningsih, T., Setyawati, L., Sochiba, S. L., & Amin, M. A. K. (2020). Pengenalan Etnobotani melalui Pembuatan Herbarium Kering di Lingkungan Sekolah MI Muhammadiyah Plumbon, Wonogiri. *Buletin KKN Pendidikan*, *2*(2), 79–83.

Harisuddin, M. I., & ST, M. P. (2019). *Secuil Esensi Berpikir Kreatif & Motivasi Belajar Siswa*. Jakarta: Pantera Publishing.

Ismuwardani, Z., Nuryatin, A., & Doyin, M. (2019). Implementation of project based learning model to increased creativity and self-reliance of students on poetry writing skills. *Journal of Primary Education*, *8*(1), 51–58.

Kadir, A., & Asrohah, H. (2015). *Pembelajaran tematik*. Depok: Raja Grafindo Persada.

Khoiri, A., Komariah, N., Utami, R. T., Paramarta, V., & Sunarsi, D. (2021). 4Cs analysis of 21st century skills-based school areas. *Journal of Physics: Conference Series*, *1764*(1), 12142.

Krajcik, J. S., & Czerniak, C. M. (2018). *Teaching science in elementary and middle school: A project-based learning approach*. London: Routledge.

Lince, R. (2016). Creative thinking ability to increase student mathematical of junior high school by applying models numbered heads together. *Journal of Education and Practice*, *7*(6), 206–212.

Lubis, F. A. (2018). Upaya meningkatkan kreativitas siswa melalui model project based learning. *PeTeKa*, *1*(3), 192–201.

Mihardi, S., Harahap, M. B., & Sani, R. A. (2013). The effect of project based learning model with kwl worksheet on student creative thinking process in physics problems. *Journal of Education and Practice*, *4*(25), 188–200.

Mulyandari, W., Pantiwati, Y., Wahyuni, S., Susetyarini, R. E., & Hindun, I. (2022). Model Project Based Learning: Meningkatkan Kognitif Siswa Dan Keterampilan Membuat Herbarium. *Jurnal Education And Development*, *10*(2), 558–561.

Mursid, R., Saragih, A. H., & Hartono, R. (2022). The Effect of the Blended Project-Based Learning Model and Creative Thinking Ability on Engineering Students' Learning Outcomes. *International Journal of Education in Mathematics, Science and Technology*, *10*(1), 218–235.

Nurhadiyati, A., Rusdinal, R., & Fitria, Y. (2021). Pengaruh Model Project Based Learning (PJBL) Terhadap Hasil Belajar Siswa Di Sekolah Dasar. *Jurnal Basicedu*, *5*(1), 327–333.

Nurhidayah, I. J., Wibowo, F. C., & Astra, I. M. (2021). Project Based Learning (PjBL) learning model in science learning: Literature review. *Journal of Physics: Conference Series*, *2019*(1), 12043.

Nurmawati, F., & Yulisetiani, S. (2022). Teacher's Perspective for

Thematic Learning Systems During the Covid-19 Pandemic. *Journal of Education Technology*, *6*(2).

Saad, A., & Zainudin, S. (2022). A review of Project-Based Learning (PBL) and Computational Thinking (CT) in teaching and learning. *Learning and Motivation*, *78*, 101802.

Sari, K. A., Prasetyo, Z. K., & Wibowo, W. S. (2017). Development of science student worksheet based on project based learning model to improve collaboration and communication skills of junior high school student. *Journal of Science Education Research*, *1*(1).

Sukardi, H. M. (2021). *Metodologi Penelitian Pendidikan: Kompetensi Dan Praktiknya (Edisi Revisi)*. Jakarta: Bumi Aksara.

Sumarni, W., & Kadarwati, S. (2020). Ethno-stem project-based learning: Its impact to critical and creative thinking skills. *Jurnal Pendidikan IPA Indonesia*, *9*(1), 11–21.

Supena, I., Darmuki, A., & Hariyadi, A. (2021). The Influence of 4C (Constructive, Critical, Creativity, Collaborative) Learning Model on Students' Learning Outcomes. *International Journal of Instruction*, *14*(3), 873–892.

Susanti, S. (2013). Pengaruh Pembelajaran Berbasis Proyek Terhadap Kemampuan Berpikir Kreatif dan Sikap Ilmiah Siswa Pada Materi Nutrisi. *Jurnal Pengajaran MIPA*, *18*(1), 35–42.

Tersiana, A. (2018). *Metode Penelitian*. Bantul: Anak Hebat Indonesia.

Yaumi, M. (2017). *Prinsip-prinsip desain pembelajaran: Disesuaikan dengan kurikulum 2013 edisi Kedua*. Jakarta: Kencana Publishing.

Zulyusri, Z., Elfira, I., Lufri, L., & Santosa, T. A. (2023). Literature Study: Utilization of the PjBL Model in Science Education to Improve Creativity and Critical Thinking Skills. *Jurnal Penelitian Pendidikan IPA*, *9*(1), 133–143.